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Editorial

Algorithms, the key to the door of wisdom

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Algorithm is the accurate and complete description of the solution, and it is a series of clear instructions to solve the problem. The algorithm represents the strategic mechanism to solve the problem by using the method of the system. With the development of information technology, the existing algorithm development and wide application in the field of computer, especially in artificial intelligence (AI), virtual reality (VR), the field of deep learning, cloud computing, big data and other cutting-edge computing technology, has a more and more important role.

The aim of Vol. 2016, No. E9 of RISTI (Revista Iberica de Sistemas e Tecnologias de Informacao) is to show the original and scientific demonstration of the related scientific problems and engineering realization of computer engineering, including the latest development of the computer technology, theory, model, method, strategy, concept, application and development trends and prospects etc.

We would like to thank all those who kindly contributed to this issue: the authors who submitted their papers couple of months ago, the distinguished reviewers who are from different fields, and the editors from Revista Iberica de Sistemas e Tecnologias de Informacao, for their gracious invitation and continued support.

In this issue, all published papers are clearly written in excellent English and contain only original work, which has not been published by or is currently under review for any other journal or conference. So, in the end, we hope that the readers will enjoy reading these 40 papers as much as we enjoyed reviewing, compiling and editing this issue.

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System Development and Realization of Computer-aided Clothing Remote Design

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Pages: 1–13

Abstract: Abstract: the modern society has entered into electronic age from mechanical age and the clothing design networking has become a new concept of modern clothing design. Method of comparative analysis is adopted in the Thesis for traditional high-level design and existing network clothing design. Comparison is made in three aspects such as characteristics, objects and processes so as to make an overall analysis of network clothing design. And then the computer clothing design system based on remote network design is established according to consumers' requirements of keeping up with the times, existing three-dimensional scanning, three-dimensional virtual fitting, remote video conversation, intelligent style design and other computer technologies so as to realize diversity in remote network design style and meet consumers' convenient shopping experience and personalized requirements.

Keywords: network clothing design, remote design, computer technology.

1. Introduction

In modern society with rapid development of computer technology and network electronic commerce, previous clothing industry is under unprecedented revolution and modern clothing industry has entered into brand new development stage (Chang and Wang, 1996). With rapid development of domestic economics and constant improvement in consumers' living standard in recent years, their shopping idea is constantly updated and they have increasingly higher requirements in clothing (Meng et al., 2012). Moreover, the rapid development of data processing, storage and touch screen and other electronic equipment enable more and more people afford and benefit from digital products, which impacts traditional clothing manufacturing industry (Mao et al, 2011).

In recent years, numerous domestic and foreign network clothing designs have emerged and more and more networks are used for on-line clothing design and sales (Sá, F., & Rocha, Á, 2012). However, majority of present modes to present network clothing design is only restricted to picture presentation and characters description of clothing and the clothing dimension is only calculated by mechanically using simple algorithm or provided by consumers (Meng et al., 2010). This circumstance greatly weakens excellent consumption experience of high-level design (Mao et al, 2008). The Author hopes to rearrange and analyze possibility and necessity existing in network clothing design from comparison between traditional high-level design and network clothing

design and then put forward solutions in service and technology as for existing problems according to existing scientific and technological achievements (Petrak, 2006). With the rapid development of computer information technology and world economic market competition, how to adapt to quick response requirements of the market characterized by limited quantities, multiple varieties, individuation, high quality and low cost is vital to survival and development of modern clothing enterprises (Westin, 1998).

The Thesis rearranges and summarizes generation, development and current status of traditional high-level design and network high-level design and then research and analysis is carried out for problems in process of network high-level design so as to redefine remote network design and its consumer group, summarize and extend concept, contents and methods of remote network design and the design internship and practical training is carried out for demonstration and practice of computer clothing design system in remote network design (Sano and Yamamoto, 2001).

2. Technological base of remote network clothing design system

2.1. Three-dimensional clothing virtual fitting

At present, there are some domestic researches on three-dimensional clothing virtual fitting. In foreign countries, the virtual fitting system of research group from Mira LAB in Geneva University in Switzerland is not to automatically establish 3D human body model according to data extracted by three-dimensional scanner and virtual human body is based on database of three-dimensional human body modeling (Torrens et al., 2004). The human body model is found from existing database to match consumers who need to try on clothes and then make minor adjustment based on this. Then, the model base which can show more complicated shapes is established according to posture of human body, dressing, skin and other databases (Belleau et al., 1992). The Shuangzixing Company and one geographic pole clothing Company in America invested heavily to promote three-dimensional virtual fitting system independently researched and developed by their own. The latter plans to establish "electronic dressmaker" fitting rooms in fourteen cities of America and it only takes 15 seconds for consumers to wear straightjacket and receive scanning (Jerrard, 1976). Besides, Toshiba Corporation in Japan also successfully develops network fitting system by which consumers can see their own three-dimensional images based on data of human body as well as built-in body movement of fitting system on the internet and consumers can also try on clothes they select through the system (Dai et al., 1999).

Figure 1 – D Fitting Room

However, most of domestic virtual fitting appear in e-commerce platform of clothing among which effects of "ishoway" 3D fitting room (Fig. 1) are relatively

outstanding. Three-dimensional human body model will be produced according to dimensions of consumers' body including hair style and face (Belleau and Bourgeois, 1991). At the same time, consumers are allowed to choose occasions corresponding to clothing they try on so as to make clothing matching effects more real and effective.

2.2. Three-dimensional human body scanning

With development of digitalization technology, successful development of three-dimensional non-contact measurement equipment has provided a new model for collection of human body type data and all countries in the world adopt it to establish their own database of human body type (Lill and Danielson, 2011). For example, there is a nationwide large-scale human body measurement project named Size UK and Size USA which is commonly completed through cooperation between British and American governments and some large clothing retailers, clothing enterprises and academic institutions and national databases of human body dimension are respectively established in Britain and America; the research center consisting of European clothing manufacturing and retailing companies, departments to provide technology, textile and clothing institutions and advanced universities jointly gather its strength to develop and integrate advanced technology and developed E-Tailor Project in 2000 (Fontana et al., 2005). In the project, the human body measurement database (EAD) to store samples of 5500 female and 5500 male is preliminarily established. In recent years, some domestic colleges and universities in field of clothing successively introduce three-dimensional human body scanner and National Tsing Hua University, Chang Gung University and other universities and enterprises have spent nearly five years in joint research of human body database and non-contact human body measurement technology in Taiwan and thus make some achievements (Kuroda et al., 2012).

2.3. Intelligent style design

Intelligent style design system is one style design system in which modern internet technology is the basis, intelligent control and artificial intelligence and other theories are guidance, clothing style designers are objects and more direct and simple design are purposes (Boyle et al., 2011). The foundation of intelligent style design is the database of abundant and various clothing components and parts so as to provide selection of graphic images, matching and overlapping of clothing components and parts as well as processing of clothing ornaments for consumers. However, as for various domestic clothing CAD style design such as ARISA clothing style design system and gold thimble design system, contents in data bank are incomplete and there are only some simple and basic styles as well as components and parts and the function of style design module is very weak (Kim and Lee, 2011).

2.4. Remote video conversation

General application of remote video technology, remote education, remote medicine and video conference etc (Prautzsch and Piper, 1994). include audio and video processing technology as well as computer information technology. By virtue of the technology, consumers can have "face-to-face" communication with others at any time in any place as long as the network is connected. At present, commonly used network video communication software include Tencent QQ, mobile phone video conversation (Face Time), MSN and so on (Merkle, 1999).

3. Concept establishment of computer clothing design system in remote network design

3.1. Contents of remote network design system

Contents of remote network design mainly contain five parts: categories, outline, local parts, texture and ornaments. The category is divided into three categories: jackets, pants and skirts. Outline is divided into two parts including long jackets, medium jackets and short jackets in single item of jackets as well as overall outline such as X-type, A-type and H-type etc. The local design can be determined according to jackets, pants and skirts and it mainly involves collar, sleeve, pocket and top fly etc. The texture design consists of four parts such as shell fabric, color, texture and flower type. However, ornament mainly involves many hand embroidery, stitching, textile printing and so on.

The detailed design category is shown in Fig. 2. Jackets include western-style clothes, coat, shirt, overcoat, wind coat, down jacket, sweater, knitted sweater, internal accessories and so on. Pants include long pants, ninth pants, cropped pants, shorts, suspender pants, and Siamese trousers and so on. Skirts include one-piece dress and overskirt (Kazanskiy et al., 1994).

Local part design mainly includes collar, sleeve, pocket and others. The collar includes turn-over collar, shirt collar, circular collar, wing collar, stand collar and so on (Catanzaro et al., 1991). Sleeve includes kimono sleeve, circular sleeve, mandarin sleeve, bubble sleeve and so on. Pocket includes side pocket, slit pocket, patch pocket and so on. Corresponding local design contents will be provided for local part design according to different varieties.

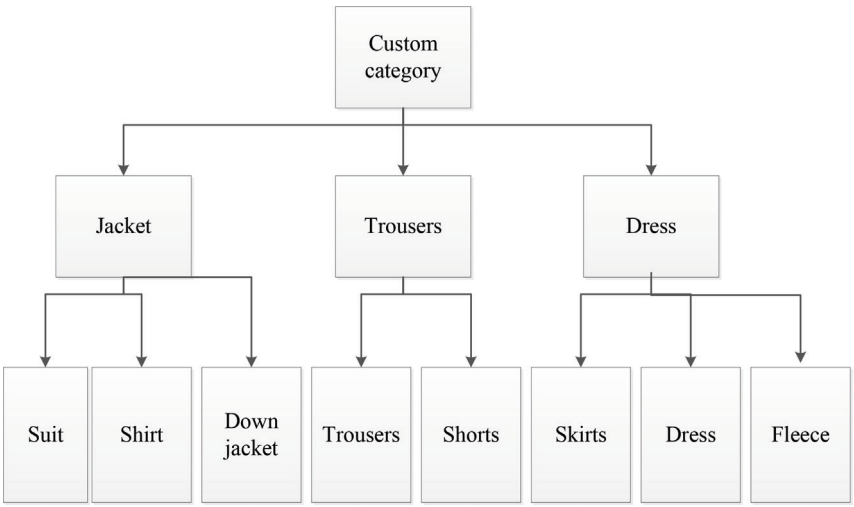

Figure 2 – Category of Remote Network Design

3.2. Process and features of remote network design system

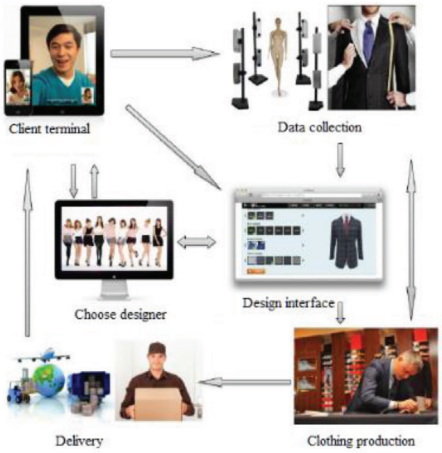

Figure 3 – Remote Network Design System

Remote network design system is shown in Fig. 3.

1. Size collection

Size collection of remote network design system is divided into two types. One is three-dimensional body scanning and the other is manual measurement following traditional high-level design.

Three-dimensional body scanning is the link for three-dimensional virtual display. Certainly, data of three-dimensional body scanning can be used for production and manufacturing directly, as the data collected is very accurate, which can reduce cloth trying times of customers. In addition, it is necessary to follow traditional high-level manual design. It is a service experience of the customer and cannot be replaced by the cold machine. Both three-dimensional body scanning data and manual measurement data will form individual size data package of the customer and the corresponding body model can be formed directly through computer. Such human body model is unique.

2. Design selection

Design selection is the selection of above design content, namely design of category, silhouette, part, texture and decoration.

Category and silhouette designs are the design link in which customers can participate and they can design and select according to their imaginary and partial clothing style and effect; partial design includes design of pocket, collar, color and pattern and it can meet customers' personalized demands on partial details such as clothing color and pattern; decoration design can meet customers' personalized demands on clothing decoration such as hand-made embroidery, hollow-out and nail bead; texture design can meet customers' demand on clothing material and texture, organization structure and style.

3. Virtual display

Virtual display will transfer two-dimensional style chart after completion of design selection link into three-dimensional fitting chart. Virtual display includes human body model and design cloth effect on human body model.

Virtual display includes two ports: application on mobile terminals and fitting mirror in physical store. Application on mobile terminals is in the computer or mobile phone. But for both application on mobile terminals and fitting mirror in physical store, virtual display can display from 3 angles such as front face, side face and back face so as to make customers fully understand body effects of the design cloth. As human body model is formed according to the size of the customer, fitting effect of the customer will be displayed virtually, which will help the costumer to judge whether the design cloth meet the expected effect or not in a direct way.

4. Confirm order

Customer will confirm final design selection through virtual display link and then will enter into ordering and payment link. Customers need to fill in delivery address and invoice form and need to confirm order information and payment method. Certainly, customers can also take delivery of goods in the physical store and can also try it on the site and can put forward modification suggestions and communicate with the designer.

5. Service experience

Service experience of remote design system is remote conversation service and after-sales service. Remote conversation starts from understanding of customers' preference and living habits and ends in customers' professional suggestions in independent design link. After-sales service includes modification and maintenance of the designed finished product.

4. Features for process simulation of remote network design system

Design practice is conducted in the Thesis with business suit matched skirt in the suit as remote network design object. Practice flow simulation is as follows:

1. Size collection

For size collection, manual measurement in physical store of JF brand is reserved. Professional designer will measure and record customer's size, including chest circumference, waistline, hipline and shoulder breadth (Fig. 4).

Apart from manual body measurement, size collection also includes three-dimensional scanning. Customers must wear close-fitting underwear and finish three-dimensional scanning in three-dimensional scanning area so as to get accurate human body data (Fig. 5).

2. Remote video conversation

After completing size collection, customers can select their favorite designer through remote network design platform and can also make an appointment on remote video

Figure 4 – Manual Body Measurement

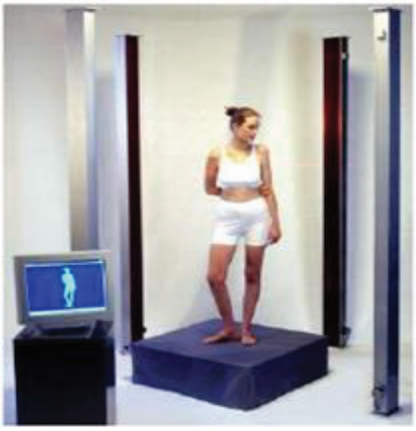

Figure 5 – Three-dimensional Scanning

conversation time (Fig. 6). In remote video conversation, designer will propose professional suggestions according to customers' personal preference and specific design demands. In addition, customers can keep communication with the designer in whole process of remote network design through remote video conversation (Fig. 7).

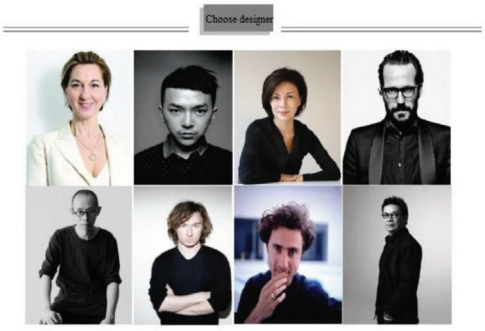

Figure 6 – Selection in Design

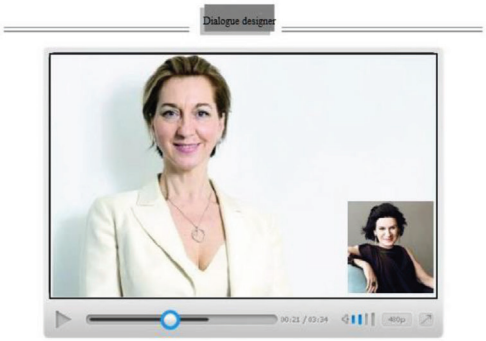

Figure 7 – Remote Communication in Design

3. Design selection

a. Category selection

As shown in category selection interface (Fig. 8-9), category for simulation selection of this practice is the business suit matched skirt in the suit.

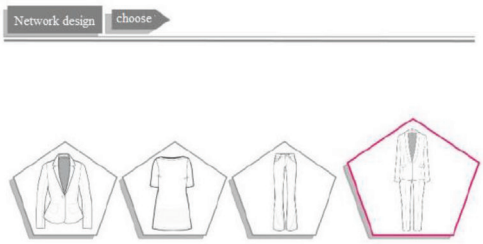

Figure 8 – Category Selection

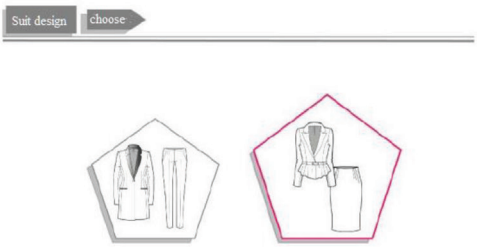

Figure 9 – Category of Suit

b. Design of business suit

Design of business suit starts from silhouette; select “close-fitting type” (Fig. 10) and then enter into texture selection; confirm texture effect as shown in Fig. 11 after selection of shell fabric, color, pattern and decoration. In addition, design brand is JF. Price range is “5000-10000” Yuan and main fabric composition is “advanced tweed”.

Next step is style selection after texture selection. Form business suit style features as shown in Fig. 12 after selection of details such as front fly, collar, wristband, pocket and hem. Finally, fill human body data of the customer in “confirm size” interface. If three-dimensional collection step is adopted, remote network design system will generate human body data of the customer automatically and will prepare for the follow-up virtual display. “Confirm size” interface of business suit design is shown in Fig. 13.

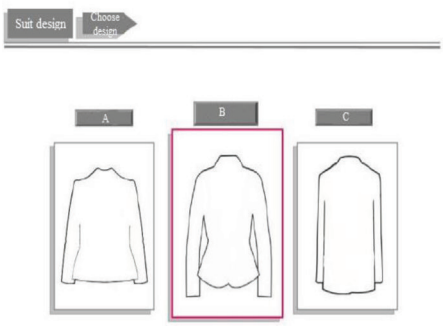

Figure 10 – Outline Selection

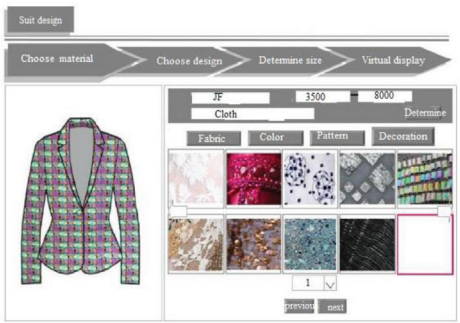

Figure 11 – Texture Selection

Next step is style selection after texture selection. Form skirt style features as shown in Fig. 14 after selection of details such as front fly, waistband, pocket and hem. Finally, fill human body data needed for skirt design in “confirm size” interface. Similarly, if three-dimensional collection step is adopted, remote network design system will generate data needed automatically and will prepare for the follow-up virtual display.

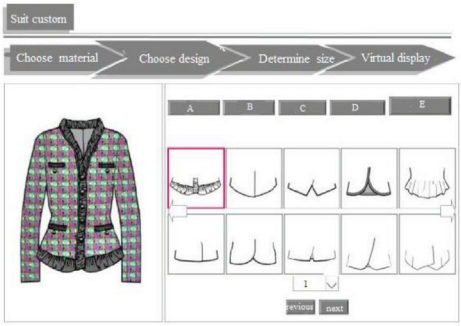

Figure 12 – Style Selection

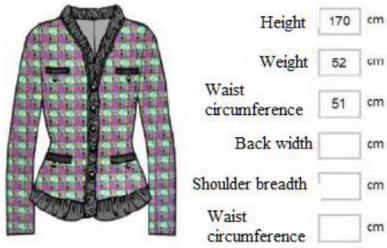

Figure 13 – Confirm Size

Figure 14 – Style Selection

4. Virtual display

Human body model shall be formed according to the size confirmed in above steps or customer's personal data and size of three-dimensional collection. Designed business suit and skirt shall be put on the human body model to form three-dimensional effect (Fig. 15). If customers are satisfied with the virtual display effect, they can "add to shopping cart" directly.

5. Display of finished product

Customers can receive and try the finished product after "production and manufacturing" of design suit is completed. Designer will make suitable modification according to customers' fitting effect. Finished suit design is shown in Fig. 16.

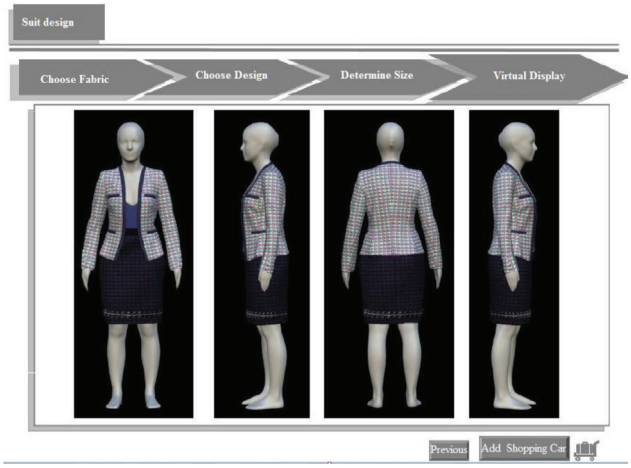

Figure 15 – Virtual Display

Figure 16 – Display of Finished Product

5. Conclusion

Concept of computer costume design system based on remote network design shall be constructed and design content and design flow of remote network design shall be described. Content of remote network design includes five parts: category, silhouette, part, texture and decoration. Remote network design flow includes size collection,

design selection, virtual display, confirm order and service experience. Features of remote network design are various styles, convenient and fast experience, independent design and high end quality. System has the following features:

1. Remote network design system adds more categories and style details, including men and women clothes. The category is not only limited to business men's clothing and there are more leisure selections such as coat, down jacket and knitting shirt. Texture is not only selection of shell fabric and there is also additional selection of color, texture and pattern. In addition, decoration details such as embroidery, split-joint and hollow-out are added in design content and consumers have a wider selection scope.
2. Convenient and fast experience of remote network design system is shown in two aspects. One aspect is remote conversation communication. Even though consumers are not in the city of the designer, they can also communicate and discuss with the designer about design details through remote video conversation. The other aspect is three-dimensional virtual display, which helps consumers to select suitable styles and details in a more convenient way. As human body data of three-dimensional scanning is very accurate, consumers need no in-person fitting step in terms of their designed product.
3. Remote network design system provides multiple selections for consumers as far as possible and makes consumers to participate in the design link in person so as to meet consumers' personalization expression. It differs from traditional senior design mode, under which almost all designs such as style, shell fabric and color are provided by the designer.
4. Although remote network design system moves many design links to the network, its feature of senior design is unchanged and its requirement on the quality of design clothes is the same as that of traditional senior design and senior shell fabric, accurate tailoring and sewing and delicate hand-tailoring are necessary so as to provide consumers with the top-quality finished design product.

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Vacancy Tax Levying Algorithm and System Design

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Abstract: China's collection of vacancy tax is just around the corner but its imposition standard and the tax rate are still in dispute. Worse still, there hasn't been an appropriate information management system in place. This paper comes up with a dual-standard tax levying scheme that considers both the size and the number of houses according to the concept of the vacancy tax and put forwards a basic algorithm for the calculation of personal tax credits. As a step forward, this paper selects .NET as the program development tool and designs a vacancy tax calculation system, with which, one's tax credits will soon be figured out after his housing information is submitted. That may provide important clues to China's smooth implementation of vacancy tax and the government's improvement of tax administration.

Keywords: vacancy tax, algorithm, system design

1. Introduction

Property tax mainly represents a tax levied on housing tenure and is also referred to as the vacancy tax hereafter. Three major opinions prevail internationally about its nature and function (Yan and Yang, 2013; An and Ge, 2014), namely, the vacancy tax is in essence a type of yield tax that pays for public services to boost the local revenue; it functions to adjust income distribution; the vacancy tax can regulate the real estate market. While drawing lessons from developed countries, particular attention should also be paid to the realities faced by our country. Given that land-transferring fees have already be charged for land transfers, to collect a vacancy tax in our country will controversially constitute duplicate taxation. As the government infrastructure is not targeted at any certain group because it instead is built for the development of the whole city, it is unfair to have owners of personally-owned houses pay for public products. Additionally, to which extent the property tax will affect the housing price varies in different markets (Sá & Rocha, 2012). Therefore, it is necessary for us to explicate the nature and function of the property tax based on our own realities. Additionally, this paper proposes a scheme for China's collection of vacancy tax and a basic algorithm for tax credits, which will contribute more or less to the theory of vacancy tax levying. China has not released one vacancy tax

collection system yet and the information management system developed on the basis of .NET has found extensive applications in many areas. Therefore, the .NET-based vacancy tax calculation system will be of great application value to China's vacancy tax initiative.

2. Implementation of vacancy tax

To project a implementation scheme of the vacancy tax, one must pinpoint basic functions of the tax first. Infrastructure in most cities of our country is far from being solid and urban functions are yet to be improved. Urban planning do upvalue the real estate by a large margin in some areas, but that does not mean that residents there have obtained tangible benefits. This is due to the fact that they are just passive beneficiaries and that houses used for self-occupation will not bring them any extra gains. If the vacancy tax is collected to adjust income distribution, it must be ensured beforehand that the real estate constitutes the main assets of high net-worth individuals. As the real estate market takes on different landscapes in different regions, it is obviously unfair to tax areas where the housing price fluctuates a lot or presents to be too high only. Vacancy tax involves also the differences between active emptying and passive emptying in terms of taxation scope, as well as the demands of the rental housing market (Shi and Chen, 2016). Comprehensively speaking, China's purpose of collecting a vacancy tax should be to improve the utilization of real estate resources, reduce vacancy rate, promote the rational allocation of housing resources and help to strike a supply-demand balance in both housing rental and trade markets. That being said, standards of vacancy tax imposition need to be discussed. Although a size-based vacancy tax is now preferred, this paper holds that number of houses should also be taken into consideration.

2.1. Double-standard tax implementation scheme

If the size is counted as the sole standard, to levy a vacancy tax on those who owns only one house will be invalid; if the number of houses is considered alone, then it will be unequal to residents who have more one house whose total area turns out to be relatively small. Therefore, this paper believes that the total housing size should be taken as the threshold first and the number of houses as a further reference. On the basis of this, a gradient vacancy rate should be formulated to accommodate increasing size and number of houses. Meanwhile, the reason why this paper refrains from a unified size-based vacancy tax is that we think that residents' diverse housing needs, needs in high-end housing included, should be meet. The vacancy tax shall not render any preference to the high net-worth group. Therefore, if there are two individuals whose housing space are of the same size, the one who has a larger number of houses will face a heavier tax burden than the other. In other words, a size-based vacancy tax and a number-based one will come with different tax rates. Assume that: S denotes the housing size, S_i the total housing size of the i-th individual; N the number of houses, N_i the total number of houses owned by the i-th individual, n_{ij} the j-th house owned by the i-th individual and t the tax rate. Let us first introduce two dummy variables D_S and D_N and suppose that S^* and N^* represent the threshold of tax exemption, then we get:

$$D_S = \begin{cases} 0 & S_i \le S^* \\ 1 & S_i \succ S^* \end{cases} \qquad D_N = \begin{cases} 0 & j \prec N^* \\ 1 & j \ge N^* \end{cases}$$

When one's housing size is smaller than that requested by tax exemption, the dummy variable equals 0; on the other way around, it gets 1. By the same token, when the number of houses owned by an individual is smaller than that requested by tax exemption, the dummy variable equals 0; on the other way around, it gets 1.

2.2. Tax calculation formula

Regardless of other transaction costs generated during taxing, we have worked out the total amount of vacancy tax due from urban residents in line with the scheme above. The formula goes as follows:

$$T_i = D_S D_N \sum_{j=N^*}^{N} p_{ij} t_{n_j} + D_S (1 - D_N) \sum_{1 \prec j \prec N^*}^{N} p_{ij} t_{s_j}$$

p_{ij} represents the estimated price of the j -th house owned by the i -th individual and it ideally will be tantamount to the actual selling price. t_{n_j} represents the tax rate levied on the j -th house based on the number. It is noteworthy here that this is not particular to any single one but applies to everyone under the same conditions. And that's why there is no subscript i . t_{s_j} represents the tax rate levied on the j-th house based on the size.

We strictly define t as the monotone increasing function of both n_j and s_j. A strict monotone increasing function means that the gradient tax rate increases with more housing resources consumed. For instance, if one has two houses that are eligible for taxation, the smaller one will correspond to a j that values less and, therefore, a lower tax rate. It's unreasonable that the bigger one employs the lower tax rate first. In addition, the large but low-priced houses are geographically poor in general. That's why we define the tax rate as the monotone increasing function of the size rather than of the estimated price. The imposition of the vacancy tax should not add any financial weight to the residents. On the contrary, it should work to alleviate the irrational use of housing resources. This formula excludes the possibility that a number-based and a size-based vacancy tax will go simultaneously. It also stipulates that taxing will be initiated only when one's total housing size overtakes that requested by tax exemption and that one-house-only owner will be tax-free no matter how large the house is. The cost of a personally-owned house will equal to the total payable tax and the interface operation can be achieved through the information management system.

3. Algorithm implementation

In light of the algorithm mentioned above, this paper designs a corresponding information system that is based on .NET. The core of .NET is .NET Framework which consists of the common language runtime and class libraries to support the intermediate codes for the application program. These codes can be managed during the running and therefore programs developed with various computer languages can be operated in a cross-platform manner (Hart et al., 2007; Tang and Zhang, 2010; Zhang and Liu, 2013). In view of those advantages, the paper chooses .NET as the application development tool.

3.1. Rationale of program implementation

The rationale of the system is that: after one's identification information is provided, the personal data such as housing holding as a whole, the size of each house and the estimated asset value input into the system will automatically be extracted from the database and analyzed; then, the system will match the information to a corresponding tax rate and do the tax credit calculations. At the preliminary design stage, however, we did not subject all the operations to the background in order to better exhibit the implementation of the algorithm. As to the implementation of the program in general, we hope that the computer will accurately work out the payable tax after we attach a specific value to a parameter and offer the personal housing information no matter how the information is obtained, automatically identified by the background or typed in artificially. The main interface after one assesses the system is shown in Figure 1.

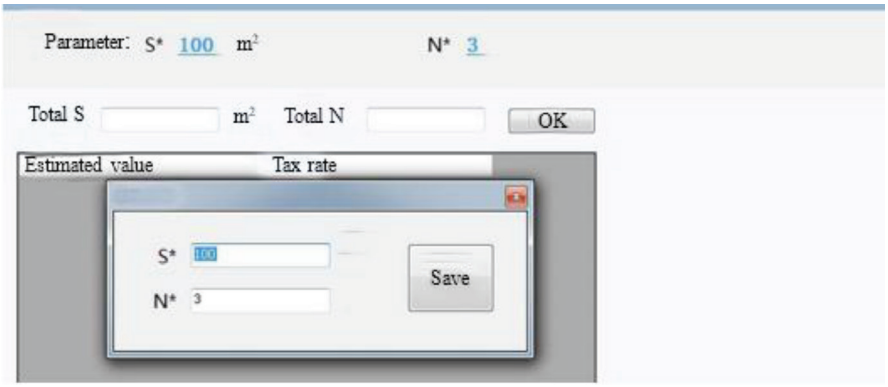

Figure 1 – Main interface

At the main interface, click "cardinal setting" and then we can set the threshold of tax exemption. The final default value will be determined with the support of scientific studies within the framework of relevant policies and rules. In this paper, we hypothetically define 100 square meters and 3(the number of houses owned by an individual) as the threshold of tax exemption. Next, the system needs to discern the personal housing information, including the total housing size S_i, the number of houses owned by an individual N or the estimated value of the houses. The system will automatically identify three cases when calculating: (1) Si <= S^* ; (2) Si> S^* , N> = N^* (3) Si> S^* , N < N^* .

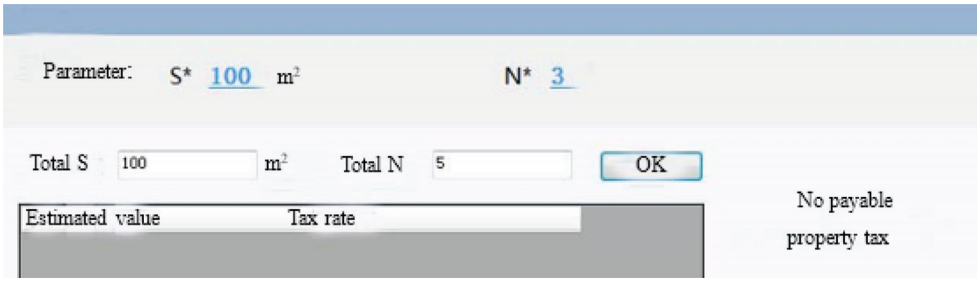

Figure 2 – Si <= S^* interface

In the case of Si <= S^* , the individual is eligible for tax paying. For example, if we type in 100 square meters(the total housing size) and 5 (the total number of houses), the program will produce “no payable property tax” (as shown in Figure 2).

In the case of Si> S^* , N> = N^* , the system will automatically calculate the tax credits based on the total number of houses. For example, if we type in 160 square meters(the total housing size) and 3 (the total number of houses), the program will turn to the number-based taxation page. Then, if we provide the estimated property value and the corresponding tax rate, the system will figure out that the payable tax comes at 30,000 (as shown in Figure 3).

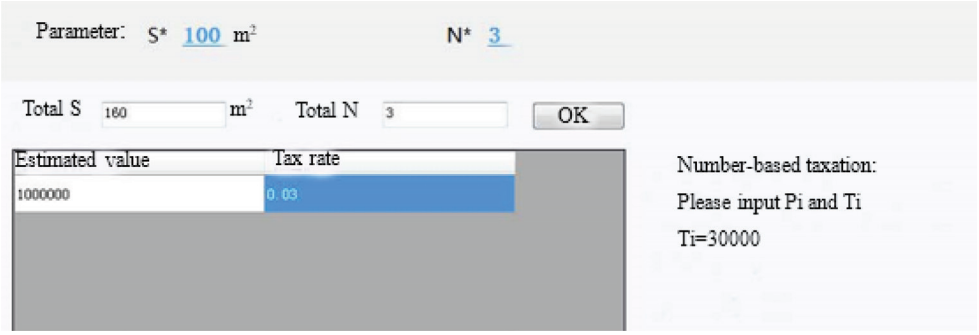

Figure 3 – Number-based taxation page

In the case of Si> S^* , N< N^* , the system will automatically calculate the tax credits based on the total size of houses. For example, if we type in 120 square meters(the total housing size) and 2 (the total number of houses), the program will turn to the size-based taxation page. Then, if we provide the estimated property value and the corresponding tax rate, the system will figure out that the payable tax comes at 20,000 (as shown in Figure 4).

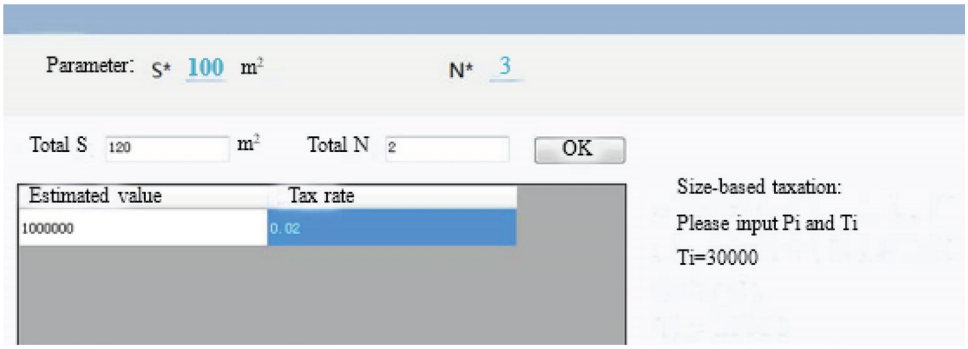

Figure 4 – Size-based taxation page

3.2. Process of program implementation

This paper presents parts of the program implementation process of the vacancy tax algorithm according to the overall rationale of the system. In order not to infringe any intellectual rights, we have to omit certain code snippets. At the outset of the program implementation, to switch swiftly between the two standards matters the most. The critical code of a number-based vacancy tax goes as follows:

```
private double UseNum()
{
   double Ti = 0;
    IList<AreaAndTax> listAreaAndTax = new
List<AreaAndTax>();
   GetAreaAndTax(ref listAreaAndTax);
  for (int i = 0; i < listAreaAndTax.Count; i++)
   {
AreaAndTax areaAndTax = listAreaAndTax[i];
    Ti += areaAndTax.Area * areaAndTax.Tax;
   }
   return Ti;
}
```

The critical code of a size-based vacancy tax goes as follows:

```
private double UseArea()
 {
    double Ti = 0;
    IList<AreaAndTax> listAreaAndTax = new List<AreaAndTax>();
    GetAreaAndTax(ref listAreaAndTax);

    for (int i = 0; i < listAreaAndTax.Count; i++)
    {
       AreaAndTax areaAndTax = listAreaAndTax[i];
       Ti += areaAndTax.Area * areaAndTax.Tax;
    }
    return Ti;
 }
```

In fact, the codes listed here are relatively simple. After coordinating with the database, the modified codes will make the computing system more intelligent and thus improve dramatically the efficiency of the government's collecting vacancy tax.

4. Conclusion

This paper presents a basic algorithm for the calculation of personal vacancy tax and develops a .NET-based information management system for the algorithm, making the automatic calculation of tax credits with housing information obtained possible. The discussed computing system, however, is still immature. With the values of relative parameters determined, such as the taxation scope and the corresponding gradient tax rate, the system will be smarter and add an interface to connect with the official Chinese Real Estate Registration System. Consequently, only with the unique personal identification, the system will conclude whether a tax is needed and, how much the payable tax will be.

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Multi-dimensional Outliers Detection Method Based on RBF Neural Network Model

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Abstract: In order to solve the problem of outlier detection in multi dimension dataset, an outlier detection model based on RBF neural network is proposed in this paper, and then we use the K-Means algorithm based on Canopy optimization to select the radial basis function center, which reduces the time of network training. Through experiments on different datasets, it is found that this method can reduce the training time compared with the non optimized RBF network. The Detection Ratio of Canopy Kmeans RBF Outliers Detection (CK-RBF-OD) algorithm is higher than other distance based outlier detection algorithm and the methods based on the density both in synthetic dataset and real dataset, while the False Ratio rate is lower than the other algorithms. This algorithm has more advantages than traditional methods in outliers detection.

Keywords: multi-dimensional dataset, outliers detection algorithm, RBF neural network.

1. Introduction

Outliers detection has been an important research direction in the field of data mining, which can detect the abnormal data in the data set. Many achievement has been widely applied to many fields, such as financial fraud detection, network intrusion and anomaly detection, process monitoring and identification, hyper spectral image anomaly detection, medical abnormal response analysis, abnormal signal detection, etc., so the outlier data detection and analysis has important academic significance and wide application prospects. However, with the advent of the era of big data, data surge in scale, in the face of increasingly complex mass high-dimensional data sets, how to rapidly and accurately detect the abnormal data and analyze the cause of abnormal become a challenging task.

In this paper the related theory of detecting outliers, methods and algorithms are studied, and made a numerical simulation is verified. In this paper, the main work and achievements are as follows:

1. Analysis of the current mainstream outliers detection technology, and compare their advantages and disadvantages.
2. Put forward a kind of outliers detection method based on regression model, through the establishment of regression model, neural network fitting multidimensional characteristics on the spatial distribution of the data set, detect the outliers in deviation regression model.
3. Through the Canopy-Kmeans algorithm to select the RBF network hidden layer center of the initial value, avoids the random initial parameters of RBF network, and for determining the cluster K interference.
4. By using UCI data sets and artificial data set tests show that the proposed CK-RBF-OD algorithm has faster convergence speed, and under the large-scale data set than the traditional method based on distance, based on the density has a better accuracy.

2. Correlational Research

2.1. Definition of Outlier

In the current academic research, the definition of outlier is not very uniform, and its definition is different with the different application fields. Researchers often give formal definitions of outliers in different application environments. Hawkins definition (Hawkins, 1980) is given from the neighborhood characteristics difference between sample points: "outliers are those from conventional data out of the ordinary object data, their performance and the vast majority of conventional data objects so different, that is suspected to be the mechanism by the addition of a completely different produce". This is the most extensive definition of outliers, to a certain extent, reveals the nature of outliers. From the point of view of pattern recognition, Chen gives the following definition: "outliers are data that does not conform to any pattern in a given application" (Chen et al., 2003). According to the above two definitions, Ramaswamy gives the following definition: "in an outlier in the data set is an observation object or a point, it is significant and most of their normal data is not similar or inconsistent" (Ramaswamy et al., 2000). Barnett and Lewis define outliers as an observed object (or a subset of observations) that is inconsistent with most of the rest of the data (Barnett et al., 1994). There are a variety of names for the name of the outlier data, including anomalies, outliers, discordant observations, exceptions, aberrations, surprises, peculiarities, contaminants etc. In this paper, two kinds of commonly accepted names are used.

Outlier data is the data points that show abnormal data patterns compared with a large number of conventional data. Many data mining methods are dedicated to reducing the impact of outliers or removing them completely, which can lead to the loss of useful information hidden in the outlier data. Outlier detection is the use of data mining, machine learning, statistics, intelligent computing, visualization, data processing technology to find outlier and mechanism of these data, to provide users with the in-depth analysis of data.

2.2. Main Detection Technology of Outlier

As early as the 19 century, Edgeworth, who has been in the field of data science and statistics to carry out outlier detection research. Through years of research and

development, the outlier detection technology involves a wide range of areas, including mathematical statistics, machine learning, data mining and information theory, etc.. To sum up, the outlier detection technology mainly has: the statistical distribution method based on distance based method, density based method, clustering method based on the deviation and the method based on information entropy based (Chandola et al., 2009).

- Outlier detection based on statistical method has some advantages. For example, they are mathematically reasonable, if a probabilistic model is given, the method is efficient, and it may reveal the significance of abnormal values (Petrovskiy, 2003). In addition, since the established models are generally given in a compact manner, it is possible to detect outliers without storage of the original data set.
- Outlier detection based on distance is, if the sample space D has at least N of sample point and object distance of O is greater than Dmin, then O is called object distance based outlier in the sample points {at least N} and Dmin parameter. The distance method was first proposed by Knorr (Knorr et al., 1998; Knorr et al., 2000). In the calculation of the reduction of unnecessary distance, Bay, S. D., & Schwabacher, M. (2003) proposed a first order random scatter data set preprocessing. Wei et al., (2003) proposed a hypergraph based outlier detection algorithm. The data distribution is uniform, and the distance based outlier detection will be difficult when the data distribution is not uniform.
- Outlier resistance modeling for data points based on the mechanism of outlier detection method based on the density of the use of more complex methods of distance. Usually, it requires the study of the local density of points and the local density of its nearest neighbors. Therefore, the outlier of a data point is usually related to the density of the point and the average density of its nearest neighbors. The density based approach is characterized by the ability to have a stronger outlier modelling but requires more computational overhead. The main methods based on density are: LOF, COF, INFLO and MDEF and other outlier detection methods (Lei, 2012).
- Outlier detection based on clustering according to the cluster analysis of data, according to the similarity between data objects, divides the data set into several clusters, which has high similarity between data objects in the same cluster, with the lowest possible similarity between data objects in different clusters. The semantic ontology base can be used to accurately calculate the similarity (Abad et al., 2016). In the result of cluster analysis, the data object that does not belong to any class can be defined as outliers. Most of the current clustering algorithms can be used for outlier detection, but the algorithm itself is concerned with how to improve the clustering accuracy, and the outlier data as noise cut out or discarded regardless of the final result in outliers as products, compared with representative clustering algorithms: CLARANS, DBSCAN, BIRCH, WaveCluster.
- Deviation based outlier detection is to identify outliers by examining the main features of a set of objects, the “Deviation” of this characteristic is the point we consider to be outliers. There are usually two kinds of techniques: first, the sequential exception technique second, using the OLAP data cube technique.
- Outlier detection method based on information theory based on the measurement method of information theory, such as Kolomogorov complexity (Li and Vitanyi,

2008), entropy, relative entropy and other means to analyze the information content and thus determine the outlier degree. Based on information theory, the advantage of outlier detection method is that it doesn't need to know the distribution of data, and does not need the training set and so on. But how to measure the complex data entropy or Kolomogorovcomplexity, is the difficulty of research.

3. Multi Dimension Outlier Detection Model Based on RBF Neural Network

Multi dimension outlier detection problem can be transformed into a multidimensional nonlinear function fitting problem, then the samples are classified according to the distance model of distance, far distance model is considered to be an outlier. How to solve the multi-dimensional nonlinear problem becomes the focus of research. According to the Cover pattern classification theory, a complex pattern-classification problem cast in high-dimensional space nonlinearly is more likely to be linearly separable than in a low-dimensional space. so in the establishment of multidimensional nonlinear function model, this paper choose radial basis function as the mapping function, the sample points to high dimension vector space. In this way, the nonlinear problem of low dimensional space is transformed into a linear problem in high dimensional space.

3.1. Overview of Artificial Neural Networks

Artificial neural network (Artificial Neural Network-ANN) is often referred to as the neural network (NN) is the computer network system, intelligent simulation of biological neural network computing system is abstract and simulation several basic characteristics of human or natural neural networks.

The characteristics and advantages of the artificial neural network are mainly manifested in three aspects: first, it has the function of self learning. For example, the realization of image recognition, only the first of many different image template and corresponding to the results of the input of the artificial neural network, the network will learn through the function, slowly learn to identify similar images. Self learning function is of special significance for prediction. Expected future artificial neural network computer will provide economic forecast, market forecast, benefit forecast, its application prospect is very big. Second, with associative memory function. This kind of association can be realized by the feedback network of artificial neural network. Third, with the ability to find the optimal solution. Optimization for a complex problem solution, often requires a large amount of calculation, the one for a problem and the design of the feedback type of artificial neural network, play computer speed, can quickly find the optimal solution.

3.2. RBF Neural Network Model

RBF is a kind of three layer feedforward neural network, which includes input layer, hidden layer and output layer. The typical RBF network structure is shown in Figure 1.

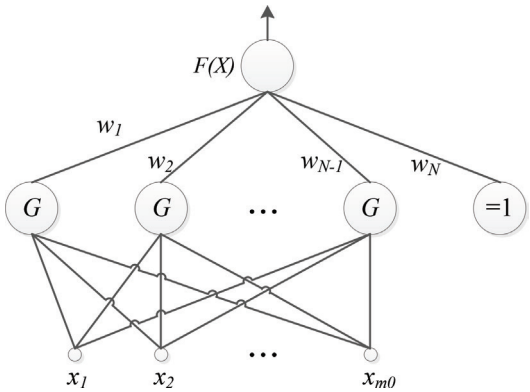


Figure 1 – The typical RBF network structure

When $G(\mathbf{X}, \mathbf{X}_i) = G(\|\mathbf{X} - \mathbf{X}_i\|)$ is taken, the radial basis function network". Another more common form of radial basis function networks:

$$\mathbf{G} = \begin{bmatrix} G(\mathbf{X}_1,\mathbf{X}_1) & G(\mathbf{X}_1,\mathbf{X}_2) & \cdots & G(\mathbf{X}_1,\mathbf{X}_{N-1}) & 1 \\ G(\mathbf{X}_2,\mathbf{X}_1) & G(\mathbf{X}_2,\mathbf{X}_2) & \cdots & G(\mathbf{X}_2,\mathbf{X}_{N-1}) & 1 \\ \vdots & \vdots & \ddots & \vdots & 1 \\ G(\mathbf{X}_N,\mathbf{X}_1) & G(\mathbf{X}_N,\mathbf{X}_2) & \cdots & G(\mathbf{X}_N,\mathbf{X}_{N-1}) & 1 \end{bmatrix}$$

Among them, the number of neurons N - 1, the number of learning samples N, second neurons can increase the hard limit function.

The number of neurons in the input layer is determined by the number of input attributes of the training sample. The number of neurons in the output layer is determined by the number of target classification tags. If Xi is an n-dimensional input vector, the output layer and the hidden layer of the M and K neurons, while the neural network model can be abstracted as follows:

$$\phi_j(x_i) = \exp\left(-\frac{1}{2\sigma^2} x_i - c_j^{\,2}\right),\ i \in \{1,2,\cdots,m\};\ j \in \{1,2,\cdots,k\}$$

$$y_i = \sum_{j=1}^{k} w_{ij}\phi_j(x_i)$$

Among them i={1,2,..., m}, j={1,2,... K}, J, phi (x) is the output J of the hidden nodes, Cj is the center vector of Gauss kernel function, its dimension is the same as X, sigma J is the Gauss function in the hidden node width J. In addition, Yi is the output of the first I output neuron, and Wij is the connection weights between the first I and the output neurons from the first J.

3.3. Method for Determining Radial Basis Function Center

At present, the method for determining the radial basis function center has two main types: the first is the random selection of radial basis function centers (such as the Gaussian radial basis function), based on the prior knowledge of the problem, determine the number of neurons for M1 < N, extracting M1 as the center of the radial basis function from random learning N sample $\{t_j \mid j = 1,2,\cdots,m_1\}$, the distance between the center of each calculation, and select the largest structures Gaussian function; second is the self-organizing radial basis function center, the first sample was randomly selected initial center, and then through the way of continuous adjustment of each sample clustering center layout. For example, through the method of literature (Yang Peng, 2010) subtractive clustering and initialization of hidden layer nodes, although it can improve the training speed of the network, but the cluster center for raw data points, cannot truly reflect the clustering center of meaning, and the threshold parameter and the neighborhood radius can only rely on the experience given, not adaptive determination. In this paper, we first estimate the number of the sample clusters in advance by using the lower performance Clustering Canopy algorithm, and then determine the radial basis function center by the K-means algorithm.

The specific algorithm steps are as follows:

1. To quantify the data set, and then put the list collection, while setting two distance threshold: T1 and T2.
2. To get one cycle from list, as a cluster center, put it in centerlist, and remove it from list.
3. The relationship between circulation from centerlist in comparison with the surrounding points on the threshold between T1, less than the minimum threshold, indicating two value similarity in a cluster, and removed from the list; if T2 is greater than the maximum threshold, then as a separate cluster center, and then removed from the list; otherwise between T1 and T2 is respectively added to each cluster center, but still retained in list.
4. Iterative 2~3 step up to list elements in the null, the algorithm ends.

The simplified pseudo-code for the Canopy K-means is as follows:

```
Input:
Data: List(D)
Algorithm:
//normalized the vectors
for every d in D do
    if(centerList is Null)
        add d to centerList;
        delete d from D;
    else
    for every c in centerList do
        if(sim(d,c)>T1)
            add d to Class c;
            delete d from D;
        if(sim(d,c)>T2)
            add d to Class c;
        if(sim(d,c)<T2)
```

```
        add d to centerList;
        delete d from D;
end for List(D) is Null
```

3.4. Network Weight Learning Method

In a supervised neural network, the weights are updated by iteratively updating the weights until the error is less than the specified threshold:

$$w_i(n+1) = w_i(n) - \alpha_1 \frac{\partial E(n)}{\partial w_i(n)},\ i = 1,\ 2,\ \cdots,\ m_1,\ m_1 + 1$$

Among them: n stands for the study of the iterative process sequence number, i stands for the value of the serial number.

$$\frac{\partial E(n)}{\partial w_i(n)} = \sum_{j=1}^{N} e_j(n)\, G\left(\mathbf{X}_j - \mathbf{t}_i\right)$$

$e_j(n)$ is to learn to enter the first n generation of the output error of the first j samples, $e_j(n) = d_j - F(X_j)$.

3.5. Network Model Comparison

In this paper, several UCI data sets are selected to detect the training speed and convergence effect of RBF network model based on Canopy - Kmeans clustering. All the variables in the data set are normalized to the range [0, 1], which makes all the input and output values in the same order of magnitude. For the calculation of K value, canopy algorithm in the T1 no sense, only to set T2 (T1>T2), this paper will be set to the average distance of the sample point T2. We compare this model with the traditional RBF model with random selection of hidden node centers, and the results are shown in table 2.

Because of Canopy - Kmeans clustering can choose more appropriate hidden node centers, it is often better to build a better network structure. The cross entropy as the network error evaluation index, we can see that for all the data sets, cross entropy RBF network based on Canopy - Kmeans clustering is smaller, and the network training time will be significantly reduced. Details of the experimental environment and data sets are described in section 4.1.

4. Experimental Analysis

4.1. Experimental Environment

The effectiveness and efficiency of the algorithm is verified, the algorithm makes experiments on synthetic and real data sets, and the distance outlier detection based on (K-Means-OD) and outlier detection based on (LOF) algorithm are compared. In order to ensure the fairness of the comparison, rewriting the K-Means-OD and LOF algorithms, so that the three algorithms on the same platform to achieve and run. Algorithm with

Matlab 2015 to prepare, in a configuration for Intel (R) Core (TM) 2.00GHZ i7 4510U CPU * 4 CPU, 8G memory of the PC machine running.

4.2. Experimental Data

The synthetic data in the experiment is based on the UCI original data set, the noise data is added to a certain proportion. The real data in the experiment are used in the Congressional voting records House-votes 84 data sets. Table 2 describes the basic situation of the experimental data set.

DataSet	Number of training set samples	Number of test set samples	Number of outliers	Number of attributes	Number of attributes classification
Iris	80	80	10	4	3
Breast Cancer	600	120	21	9	2
Glass	180	50	16	9	2
Thyroid	6300	1000	100	21	3
Wine	120	70	12	13	3
House Votes 84	350	100	15	16	2

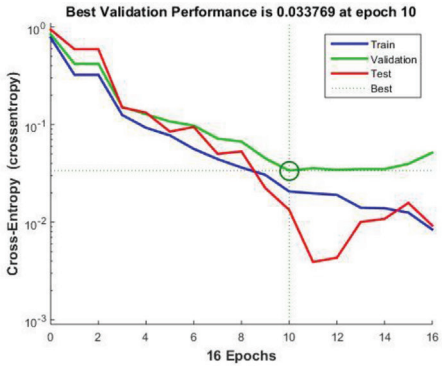
Table 1 – The basic information of the experimental data set

4.3. Experimental Result

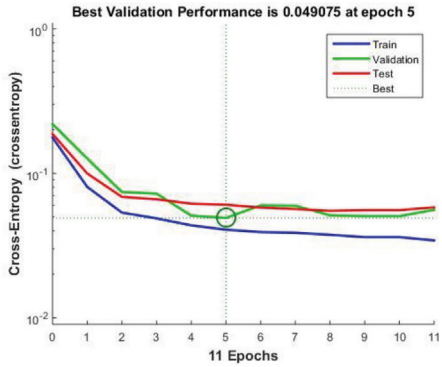
In the experiment, the RBF network error tolerance threshold is set to 1.00e-06, the number of input layer neurons is the number of samples, the number of output layer neurons is the number of samples, and the number of hidden layer neurons is set to 10. As shown in Figure 2, in which the X axis indicates the number of training rounds, Y axis indicates the training error, in the test data set, set the number of continuous validation to achieve the 6 network error is less than the specified threshold convergence. The results show that the RBF network training time is greatly shortened and the outlier detection accuracy is improved after the Canopy pretreatment K-Means clustering is used to set up the network center.

DataSet	RBF network cross entropy	CK-RBF network cross entropy	RBF network training time (s)	CK-RBF network training time (s)
Iris	0.035	0.033	0.764	0.373
Breast Cancer	0.084	0.049	0.786	0.384
Glass	0.120	0.098	1.064	0.523
Thyroid	0.087	0.050	1.067	0.538
Wine	0.048	0.036	0.882	0.413
House Votes 84	0.079	0.067	0.850	0.408

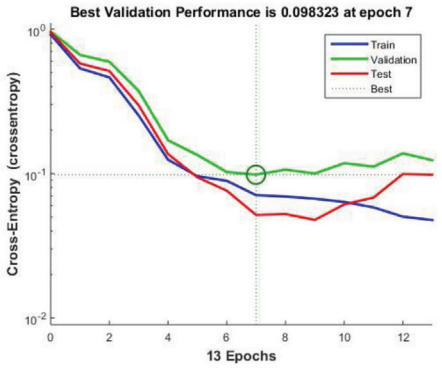
Table 2 – Comparison of different training algorithms



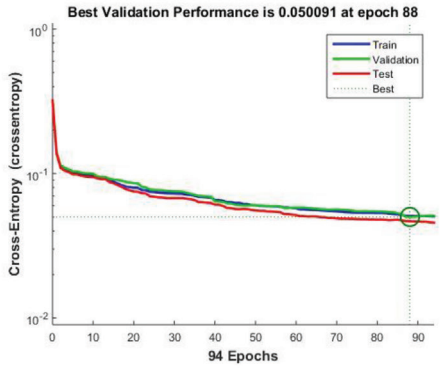
a) Iris



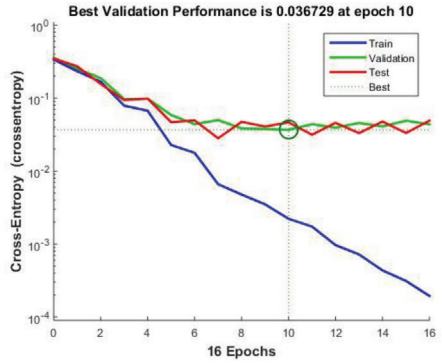
b) Breast Cancer



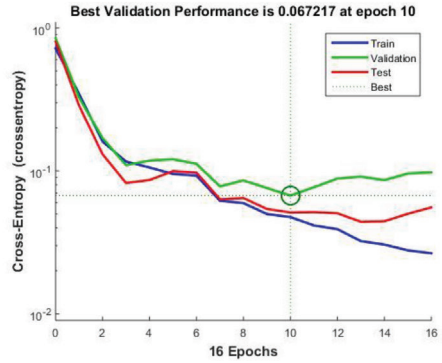
c) Glass



d) Thyroid



e) Wine



f) House Vote 84

Figure 2 – The error curve of the CK-RBF neural network trained on different datasets

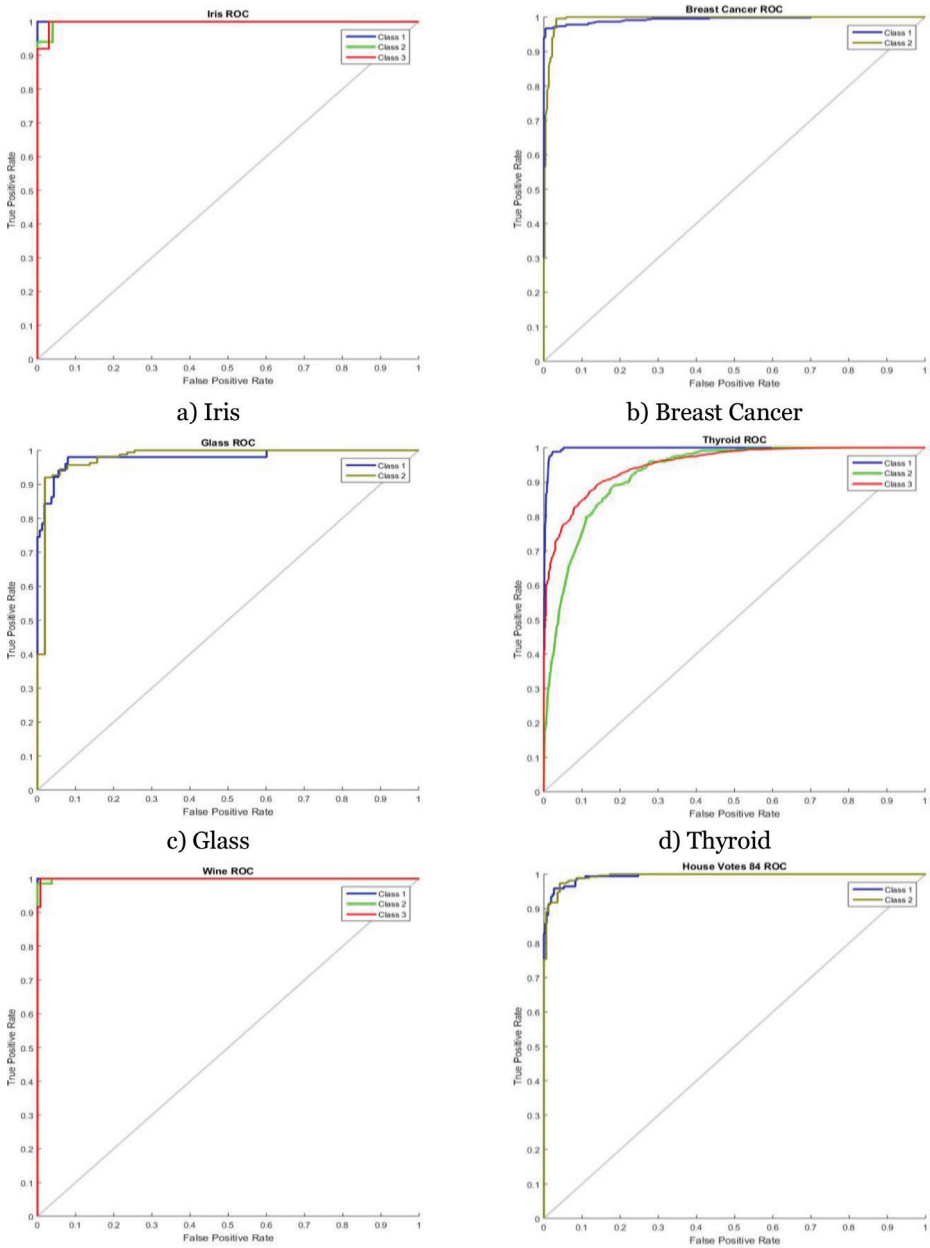


Figure 3 – The ROC curve of the CK-RBF-OD algorithm on different datasets

In this paper, the outlier detection evaluation index has detection ratio (DR) and false ratio (FR) (Cerioli and Farcomeni, 2011), and then through the detection rate and false alarm rate based on the ROC curve (Davis and Goadrich, 2006), the overall performance evaluation algorithm. Fig.3 shows the ROC curves of CK-RBF-OD algorithm for outlier detection in different data sets.

DataSet	CK-RBF-OD		K-Means-OD		LOF	
	DR	FR	DR	FR	DR	FR
Iris	0.92	0.005	0.80	0.013	0.85	0.04
Breast Cancer	0.93	0.01	0.78	0.05	0.85	0.03
Glass	0.87	0.005	0.81	0.014	0.85	0.009
Thyroid	0.78	0.06	0.70	0.08	0.75	0.07
Wine	0.98	0.001	0.83	0.011	0.78	0.018
House Votes 84	0.91	0.05	0.87	0.06	0.84	0.07

Table 3 – Comparison of DR and FR of different outlier detection algorithms

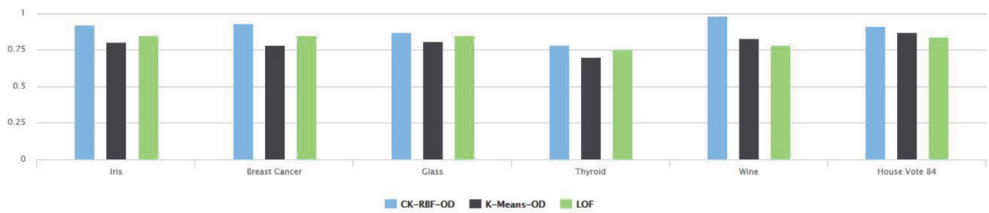


Figure 4 – Comparison of outlier detection ratio of each algorithm on different datasets

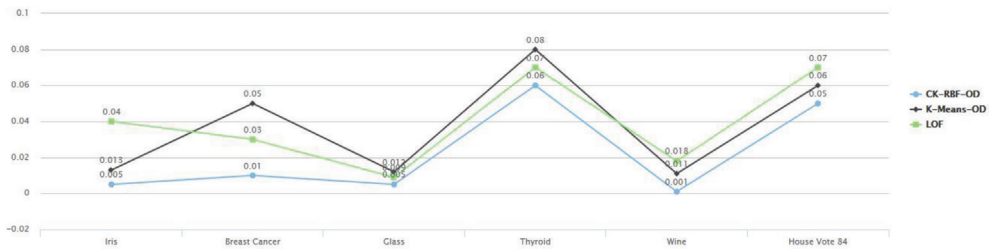


Figure 5 – Comparison of outlier false ratio of each algorithm on different datasets

The detection rate and false alarm rate curve is shown in Figure 4 and figure 5. It can be seen that the proposed CK-RBF-OD algorithm in the detection of synthetic and real data sets the rate is higher than other distance based outlier detection algorithm and the methods based on the density, while the false positive rate is lower than the other two algorithms.

5. Conclusions

Compared with the traditional distance and density based outlier detection method based on regression model more effective outlier detection methods, because the first is the model generated by a large number of prior knowledge, has strong generalization ability, can accurately classify the samples; secondly to judge the degree of offset samples from generalization model in outlier detection in the process, rather than by clustering or density method to complete the data processing, and then calculate the offset of sample points and classification center in the complete works, can save a lot of time, improve the detection efficiency.

However, with the advent of the era of big data, not only the size of the data increases, and the data set is no longer static, but in a constantly updated state. So, how to solve the outlier detection problem of dynamic data will become the future development trend.

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Study on Ecological Efficiency Prediction for Industrial Park Based on Rough Set Reduction Algorithm and Support Vector Machine Method

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Abstract: The thesis develops a new ecological efficiency prediction model for industrial park based on the rough set reduction algorithm and support vector machine classification method, which uses rough set theory to discretize the original impact factors and then selects the samples for training, the support vector machine model was used to predict the results and the comparisons between the predicted values and sample values are given. The final empirical study on ecological efficiency of industrial park shows that the method in this thesis could significantly improve the ecological management capabilities of industrial parks and has a great significance for the top design of the ecological planning.

Keywords: Park Ecological Efficiency, Rough Set, Support Vector Machine.

1. Introduction

For all this time, ecological development of industrial park is being attached great importance by the whole society, therefore, for the managerial personnel, how to dig technical opinions and predict ecological efficiency of industrial park by using data is very important. Support vector machine (SVM) is a new machine learning method built on the basis of statistical theories, better than other prediction methods in many respects, and as a result, it is extensively used (Esteban, 2014). By combining the strengths of rough set and least-square SVM, Chinese scholar (Peng, 2012) developed an intelligent prediction model with economic climate indexes, designed to solve index redundancy, nonlinear prediction difficulties and other problems. After making some improvements on the prediction method of SVM, Zhao et al. (2014) proposed to apply the prediction model consisting of rough set and improved and weighted least-square SVM to the prediction of guided missile parts consumption, whose effectiveness will be verified in case study. And the prediction method combining rough set and support vector machine performs better (Yang et al., 2008; Thangavel and Pethalakshmi, 2009; He et al., 2016; Dufrenoisd and Noye, 2016; Shigeo, 2015; Tagliaferri et al., 2015; Antonio et al., 2014).

SVM is a small sample management tool widely used, which itself is not able to simplify dimensions within information space automatically. Therefore, a large quantity of

information and high space dimensionality will trigger a longer time for SVM training and slower processing speed. Rough set reduction can remove redundant knowledge within the information system and decrease the dimensions of vector space produced during classification, which precisely covers the shortages of SVM. By combining strengths of rough set and SVM and keeping away from their shortages, a text categorization method based on rough set and SVM is developed. With accuracy rate remain unchanged, the combination of these two (a. reduction theory of rough set reduces the training data of SVM; b. SVM is used to replace rules of rough set) decreases the vector dimensions, which further reduces the difficulty of computation and improves classification efficiency.

2. The text

In this thesis, Tianjin TEDA Industrial Park, also known as Tianjin Economic-Technological Development Area, is taken for example. Built on December 6, 1984, after several decades of development, it has developed an eco-industrial park road featured with optimized resource utilization, minimum environmental pollution and maximum economic benefit and its next object is "building a new model for regional green development". For this purpose, we developed a prediction model combined rough set (used for processing data) and SVM to predict the ecological efficiency of park. See Figure 1 for its major steps.

On the basis of objective requirements for park ecological efficiency evaluation and following the fundamental thought of optimizing resource utilization, minimizing environmental pollution and maximizing economic efficiency, we divided influence factors into five categories: economic development, resource saving, environmental protection, social development and technology support.

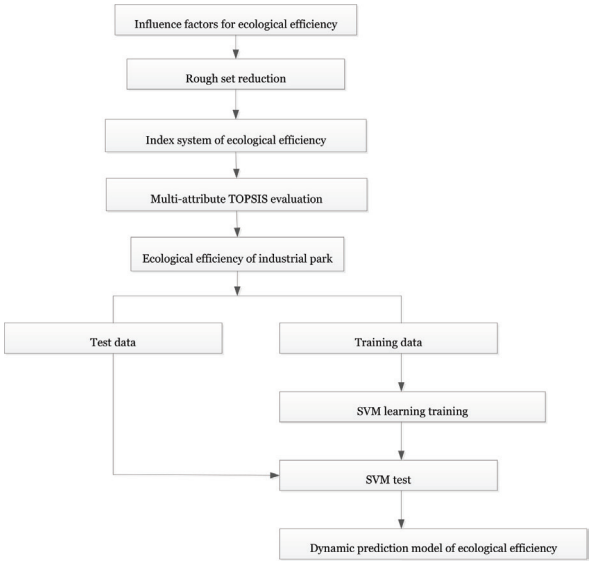

Figure 1 – Flow of Ecological Efficiency Prediction Model for Industrial Park Based on Rough Set Reduction Algorithm and Support Vector Machine Theory

2.1. The data source

With the help of EBSCOhost, Science Citation Index Expanded, EI village, Wiley, Springer, Duxiu.com, Wanfang Data, CNKI and other database, we collected some literature related to park ecological efficiency and systemized indexes relevant to eco-industrial park and sustainable development. Considering the objective requirements for the evaluation of eco-industrial park efficiency, we chose 32 influence factors after screening and categorized them into five headings: economic development, resource

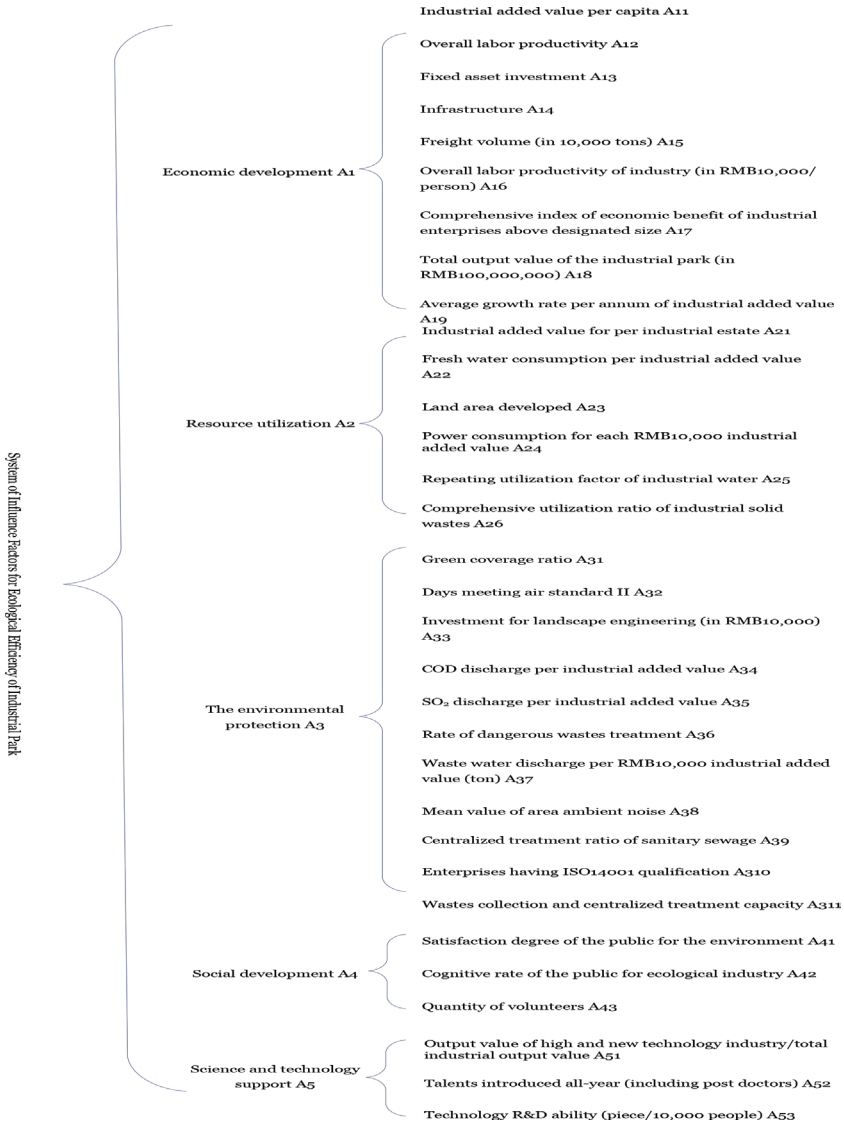

Figure 2 – Index System of Influence Factors of Ecological Efficiency

saving, environmental protection, social development and technology support. See Figure 2 – for the index system of influence factors of ecological efficiency.

At first, we standardize original data (see attached Form 1) and establish a decision matrix N ; for the purpose of reducing computational difficulty, equal weight method is used for evaluation function S; satisfaction matrix $SM=(s_{ij})_{m'n}$ is developed; positive ideal solution A^* is indicated by the maximum value of each index within the system while non-positive ideal solution A^* is indicated by the minimum value of each index within the system. See table 1 for the reduced data after importing and systemizing.

Reduced indexes	Integrity	Quantity
{A6, A17, A18, A28}	100	4
{A11, A18, A20, A27}	100	4
{A6, A8, A15, A18}	100	4
{A8, A10, A14, A21}	100	4
{A8, A11, A12, A18}	100	4
{A5, A6, A15, A18}	100	4
{A5, A15, A18, A26}	100	4
{A6, A16, A18, A29}	100	4
{A10, A13, A16, A18}	100	4
{A9, A11, A15, A21}	100	4
{A2, A11, A18, A29}	100	4
{A2, A11, A18, A28}	100	4

Table 1 – Reduced Indexes

Considering indexes are integral and diverse, with the help of rough set reduction, this thesis takes index 1: {A8, A10, A14, A21}, index 2 {A9, A11, A15, A21}, index 3 {A6, A9, A16} as the reduced indexes, which are used for the evaluation of ecological efficiency of industrial park to examine the robustness of the method. We deleted several indexes that have no effect to evaluation from Table 1, e.g. rate of dangerous wastes treatment, centralized treatment rate of sanitary sewage, wastes collection and centralized treatment capacity of each year have the same value, meaning treatment capacity of wastes and sewage of this industrial park meets basic ecological requirements.

2.2. The data analysis

Based on the estimation of value of satisfaction degree of influence factor, we obtained the distance value between the actual value and the maximum value as well as the actual value and the minimum value of the industrial park:

On the basis of index 1 {A8, A10, A14, A21}, we obtained scores of each year. On the basis of index 2 {A9, A11, A15, A21}, we obtained scores of each year. Among ecological efficiency scores calculated in index system 2, indexes of fresh water consumption per industrial added value and waste water discharge per RMB10,000 industrial added

value partly indicate that the direction of these indexes are opposite to other indexes. On the basis of index 3 {A6, A9, A16}, we obtained scores of each year.

We estimated and evaluated ecological efficiencies of different years:

Ecological efficiency scores calculated based on index 1, 2 and 3 are indicated in Figure 3:

Figure 3 – Ecological efficiency scores calculated based on three indexes

Positive ideal solutions are indicated by the maximum values chosen from indexes 1, 2 and 3, based on which ecological efficiency values of different years can be decided.

Time	Index 1	Index 2	Index 3	Mean value
2006	0.23	0.35	0.52	0.37
2007	0.09	0.38	0.55	0.34
2008	0.42	0.31	0.43	0.39
2009	0.52	0.41	0.53	0.49
2010	0.39	0.48	0.27	0.38
2011	0.51	0.57	0.44	0.51
2012	0.70	0.80	0.59	0.70
2013	0.79	0.71	0.48	0.66
2014	0.85	0.65	0.49	0.66
2015	0.75	0.64	0.44	0.61

Table 2 – 2006-2015 Ecological Efficiency Scores of Three Indexes

According to experimental results, index of power consumption for each RMB 10,000 industrial added value gets better when smaller while other indexes are on the opposite. Therefore, range transformation is needed and for the purpose of this thesis, "-" is used for symmetry transformation. Moreover, this index tends to go down in an obvious way

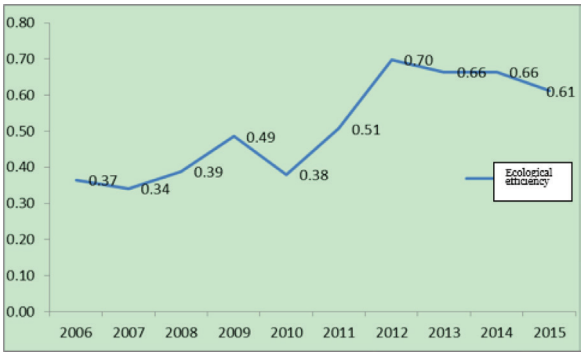

Figure 4 – 2006-2015 Ecological Efficiency of TEDA Industrial Park

and for the purpose of accuracy, trend extrapolation is used for data completion. See Figure 3 for the final ecological efficiency evaluation.

2006-2015 ecological efficiency of Tianjin TEDA industrial park fluctuates between 0.34-0.70 and fluctuation range of different years is steady, indicating that the ecological efficiency of TEDA industrial park of recent ten years is developed in a relatively steady manner. 2007 and 2010 saw a relatively low ecological efficiency, which can be attributed to the lower landscape engineering investment comparing to previous year. After 2010, TEDA industrial park gradually increased its investments into ecology substantially. With the growth speed of park economy getting slower, the contribution of output value of high and new technology industry to total industrial output value continues to decrease, bringing a obviously negative effect to the ecological efficiency; while power consumption for each RMB 10,000 industrial added value gliding year by year gives an obvious positive effect to the improvement of park ecological efficiency; repeating utilization factor of industrial water keeps steady. It can be seen that ecological efficiency of TEDA industrial park of ten years from 2006 to 2015 falls into normal range. However, when coming down to how to improve ecological efficiency of industrial park, the managerial personnel needs to take how to improve the overall economic growth speed of the park and continuing to enhancing support to high and new technology industry.

2.2. The data analysis

According to Table 1, the reduced indexes are as follows: index 1 {A8, A10, A14, A21}, index 2 {A9, A11, A15, A21} and index 3 {A6, A9, A16}. In the light of Figure 5, three indexes tend to be convergent (other two indexes of 2 and 3 will not be repeated here given the limited space), indicating that samples of three index data can be operated.

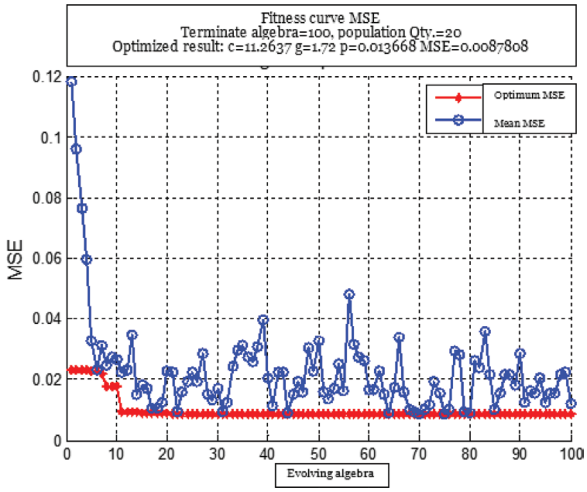

Figure 5 – Convergence Examination for Data of Index 1

First, we take the former eight years of 2006-2015 TEDA industrial park within index 1 as the training set, and as we can see, Figure 6 is the training result of index data of 2006-2013 TEDA industrial park.

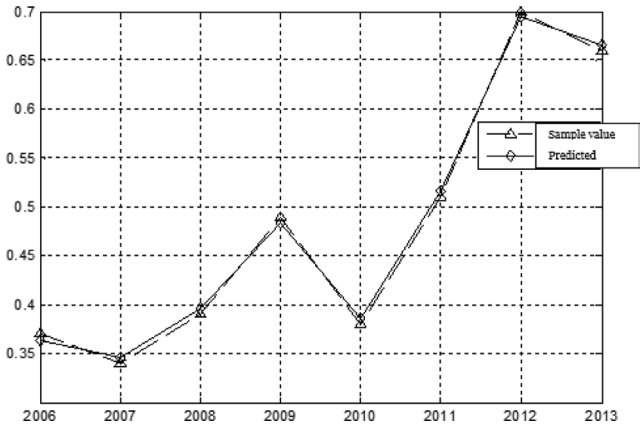

Figure 6 – Training Result of 2006-2013 TEDA Industrial Park data within Index 1

As we can see from the regression result of training set, predicted value and sample value fit each other well, meaning the training set meets training requirements and may be used for the prediction for the future ecological efficiency. Whereby we took 2014-2015 for prediction and compared values produced with the sample values of them for analysis. The predicted regression result is indicated in Figure 7.

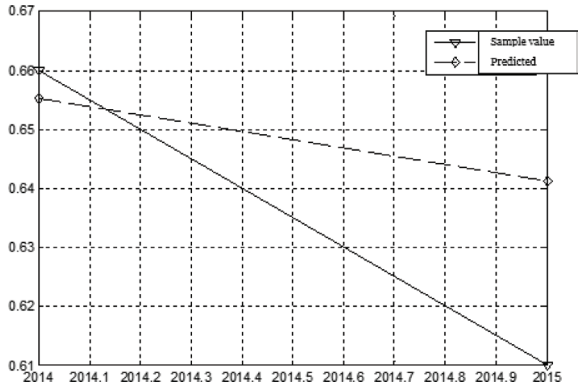

Figure 7 – Predicted Regression Result after Training of Index 1

As we can see from the result, the former 8 years were taken for the training set while the latter 2 years were taken as the sample set with a purpose of examining the accuracy of predictive model. According to the result, the predicted value was 0.64-0.66, changing within a very small range while the sample value was 0.61-0.66, changes less than 0.1, meaning predicted result was acceptable.

If data of 2006-2013 within index 2 {A9, A11, A15, A21} is chosen for training, its training result is indicated in Figure 8.

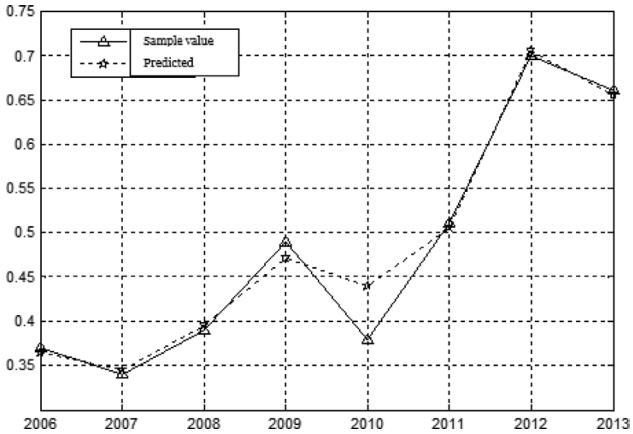

Figure 8 – Training Result of 2006-2013 TEDA Industrial Park Data within Index 2

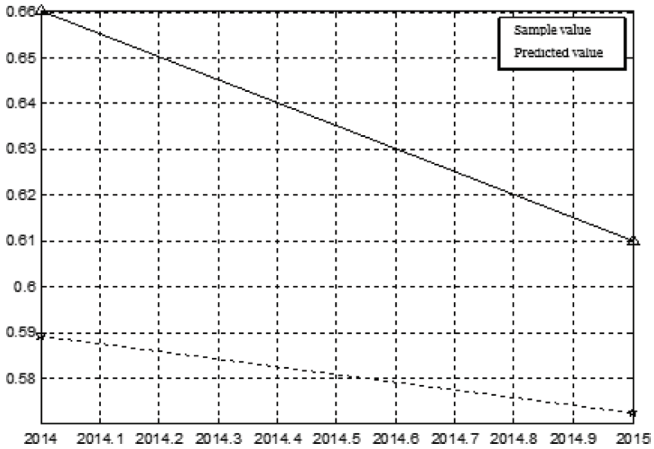

Figure 9 – Predicted Regression Result after Training of Index 2

The training result of 2014-2015 ecological efficiency within index 2 is not as good as that of index 1.

If data of 2006-2013 within index 3 {A6, A9, A16} is chosen for training, its training result and prediction result are indicated in Figure 10 and Figure10, respectively.

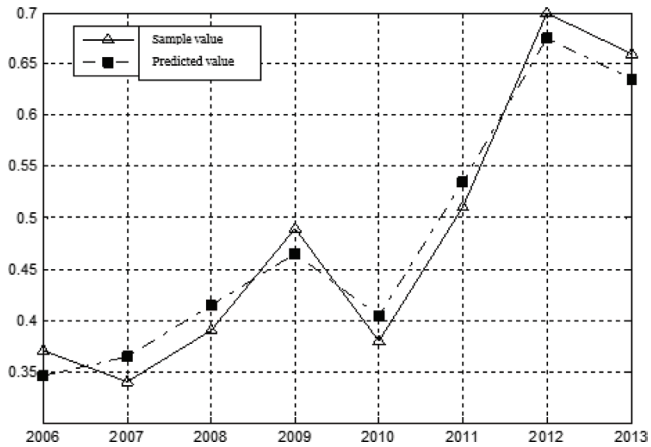

Figure 10 – Training Result of 2006-2013 TEDA Industrial Park data within Index 3

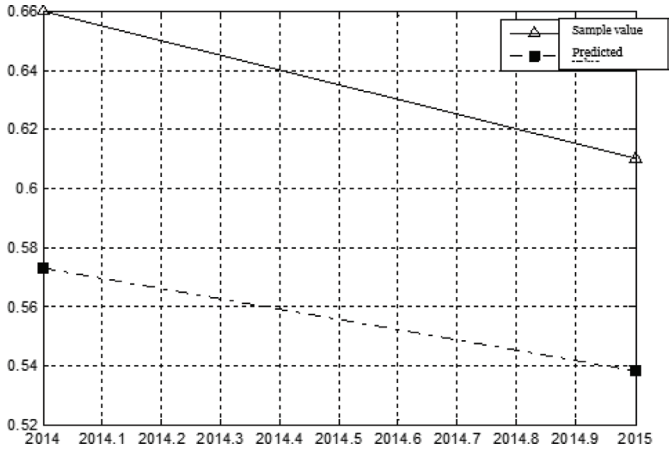

Figure 11 – Predicted Regression Result after Training of Index 3

Likewise, the training result of 2014-2015 ecological efficiency within index 3 is not as good as that of index 1.

Comparison of ecological efficiency of three indexes is indicated in Figure 12.

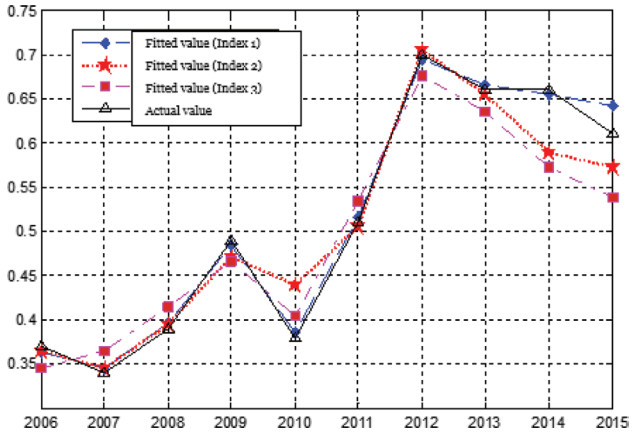

Figure 12 – Ecological Efficiency Comparison of Three Indexes

Time	Index 1			Index 2		Index 3	
	Actual value	Predicted value	Relative error	Predicted value	Relative error	Predicted value	Relative error
2014	0.663	0.655	1.21%	0.589	11.15%	0.573	13.64%
2015	0.611	0.641	3.30%	0.572	13.68%	0.538	18.84%

Table 3 – Relative Error between Actual and Prediction Values of the Training Set

Given the fact that index 1 has the best fitting results, it was chosen to predict ecological scores of 2016 and 2017, for which second exponential smoothing method is used for extrapolation of explaining variables, alf=0.3.

2.3. Predict

As we can see from the predictions of training set indicated in Figure 13, ecological efficiency of TEDA Industrial Park in 2016-2017 are as follows:

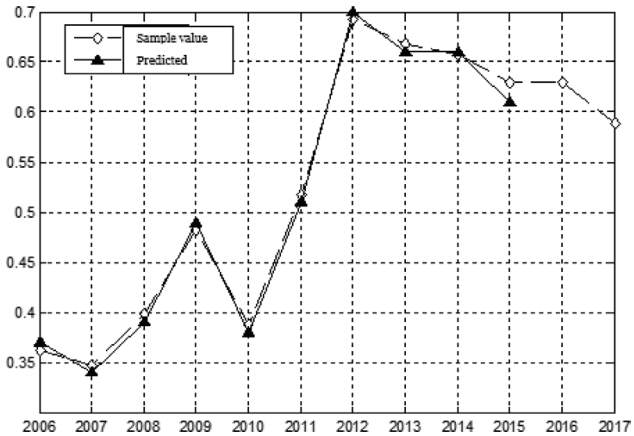

Figure 13 – 2016-2017 Predicted Results of Ecological Efficiency of TEDA Industrial Park

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Ecological efficiency	0.37	0.34	0.39	0.49	0.38	0.51	0.70	0.66	0.66	0.61	0.63	0.59

Table 4 – Predicted Ecological Efficiency of TEDA Industrial Park

3. Conclusions

2016-2017 Predicted Results of Ecological Efficiency of TEDA Industrial Park are 0.63 and 0.59, comparing to 2012-2015, they tend to slide. To sum up, with the overall economy slowing down, contribution made by high-technology industry gets lower; as for sentiment analysis of internet data themes, the same standard for talent introduction to the park shall be given emphasis; moreover, 8/12 event brings more attention to the influence of park ecology. For the managerial personnel of the park, they should put more attention to aspects mentioned above and make countermeasures in advance coping for ecological efficiency change trends, e.g. increase contribution made by science-and-technology enterprises and make talents introduction standards more transparent.

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Research on Promotion of Teaching Quality with a New Physical Education Teaching Mode Based on Virtual Reality

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Abstract: As a metasynthesis of developed technologies, such as computer technology, artificial intelligence, control technology, sensor technology, and simulation technology, the technology of virtual reality (VR, for short) has wide application. To address existing problems in physical education (PE) teaching, the paper discussed the necessity of introducing VR to PE teaching, analyzed characteristics of VR in terms of its application to PE teaching, and discussed methods and approaches of VR-based PE teaching. The promotion of teaching quality by the VR-based PE teaching mode was also analyzed in the paper. On this basis, performance analysis was conducted accordingly, where evaluation indices were determined, and an AHP-based performance analysis fuzzy evaluation model was established. Finally, by case study, the corresponding method and model were explained and analyzed.

1. Introduction

As an important teaching link of higher education, PE teaching is of great significance to promoting comprehensive development of postsecondary students (Peng, 2009; Li and Yang, 2010). The double parts of PE teaching, namely PE theoretical teaching and PE practical teaching, supplement each other. Traditional PE teaching tends to focus on imparting theories of physical education, with insufficient emphasis on practical training. Along with social progress and rapid technological development, the integration of PE theoretical teaching and PE practical teaching plays an increasingly important role in PE teaching and physical quality cultivation. The development of multiple advanced sciences and technologies drives PE teaching mode to break through the shackles of theories and become more scientific and practical (Sheng, 2014; Hu, 2001). Numerous corresponding studies have achieved favorable application results (Yu, 2014; Liu and Wu, 2010; Yu, 2014; Zhang, 2015). Virtual reality (Lorenzo et al, 2016; Chwen et al, 2013; Fillatreau et al, 2013) is a metasynthesis of developed technologies, such as computer technology, artificial intelligence, control technology, sensor technology, and simulation technology. VR is conducive to changing traditional PE teaching concept, improving PE teaching approach, and broadening PE teaching means as well. It helps improve PE teaching quality, and actively promotes the transformation of PE teaching

mode. Therefore, relative issues of PE teaching based on VR are discussed and analyzed in the paper.

2. The application of VR to PE teaching practice

2.1. Existing problems in PE teaching

1. Redundant teaching contents: trapped in the mode of exam-oriented education, PE teaching mechanism is based on knowledge inculcation, whose source is old, hoary textbooks such that the teaching contents are lack of innovativeness and practicability.
2. Unreasonable evaluation mode: existing PE examination and assessment places more weight on theoretical examination than practical performance, test results than class behavior, and technique demonstration than physical quality.
3. The structure of faculties needs for improvement: highly-educated specialized teaching staffs with advanced titles are in low proportion, and reserve talent development is inconsistent. This phenomenon renders the integral level and teaching quality of faculties low.
4. lack of physical equipment; PE hardware needs for enhancement: expansion of university enrollment especially increases student numbers. The existing facilities and sites provided by universities and colleges can no longer meet the demands of the gain of students, and thus impair PE teaching quality.
5. Monotonous teaching mode; theories are divorced from practice: conventional PE teaching tends to focus on imparting theories of physical education, with insufficient emphasis on practical training. The traditional PE teaching mode is monotonous particularly, which causes theoretical teaching to be divorced from practical teaching.
6. Teaching reform is not systematic: present PE teaching reform is more formalistic than targeted or systematic. The comprehensive reform is ignored concerning keys links including textbooks (teaching contents), teaching methods, teaching means, teaching management and organization.
7. Lack of innovative teaching means and approaches: under the background of rapid technological development, if PE teaching sticks to convention instead of effectively upgrades and innovates itself, the PE teaching means and approaches will not keep up with the trend of era, and the teaching quality will be greatly affected.

2.2. Characteristics of VR for PE teaching practice

1. Multi-perception: with the application of VR, PE teaching contents can be integrally displayed through visual sense, force perception, tactile sense, aural sense, and motion perception. Students thus perceive real teaching effects from various aspects, angles, and dimensions, and the teaching horizons are broadened as well.
2. Sense of presence: by using VR to simulate real environments and scenarios of PE classes, students are allowed to experience the feelings and senses that are originally difficult to perceive directly in PE class. The realness of sports can be represented to the largest degree in virtual environments, and thus the actual effects of PE teaching are enhanced.

3. Interactivity: VR-based PE teaching should make full and effective use of interactivity of VR by efficaciously integrating theoretical teaching with practical teaching through more cooperation, interaction, and participation. In this way, not only can theoretical knowledge be deepened, but the practicability, executive force, and intelligence of PE teaching are intensified.
4. Autonomy: VR is used to represent and reflect the movement degree of human bodies according to physical laws under virtual environments. For example, with VR, skillful, technical, and practical sport environments can be constructed for PE teaching, so that the imagination and cognition of students during perception can be broadened to a larger extent. This will help students produce an integral cognition of physical activities both qualitatively and quantitatively, and have a deepened cognitive force in terms of PE classes as well.

2.3. The promotion of PE teaching quality by VR

VR is used to build up key technical modules of PE teaching, such as scene modeling, man-machine interaction, sensor and control, and detection and feedback, with the intention of supporting PE teaching and improving its quality. Specific roles that VR plays in PE teaching are shown as follows.

1. The change of PE teaching concepts and approaches: with the help of VR, PE teaching can be effectively transformed from spoonfeeding to dynamic, initiative education, accompanied by radical transition of teaching concepts. The resulting new teaching mode will be more diversified, personalized, and adaptive, and can comply with the trend and requirements of developing essential-qualities-oriented education as well.
2. Overwhelming abundance in PE teaching contents and means: once VR is introduced to PE classes, the teaching contents will not completely rely on textbooks any more, but achieve certain innovations in aspects of knowledge acquirement, knowledge accumulation, knowledge transformation, and knowledge itself. The creativeness of PE teaching contents will promote teaching approaches to be more scientific, intelligent, and highly-efficient. What's more, the improvement of teaching contents and means allows students to continue analyzing, summarizing, deducing, and innovating the physical knowledge that has been imparting to them.
3. Improvement of PE cognitive ability and creativity: VR-based PE teaching is characterized by multi-perception, the sense of presence, interaction, and autonomy. This permits the virtual PE teaching environment to provide students with a broader and more real way to learn and perceive, and renders complicated, abstract physical knowledge more direct and formal as well. VR-based PE teaching is more conducive to improving students' physical cognition and innovation.
4. PE teaching methods become more demonstrative: VR-based PE teaching can provide real scenes of physical activities more vividly, and the implementation of PE teaching thus becomes more targeted. The application of VR helps PE teaching break through the shackles of tradition, arouse students' learning interests, and enhance the autonomy of learning.

5. The improvement of PE teaching environments and the comprehensive level of faculties: the application of VR to PE teaching can greatly upgrade PE teaching environments, so that students have enough time and opportunities to perceive the internal essence of physical activities and to fully understand the connotations of PE teaching. PE teaching based on VR will not all depend on highly-educated teaching staffs with advanced titles, thus the lack of faculty quality is offset.
6. The change of PE teaching mode: VR-based PE teaching better conform to the mainstream development of modern society. The combination of high-tech approach and advanced teaching concept will change PE teaching from the one with traditional features to the one with modernized teaching mode, and achieve perfect integration of PE theoretical teaching with PE practical teaching as well.

3. Performance analysis of promotion of VR-based PE teaching quality

3.1. Performance analysis evaluation index

Through the above analysis, the author suggested that the evaluation indices for performance analysis of promotion of VR-based PE teaching quality contained: (1) abundance of teaching contents u_1; (2) advancement of teaching means and methods u_2; (3) improvement of cognitive force and creativity u_3; (4) enhancement of teaching levels u_4; (5) effectiveness of teaching concepts and approaches u_5; (6) integration of PE theoretical teaching with PE practical teaching u_6.

Thus, the index set U could be expressed as

$$\mathbf{U} = \{u_1, u_2, u_3, u_4, u_5, u_6\} \tag{1}$$

3.2. Fuzzy evaluation grades

By consulting experts, the paper classified the fuzzy evaluation grades of performance analysis results into four categories: 1. excellent G_1, 2. favorable G_2, 3. intermediate G_3, 4. poor G_4. Thus, the fuzzy evaluation grade set G was given as

$$\mathbf{G} = \{G_1, G_2, G_3, G_4\} \tag{2}$$

3.3. AHP-based index weight distribution

AHP (Mohammad et al, 2011; Prata et al., 2013) was used in the paper for evaluation index weight distribution. If there was Q evaluation indices, and experts were invited to score them pairwise according to the ratio scale of 1-9, the evaluation matrix B of the Q indices was expressed as:

$$\mathbf{B} = \left[b_{ij} \right]_{QxQ} = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1Q} \\ b_{21} & b_{22} & \cdots & b_{2Q} \\ \vdots & \vdots & \cdots & \vdots \\ b_{Q1} & b_{Q2} & \cdots & b_{QQ} \end{bmatrix}_{QxQ} \tag{3}$$

and

$$\begin{cases} b_{ij} = 1 / b_{ji} \\ 1 \le \left\langle b_{ij}, 1 / b_{ji} \right\rangle \le 9 \end{cases} \tag{4}$$

Where the connotations of b_{ij} was listed in Table 1.

evaluation magnitude b_i	**The relationship between evaluation index i and evaluation index j**
1	Equally important
3	*i* is slightly more important than *j*
5	*i* is relatively more important than *j*
7	*i* is quite more important than *j*
9	*i* is extremely more important than *j*
2,4,6,8	Among corresponding adjacent magnitudes
Reciprocal	$b_{ij}=1/ b_{jt}$

Table 1 – The connotations of evaluation magnitude b_{ij}

The relationship between the maximum eigenvector *Y* and the eigenvalue r_{max} of the evaluation matrix *B* satisfies the following formula:

$$\mathbf{BY} = \lambda_{\max} \mathbf{Y} \tag{5}$$

The consistency index *CI* was then obtained as

$$CI = \left(\lambda_{\max} - Q \right) / \left(Q - 1 \right) \tag{6}$$

The magnitude of a randomized consistency index *RI* was acquired by referring to the table, and the consistency ratio *CR* was expressed as

$$CR = CI / RI = \left(\lambda_{\max} - Q \right) / \left(RI * \left(Q - 1 \right) \right) \tag{7}$$

If

$$CR \leq 0.1 \tag{8}$$

Then the evaluation matrix *B* was reasonable. Or else a second scoring should be done for acquirement of a new evaluation matrix until *CR£0.1*.

The weight w_j of evaluation index *j* was given as:

$$w_j = \left(\sum_{j=1}^{Q} b_{ij} \right) / \left(\sum_{i=1}^{Q} \sum_{k=1}^{Q} b_{ik} \right) \tag{9}$$

If the weight of evaluation index j by expert p was defined as w_{ip}, then the absolute weight w_j of evaluation index j by expert p was expressed as:

$$w_j = \frac{1}{P} \left(\sum_{p=1}^{P} w_{jp} \right) \tag{10}$$

3.4. The performance analysis fuzzy evaluation model based on AHP

Through fuzzy membership analysis of each evaluation index, the fuzzy membership degree q_{ji} between evaluation index j for the evaluation objective and evaluation grade i from the fuzzy evaluation grade set G was obtained, and the fuzzy membership degree matrix q was acquired and expressed as:

$$\boldsymbol{\theta} = \left[\theta_{ji} \right]_{mxn} = \begin{bmatrix} \theta_{11} & \theta_{12} & \cdots & \theta_{1n} \\ \theta_{21} & \theta_{22} & \cdots & \theta_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ \theta_{m1} & \theta_{m2} & \cdots & b_{mn} \end{bmatrix}_{mxn} \tag{11}$$

Considering the weight w_j of different evaluation indices, the weighted comprehensive fuzzy membership degree x_i between the evaluation objective and evaluation grade *i* from the fuzzy evaluation grade set *G* was obtained as:

$$\boldsymbol{\xi} = \left\{ \xi_i \right\}_{1xn} = \left[w_1, w_2, \cdots, w_m \right]_{1xm} * \left[\theta_{ji} \right]_{mxn} \tag{12}$$

If the comprehensive fuzzy membership degree x_k satisfied the conditions of

$$\xi_k = max\left\{ \xi_1, \xi_2, \cdots, \xi_n \right\}, 1 \leq k \leq n \tag{13}$$

Then the fuzzy evaluation grade of the performance analysis of promotion of VR-based PE teaching quality was grade *k*.

4. Case study

A university attempted to reform its PE teaching mode with the help of VR. It had conducted preliminary engineering construction, and established corresponding fundamental facilities, equipment, and sites. To test the initial implementation effect of the PE teaching mode based on VR, the paper undertook fuzzy evaluation on it. By consulting experts, through statistical analysis, the fuzzy membership degree of each evaluation index was obtained, as shown in Table 2.

Evaluation index	**Fuzzy grade**				
	G_1	G_2	G_3	G_4	G_5
u_1	0.30	0.70	0	0	0
u_2	0	0.40	0.60	0	0
u_3	0	0.10	0.70	0.20	0
u_4	0	0	0.60	0.40	0
u_5	0	0.20	0.70	0.10	0
u_6	0.50	0.40	0.1	0	0

Table 2 – The fuzzy membership degree of each evaluation index

AHP was used to distribute weight for each of the evaluation indices, and the initial evaluation matrix *B* was obtained:

$$\mathbf{B}=\begin{bmatrix} 1 & 1/2 & 1/3 & 1/3 & 1/2 & 1/3 \\ 2 & 1 & 2/3 & 1 & 2 & 1/2 \\ 3 & 3/2 & 1 & 2 & 3 & 1 \\ 3 & 1 & 1/2 & 1 & 1 & 1/2 \\ 2 & 1/2 & 1/3 & 1/2 & 1 & 1/2 \\ 3 & 2 & 1 & 3/2 & 2 & 1 \end{bmatrix}$$

The weight vector of evaluation indices was obtained as: w={0.069,0.158,0.261,0.169,0.100,0.243}.

According to the proposed performance analysis fuzzy evaluation model based on AHP in the paper, the comprehensive fuzzy membership degree vector was obtained as x={0.142,.255,0.473,0.130,0}. As can be seen from the vector, the evaluation grade of the preliminary VR-based PE teaching mode of the targeted university is "intermediate". More improvement and investment is required for follow-up engineering construction such that the application of VR effectively promote upgrade of PE teaching quality.

5. Conclusion

The paper conducts research on the promotion of teaching quality with a new physical education teaching mode based on virtual reality, analyzes existing problems in physical education (PE) teaching, and discusses characteristics of VR in terms of its application to PE teaching. Also, multi-aspect functions of VR on the promotion of PE teaching quality are analyzed herein. On this basis, performance analysis was conducted accordingly, where an AHP-based performance analysis fuzzy evaluation model was established. Finally, by case study, the corresponding method and model were proved to be feasible.

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Organization learning, knowledge management and value co-creation: A fuzzy-set analysis

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Abstract: Organization leaning plays a positive role in enhancing knowledge management and value co-creation. Most present-stage empirical research into organization learning prefers to analyze it as a gestalt construct, but ignores the influence of its complicatedly interlinked elements on the process of corporate value co-creation activities, which is harmful to an in-depth understanding of its influential mechanism. Given this, this paper decomposes organization learning into three elements: leadership & authorization, open experiment, and shared vision. This research conducts fuzzy-set quantitative comparative analysis on firm samples, and discusses multiple causal pathways to the occurrence of knowledge management and value co-creation. The conclusion provides theoretical supports for a rational construction of organization learning as well as the implementation of knowledge management plans.

Keywords: organization learning, knowledge management, value co-creation, fuzzy-set analysis.

1. Introduction

The heterogeneity of resources characteristics, as knowledge resources are of great value and scarcity, difficult to imitate and difficult to replace, has become the base of competitive advantage (Hong et al., 2013). Usually, a new started firm with naturally disadvantage and the lack of knowledge resources has to implicate knowledge acquisition, integration, requiring managing knowledge more effectively. Organization learning is the basic learning value established by a firm. By regulating and instructing its learning behaviors, an organization improves and updates the inherited environment of knowledge system. Organization learning, as a crucial precondition for knowledge innovation, is the foundation of value co-creation activities and market performance (Sheng and Chien, 2015), contains three dimensions: leadership & authorization, open experiment, and a shared vision (Sinkula et al., 1997).

Existing organization learning research focuses primarily on contingent variable exploration in the relationship between organization learning and company performance. Rare studies concentrate on how organization learning motivates an organization's learning behaviors themselves and further improves corporate value co-creation and

competition (Melton and Hartline, 2013). In addition, leadership & authorization, open experiment, and shared vision represent independent value propositions over the dynamic learning process respectively (Sinkula et al., 1997; Lino et al., 2016)). However, most present-stage empirical research into organization learning prefers to analyze it as a gestalt construct, and ignores the impact on corporate value co-creation activates by its complicatedly inter dimensions. In practice, establishing value co-creation is always a fruit of the equivalent effect of the strategy's different sets through multiple causal paths.

2. A configurationally approach to customer-oriented firms

The function of organizational learning is to ensure companies to access information and knowledge, understand the technical know-how, methods and practice of organizational processes and mechanisms (Lim, 2016). Organizational learning is a dynamic mechanism based on knowledge management, the mechanism to promote knowledge on different levels such as individual, team and organization. Individuals acquire external knowledge, teams focus on existing knowledge to compile and integrate, while organization aims at systemize knowledge and create new knowledge (Lyles, 2014). Organization learning is contingent on knowledge creation. It contains three elements: leadership & authorization, open experiment and a shared vision (Sinkula et al., 1997). The leadership & authorization reflects how greatly an organization weighs learning. By improving learning systems on organizational level, an organization promotes its members to comply with learning schedules so as to accomplish the learning mission that provides them with more skills (He and Feng, 2013). By open experiment, the organization encourages its members to break conventional hypotheses, instead of critically querying fixed intellectual modes. In a turbulent environment, original value-creating skills always have the corporation trapped in core rigidity due to path dependence (Barney, 2014). Given this, it is a necessity to break the norms or routines formed by knowledge extension accumulation over the course of learning, so that enhancing learning fitness. A shared vision reflects the degree that the decision-making level spurs the members to carry the organization's picture in their heads and hearts. The collective knowledge on organization level is derived from complete knowledge sharing among the individuals (Lin and Wu, 2014).

Knowledge management refers to the enterprise to acquire knowledge from outside, make the enterprise employee may at any time and any place apply knowledge in the process of knowledge integration, in order to create new knowledge and achieve organizational goals of corporate activities (Agha et al., 2016). Some scholars believe that knowledge management theory can explain the source of the enterprise competitive advantage in the market (Swift and Hwang, 2013), the reason for the existence of the enterprise is the creation, transformation and application of knowledge. There are mainly two aspects: one is the management of knowledge, the second is the process of knowledge management (He and Feng, 2013). Knowledge management process is mainly composed of three basic activities i.e. knowledge acquisition, knowledge integration and knowledge innovation (Baker and Sinkula. 1999). Knowledge acquisition is the process of transform the external enterprises tacit knowledge to search and assessment, as well as the process of acquiring new knowledge. Knowledge, showed through formal and informal processes in the enterprise, is structured to ensure knowledge sharing and integrating activities between different functional departments within the enterprise, such as analysis, compilation,

etc. Knowledge creation is the process of the enterprise to create new knowledge (Wang and Wang, 2012). Knowledge acquisition, knowledge integration and knowledge creation is not a linear process with strict order. The resource set of organization learning is composed of three resources: leadership & authorization, open experiment, and a shared vision (Achcaoucaou et al., 2014). During the practice, a company applies different knowledge resource sets to the process of corporate value co-creation activities on the basis of its own endowment and learning mechanism. Through knowledge acquirement, integration and innovation, the company gains positive market performance.

Due to the discrepancy between knowledge creation paths, knowledge creation and knowledge integration differentiate from each other in the degree of employing knowledge resource sets. The former one lays more emphasis on open mind and shared visions in order to strengthen the force to search large-scale knowledge; whilst the latter one attaches more importance to leadership & authorization so as to render knowledge creation more efficient (Newbert, 2007). However, since knowledge features path dependence, both of the learning mechanisms share the same ultimate goal of establishing resource integration for value co-creation, which is to store new knowledge elements in organization memories as a way to vary tacit organization routines formed by knowledge extension (Agha et al., 2016).

Learning behaviors in an organization is always inserted in the link of value co-creation. Value co-creation is the process where "the consumer and the firm are intimately involved in jointly creating value that is unique to the individual consumer and sustainable to the firm" (Prahalad & Ramaswamy, 2004). value of a service or a product is not created by any actor solely, but co-created by the manufacturer/supplier and the consumer of the product or the service through engagement platform (Prahalad and Ramaswamy, 2014). Another stream of marketing research investigates value co-creation applying service-dominant logic including Foundational Propositions (FPs) (Vargo and Lusch, 2004). They recently updated the FPs into 5 axioms, stated that "Value is cocreated by multiple actors, always including the beneficiary." (Vargo and Lusch, 2016). This paper discusses corporate value co-creation activities from two aspects: resource integration and service exchange. The first one refers to operant resources (primarily knowledge and skills) enhancing human viability, especially through the creation of new resources; while the second one specifies service as the basis, rather than the unit of exchange (Peters, 2016). In order to retain competitive advantages in changeable markets, a firm needs to switch their marketing logic to co-create value with all the actors in the service ecosystem as a whole picture. Value co-creation plays a positive role in enhancing user satisfactions and company profitability as well and thus becomes the decisive variable for the company to achieve high performance returns.

Existing additive-approach-based regression equations or structural equations can be used to explain the uniqueness of variable relationships under specific circumstances, but fail to reflect the complexity (Fan et al, 2016). Moreover, they will lead to less prudent research findings if hidden influences of other variables are ignored, just as what they tend to do. fsQCA, founded on logical condition sets, builds up multi-element causal paths towards multiple conjunctional causations that a variable functions (Lisboa et al, 2016). fsQCA overcomes the shortages of existing research methods in that it effectively takes into account both the uniqueness and complexity of variable relationships. It is a

set-theory-based research approach that explains sufficient and/or necessary relationships between conditions and results, which allows the construction of multiple sets of logical conditions (causal paths). These paths can be used to identify multiple conjunctional causes to the result while remains comparable under specific conditions. In this way, the uniqueness and complexity of variable relations are both reflected by fsQCA. It uses consistency and coverage to test the relationship between independent variables and dependent variables.

As a summary, by use of a theoretical framework of the knowledge resource-based view, this research conducted fuzzy-sets quantitative comparative analysis on 232 Chinese firm samples, in an attempt to discuss multiple conjunctional causation to value co-creation. This research intends to enrich research achievement pools with respect to organization learning theories, and provide reference and supports for corporate value co-creation. Figure 1 is the concept model in the paper.

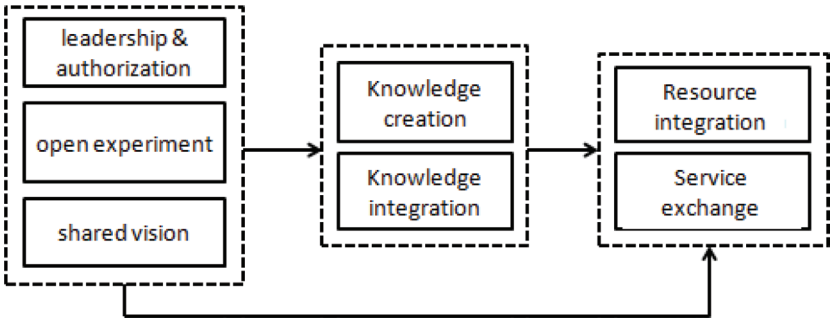

Figure 1 – The concept model

3. Research design

3.1. variable measurements

This research involved the following variables: organization learning, knowledge management and value co-creation. All items were graded by respondents using 7-point Likert scales. “1” represents “totally disagree”, and “7” is “totally agree”. To ensure the credibility and validity of this measurement tool, we adopted an empirically verified scale that was co-developed by domestic and foreign scholars. After referring to reviews of related experts and corporation administrators, we conducted a preliminary survey among the EMBA groups in our university, and modified part of the items thereafter. With the final version of our questionnaire, we offered a formal investigation.

3.2. research sample and data collection

We surveyed the manufacturing industry and the service industry in five national high-tech science parks (i.e. Zhongguancun Science Park in Beijing, Zhangjiang Hi-tech Park in Shanghai, Suzhou Industrial Park, Tianjin Economic-Technological Development Area, and Shenzhen High Tech Industrial Park). To ensure the diversity of sample

sources, we collected research samples from online business directories of the said science parks as well as the business directory of EMBA members in a university. Among 400 questionnaires we issued, 232 were valid ones.

3.3. credibility and validity test

The paper first analyzed the credibility of the four variables, and found out that their Cronbach's α coefficients were 0.83、0.81、0.89 and 0.90, respectively. This result indicates good internal consistency. For validity test, we used the structural equation model to conduct confirmatory factor analysis on all variables. The result showed that the three organization learning factors had good fitness (χ2/df=1.22, GFI=0.971, RMSEA=0.033, CFI=0.990, TLI=0.983, AGFI=0.935), and that the two knowledge management factors had good fitness (χ2/df=1.913, GFI=0.945, RMSEA=0.068, CFI=0.961, TLI=0.932, AGFI=0.913). As the company performance factor is single, we produced a three-factor model by combining it with all items contained in the value co-creation. The fitness result was favorable (χ2/df=1.211, GFI=0.931, RMSEA=0.059, CFI=0.990, TLI=0.974, AGFI=0.911).

4. Data analysis

4.1. fs/QCA analysis

Calibrating is the first step of fsQCA. As the initial sample data failed to satisfy Boolean logic, we necessarily converted them into aggregate data falling in the interval of [0, 1]. With the scheme of continuous assignment (Ragin, 2008), we first defined [0, 1] continuous fuzzy sets. Then, sample data was mapped into [0, 1] interval by use of the linear contraction method. Numbers in the interval represented membership, for which "1"= "full membership" and "0"= "non-membership". Taking knowledge integration as an example, the original interval of its initial sample data was [1, 7]. We mapped it into the membership interval of [0, 1] using the approach of linear contraction, where the data whose membership was 1 represented the highest level of knowledge integration, and the data whose membership was 0 represented the lowest level of knowledge integration.

After calibrating data, in fsQCA2.5 software, we adopted the Quine-McCluskey algorithm to explore multiple causation paths for different variables under high company performance. The calculation result usually encompassed three logical condition sets: complex solution, parsimonious solution, and intermediate solution. The complex solution is commonly the subset of another two sets. In light of general practice of existing documents, on the premise of meeting the requirements of consistency and raw coverage, the paper adopted the logical condition set of complex solution. Table 1 is the calculation result.

As can be seen from table 1, the consistency of all logical condition sets exceeds 0.8, while the raw coverage ranges from 0.25 to 0.75. This shows that the data result is explanatory (Ragin, 2008). Please note that ● denotes the existence of causality conditions, ⊗ is the non-existence of causality conditions, the blank indicates that the corresponding variable does not influence the result. ●shows the existence of core-necessary conditions, while ○ shows non-existence. Consistency is the degree of empirical data sharing a given logical condition set that spawns the occurrence of the result; raw coverage shows to what extent

the given set explains the occurrence of the result; unique coverage reflects the proportion of the empirical data to be explained and only can be explained by the given set.

	Knowledge creation			**Knowledge integration**			**Value co-creation resource integration**			**Value co-creation service exchange**		
variables	**1**	**2**		**1**	**2**		**1**	**2**		**1**	**2**	
Leadership & authorization		●	○		⊗	○	⊗		○	⊗	●	○
Open mindedness	⊗		○	●	●	●	●	●	●	●	⊗	○
Shared visions	●		○	●		○		●	○	●		○
Knowledge creation							●	⊗	○	●	●	●
Knowledge integration							●	●	●	●		○
consistency	0.81	0.82		0.85	0.88		0.89	0.90		0.87	0.91	
raw coverage	0.47	0.69		0.71	0.58		0.30	0.41		0.35	0.30	
unique coverage	0.05	0.39		0.08	0.04		0.07	0.11		0.12	0.06	
solution coverage	0.84			0.76			0.43			0.37		
solution consistency	0.88			0.85			0.87			0.88		

Table 1 – Configurations for achieving high levels of the outcome conditions

There are two causation paths incurring high-level knowledge creation: Path 1 shows that the logical condition set of low-level open mindedness and high-level shared visions triggers high-level knowledge creation (consistency=0.81, raw coverage=0.47); Path 2 shows that the logical condition set of high-level leadership & authorization itself can trigger high-level knowledge creation (consistency=0.82, raw coverage=0.69), but not necessary.

There are two causation paths incurring high-level knowledge integration: Path 1 shows that the logical condition set of high-level open mindedness and high-level shared visions triggers high-level knowledge integration (consistency=0.85, raw coverage=0.71); Path 2 shows that the logical condition set of high-level open mindedness and low-level leadership & authorization can trigger high-level knowledge creation (consistency=0.88, raw coverage=0.58). As it occurs in both of the two paths, high-level open mindedness can be deemed as the necessary but not sufficient condition for the occurrence of high-level knowledge integration.

There are two causation paths incurring high-level value co-creation resource integration: Path 1 shows that the logical condition set of low-level leadership & authorization, high-level open mindedness and high-level knowledge integration triggers high-level value co-creation resource integration (consistency=0.89, raw coverage=0.30); Path 2 shows that the logical condition set of high-level open mindedness, high-level shared visions, low-level knowledge creation, and high-level knowledge integration can trigger high-level value co=creation resource integration (consistency=0.90, raw coverage=0.41). As it occurs in both of the two paths, high-level open mindedness and high-level knowledge integration can be deemed as the necessary condition for the occurrence of high-level value co-creation resource integration.

There are two causation paths incurring high-level value co-creation service exchange: Path 1 shows that the logical condition set of low-level leadership & authorization, high-level open mindedness, high-level shared visions, low-level knowledge creation, and high-level knowledge integration triggers high-level value co-creation service exchange (consistency=0.87, raw coverage=0.35); Path 2 shows that the logical condition set of high-level leadership & authorization, low-level open mindedness, and high-level knowledge integration can trigger high-level value co-creation service exchange (consistency=0.91, raw coverage=0.30). As it occurs in both of the two paths, high-level knowledge integration can be deemed as the necessary condition for the occurrence of high-level value co-creation service exchange.

4.2.SEM analysis

Table 2 presents relevant results of a supplementary analysis of the proposed research model using SEM, as we can see, SEM results only shows the net effects among variables, and not all cases support an exclusive negative or positive relationship between the independent and the dependent variables

Relationship (from x to y)		**Standardized estimate(t-value)**
x	**y**	
Leadership & authorization	Knowledge creation	0.36 (4.12)*
Leadership & authorization	Knowledge integration	−0.04 (−0.83)
Leadership & authorization	Resource integration	−0.00 (−0.02)
Leadership & authorization	Service exchange	0.40 (4.01)*
Open mindedness	Knowledge creation	0.13 (1.25)
Open mindedness	Knowledge integration	0.41 (5.01)*
Open mindedness	Resource integration	0.43 (2.66)*
Open mindedness	Service exchange	0.29 (2.24)*
Shared visions	Knowledge creation	0.15 (1.39)
Shared visions	Knowledge integration	0.08 (0.84)
Shared visions	Resource integration	0.37 (3.48)*
Shared visions	Service exchange	0.15 (1.65)
Knowledge creation	Resource integration	0.08 (1.79)
Knowledge creation	Service exchange	0.52 (4.96)*
Knowledge integration	Resource integration	0.39 (4.21)*
Knowledge integration	Service exchange	−0.08 (−0.61)

Table 2 – SEM results

5. Conclusions

This paper regards organization learning as an enabler of knowledge resource set composed of three resource elements: leadership & authorization, open mindedness and a shared vision. Knowledge management is deemed as dynamic capability, which provides an access to corporate value co-creation activities. On this basis, the organization learning performance mechanism model is constructed in the paper. fsQCA is used to discuss multiple conjunctional causations to the occurrence of knowledge management, value co-creation, as well as company performance in that mechanism. We conclude that:

In terms of the construction conditions for high-level knowledge creation and high-level knowledge integration, (1) High-level leadership & authorization is its sufficient but not necessary condition. This means that the establishment of good learning systems in the organization facilitates knowledge accumulation and expansion for a company. And, members with high-level open mindedness may tend to have divergent thinking but instead fail to meet the demand for learning efficiency. In this connection, by building up a common development goal such that helping reach consensus, the organization enlarges its knowledge sharing space. Knowledge diffusion among organization members is accelerated accordingly, which improved the level of knowledge creation. (2) High-level open mindedness is its necessary but not sufficient condition. It is the integration of high-level open mindedness with either high-level shared visions or low-level leadership & authorization that realizes high-level knowledge integration. Leadership & authorization, with its emphasis on planning and regulations, will restrict divergent thinking required for pursuit of new knowledge, thus being adverse to the formation of high-level knowledge integration. Meanwhile, if the organization promotes its members to reach consensus, new knowledge will be diffused and created in the organization better than before, so that consolidating the fruits of knowledge integration. Therefore, at high-level open mindedness, it is high-level shared visions that facilitate the occurrence of high-level knowledge integration.

In terms of the construction condition for high-level value co-creation resource integration, high-level open mindedness and high-level knowledge integration are its necessary but not sufficient condition. The cultivation of members' open experiment will accelerate the integration and exploitation of knowledge resources in and out of the organization, which further promotes value co-creation. On this basis, knowledge integration helps speed up the collection, acquisition and integration of non-technology information. Please note that the action of knowledge creation on value co-creation resource integration may be influenced by the antecedent variables of leadership & authorization and shared visions. Specifically, path 1 shows that high-level leadership & authorization helps mitigate the effect of low-level knowledge creation on the formation of value co-creation resource integration; while knowledge creation plays an efficacious role in covering the loss of shared visions in path 2. Both of the two paths reflect that there is a nonlinear relation between knowledge creation and value co-creation resource integration which responses to leadership & authorization and/or shared visions. This summarization provides a new perspective for research into organization learning performance mechanism.

In terms of the construction condition for high-level value co-creation service exchange, different from the antecedent variables constituting value co-creation resource integration, high-level knowledge creation displaces high-level open mindedness

and high-level knowledge integration and becomes the necessary condition for high-level value co-creation service exchange. With the feature of efficiency, extraction and execution, knowledge creation emphasizes the application of existing knowledge resources in order to maintain competitive advantages in the competitive market. Path 1 shows that at the low level of leadership & authorization, which corresponds to the lack of mature and planned learning systems at the organization level, value co-creation service exchange can be accelerated by increasing the level of open mindedness, shared visions, knowledge creation and knowledge integration. Path 2 shows that at the low level of open mindedness, value co-creation service exchange can be quickened by increasing the level of leadership & authorization and knowledge creation.

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Practice Study of the Teaching of Urban Planning and Architectural Design Assisted by Computer

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Abstract: Experimental teaching is an important component of the whole teaching process in colleges and universities and is an important process of cultivating high-quality talent. Linking theory with practice and cultivating practical abilities and creative abilities of students can only be realized by emphasizing practice teaching; i.e., the integration of hands-on practice in teaching methodology. Urban Planning and Architectural Design are courses with very strong practical applicability, and the practice teaching of computer graphics becomes more important. Therefore, it must lead the students to make outside the classroom on-site practice, encourage students to make more hands-on practice in class and adopt targeted special exercises. At the same time, it must handle the relationship between theoretical teaching and practice teaching in a better way, increase the investment of funds for practice, and ensure the smooth going of practice steps and work hard to improve the teaching methodology of teachers in the area of practice teaching.

Keywords: Urban Planning and Architectural Design teaching, computer assistance teaching, practice application.

1. Introduction

Competition in the 21st century includes competition for quality talent (Chambers and Charman, 2004). In the era of science and technology with rapidly changing and swift and vigorous advancement, the requirement for high-quality talent has become more intense (Fishman, 1982; Kantor, 1971; Sá & Rocha, 2012). The CPC (Central Committee and the State Council) has pointed out about the need for deepening educational reform and implementing quality education in a comprehensive way by stating, “Colleges and universities need to put emphasis on innovation ability, practice ability and enterprising spirit of college students and improve the humanistic quality and scientific literacy of college students generally. (Jonathan, 1982)” To achieve this target, it should update their concept of education and pay close attention to teaching reform. Experimental teaching is an important component of the whole teaching process in colleges and universities, and is an important process for cultivating high-quality talent and is an important method of cultivating experimental skills of students, developing intelligence, generation invention and enriching scientific knowledge (Jonathan and Keoller, 2009).

Current efforts to deepen educational reform and cultivate innovative talents, practice teaching should be given high priority. Practice teaching is the integration of hands-on practice in teaching methodology (Ford, 1992; Mokrech et al., 2012).

2. The Necessity of the teaching of Computer Graphics Practice

2.1. The importance of the role in the learning of resource environment for urban planning majors

Computer graphics is an important aspect of city planning, as traditional hand drawing for city planning has gradually been replaced by computer graphics (Gheorghe et al., 2000). At present, most graphics platforms for making drawings in Urban Planning are AutoCAD software which has been widely applied in many fields and provides valuable drawing and editing functions and plays an important role in the study of urban-rural planning majors. Making maps is the important component of planning and is an intuitive form of expression (Fish, 2001). The traditional hand drawing is not only slow but also is very inconvenient to revise (Pezzey, 2008). In addition, the poor accuracy affects the planning quality. For example, when calculating the coordinate of a system of roads, it usually adopts the coordinates of known points and their distances to calculate the coordinates of other points (Kery and John, 2003). However, distance can only be measured on a map, which can easily cause errors. In particular, the error is greater when calculating the areas of various lands. Adopting computer graphics improves the efficiency of drawing, and also improves the accuracy and overall quality of planning (Arrow et al., 2005). For example, when adopting AutoCAD in city planning, it only needs to capture the crossing point to attain the coordinate of this point, and it has an accuracy of 10-10 mm, which greatly improves the accuracy of planning (Daily and Ehrlich, 1992). Computer aided architectural design teaching can vividly display the architectural design through the computer software of 3d modeling, and can induct architectural aesthetic form, simulate the building in different climatic conditions physical environment. Computer aided architectural design teaching can vividly display the architectural design through the computer software of 3d modeling, and can induct architectural aesthetic form, simulate the building in different climatic conditions physical environment.

2.2. Pure theoretical teaching cannot stimulate learning initiative

Pure theoretical teaching cannot stimulate the learning initiative. Traditional theoretical teaching focuses on classroom teaching and students study passively from the teacher, which ignores the relationship between theory and practice and does not cultivate hands-on ability of students (Mingione, 1996). In the teaching of a traditional drawing course, many students loose interest in learning mapping due to their inability to digest the teaching content as taught and cannot establish spatial imagination capability in time (Koski, 2010). Moreover, the students need to spend much time after class to finish a series of drawing assignments. The adoption of computer graphics has changed the traditional method of training basic skills, has improved the quality and efficiency of practice, and has decreased homework time (Michael, 2000). In this way, it saves paper and makes it easy to revise multiple times. Furthermore, and most importantly, it arouses the interest of students and strengthens their sense of achievement after finishing a homework assignment (Nils, 1996; Kery and Krutilla, 1979).

3. Forms and Methods of Practice Teaching

3.1. Lead students to make on-site practice

As a professional course of "Regional and Urban Planning", sometimes the teacher will lead the students to visit and study outside the school, such as visiting city planning and designing department and inspecting city planning process on the spot, to expand the thinking of students, increase the perceptual knowledge of students for Urban Planning and cultivate the planning abilities of students (Arrow et al., 1995; Daily and Ehrlich, 1992; Larry, 1992). The feedback from students about such practice is positive and they believe that it achieves an effect which cannot be achieved in the classroom (Chambers and Charman, 2004). In architectural design course, teachers guide students to learn every type of architectural design principle, and encourage students to visit outstanding case of the same type. After the research site conditions and the surrounding environment of the project, students start to design their own design.

3.2. Encourage students to make more hands-on practice in class

In the teaching process, students should experience the occurrences, developing and forming knowledge in the process of operation-perception-imagination-concept-application (Segpo and Perth, 2000; Asleena, 2001). This helps thinking with intuition, cultivates spatial imagination, deepens memory while at the same time, allows students to experience the fun of participation (David and Zippy, 2001; Sheulur, 1998; Gordon, 2014). A very effective method

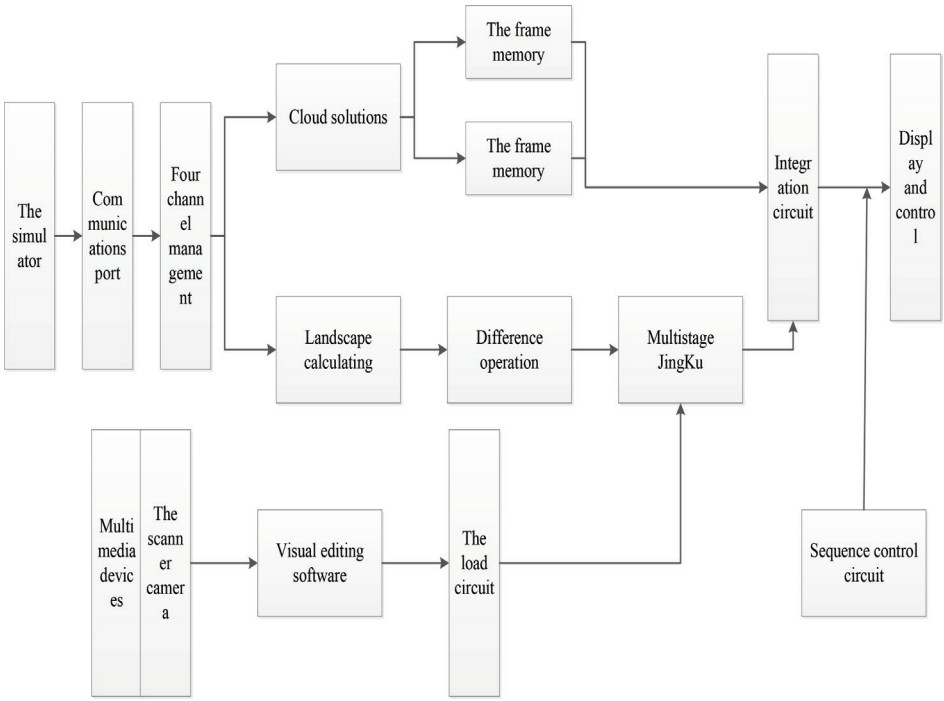

Figure 1 – Teaching of Urban Planning using a computer

is to teach with a combination of the teachers' planning projects and letting the students participate, or use a more traditional planning design case to let students copy, which not only improves the hands-on ability of students, but also combines theory and practice together, so the students can learn the knowledge and experience and fun of participation, while at the same time, improving the study interest and enthusiasm, as shown in Figure 1 (Nancy, 2010).

3.3. "Exercise more" in class with a target

"Exercise more" mean to observe more, and have more hands-on experiences and practice more. After the teacher finishes quantitative teaching content, they should implement targeted training for students with a combination of teaching content and practical situations, by adopting thinking questions in teaching material as well as carefully designing classroom exercises and homework (Latchman et al., 1999). The questions must be targeted and made useful to help students to summarize and master the key points of teaching material, discuss ideas for solutions and analyze the common mistakes, focusing on training students to improve their drawing speed and quality. Students should be encouraged to explore and summarize their drawing skills through plentiful drawing exercises, and apply these skills properly in practical drawing. Students should be helped to summarize the experience, promote some methods with regularity to all students and attain the overall improvement of their drawing level. The targeted characteristic of "exercise more" is presented in making special exercises for important points and difficult points in the process of Urban Design; for example, making special exercises for crossroad drawings, filling in with colors as well as text input of different styles, etc (Athula and Tamara, 2012).

"Exercise more" can strengthen the perceptual knowledge of students of graphics, accumulate the amount of graphics in the mind and improve drawing and map reading ability as shown in Figure 2.

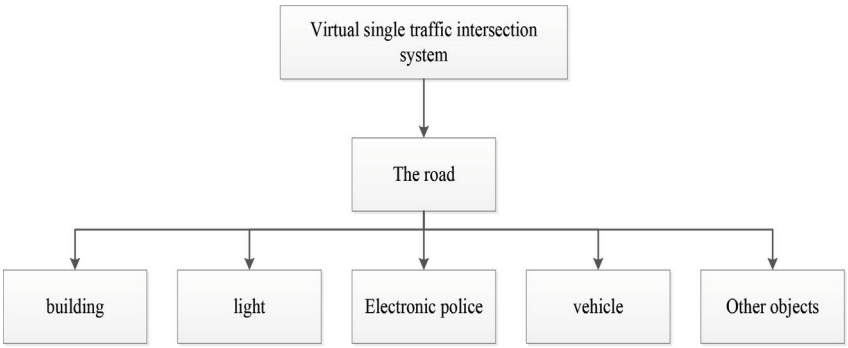

Figure 2 – Virtual single traffic intersection system

4. Aesthetic and architectural designs

4.1. Existing Problems

1. Incomplete understanding of practice teaching of computer graphics

Influenced by traditional educational ideas, the tendency among some teachers of "emphasizing theory, neglecting practice; emphasizing class and neglecting outside of class", and these teachers consider instructional experiments and internship as auxiliary work to be done outside of class. This way of thinking lacks the participation of high-quality teachers, lacks the overall design of practice teaching content and practice teaching has not yet been given the priority that it should have (Joan, 1999; Deryn et al., 2008; Frank, 1995). This inevitably results in a disconnect between theory and practice among students, poor hands-on ability of graduates, and low quality innovation; these are traits that employers find unfavorable. Especially for computer graphics with very strong technicality, if it cannot be mastered skillfully, it will greatly weaken the competitiveness of graduates in the job market.

2. Inadequate investment of funds for practice teaching, deficient hardware facilities

It is common to find that there is inadequate investment of funds for practice teaching in colleges and universities, which seriously hinders the process of practice teaching reform. Inadequate equipment for experiments, unsound and unsuitable professional laboratories, and even basic laboratories all need to be further improved. The obviously inadequate fund for practice teaching leads to hardware facilities that cannot meet the requirements of practice teaching. For example, an insufficient number of computers needed for computer graphics does not allow for independent operation of students, meaning that students can only train in groups, which leads to inadequate operation time for students, making it difficult for students to master the skills of computer graphics proficiently [9]. Due to the inadequate funds, some computers which have already exceeded their reasonably usable lifespan have not been timely updated, so computers frequently freeze or crash, or due to the low configuration (little RAM or disk space), these computers cannot meet the requirements of students' practice. Furthermore, the backwardness of laboratory management causes the low utilization rate of some laboratory equipment. There are also some problems in the operation of some experimental teaching platforms. In short, the experimental sites are lacking and the degree of access to laboratories is inadequate.

3. Inadequate teachers of practice teaching and unstable teams

In recent years, higher education in China has experienced rapid development, and all colleges and universities are supplemented with more young teachers. The introduction of young teachers is a significant trend, but most of these young teachers move from school to school, from theory to theory and most of them started to teach directly after graduation, and therefore lack the related vocational skill training and research practice. Therefore, these young teachers have insufficient practical teaching experience and little hands-on ability, so it is difficult for them to instruct students in a practical way. In addition, in professional teaching, they usually consider how to arrange the theory teaching first, while the practice teaching takes a lower priority. Moreover, influenced by titles, post allowances, work hours and other factors, the teachers do not focus on the teaching of practical courses such as laboratory classes. Some teachers with proficient computer graphics skills prefer to have part-time positions outside of school instead of carefully instructing students to make practical operations. All the above factors have contributed to an unstable team of teachers for practice teaching (seen as Figure 3).

4.2. Specific countermeasures

The Chinese Ministry of Education has pointed out in the document "Some Opinions on Further Strengthening Teaching Work of Undergraduate in Colleges and Universities" that "it needs to strengthen practice teaching vigorously and improve the practice ability of college students in a practical way. Colleges and universities need to strengthen the awareness of educating people by practice, distinguish the requirements of different subjects for practice teaching, make practice teaching program reasonably and improve practice teaching system." Efforts must be made to fulfill the spirit of the message of the Ministry of Education, especially by integrating practice teaching of computer graphics in the subject of Urban Planning and Architectural Design.

1. Deal properly with the relationship between theoretical teaching and practice teaching

Practice teaching and theoretical teaching are not only different and mutually independent, but also mutually combined and included, which are unified dialectically in the whole teaching process, as shown in Figure 4. The purpose of theoretical teaching is to strengthen the basic theoretical basis of students, and train abstract thinking abilities of students, while the purpose of practice teaching is to improve the ability of students to solve practical problems and cultivate the observation and operational ability of students. When the two are understood and properly dealt with, the mutual difference between them must be paid attention to in order to maintain the independence of each. At the same time, the mutual connection between them also must be paid attention to in order to attain mutual promotion and coordinated development, especially for computer graphics in the courses of Urban Planning and Architectural Design.

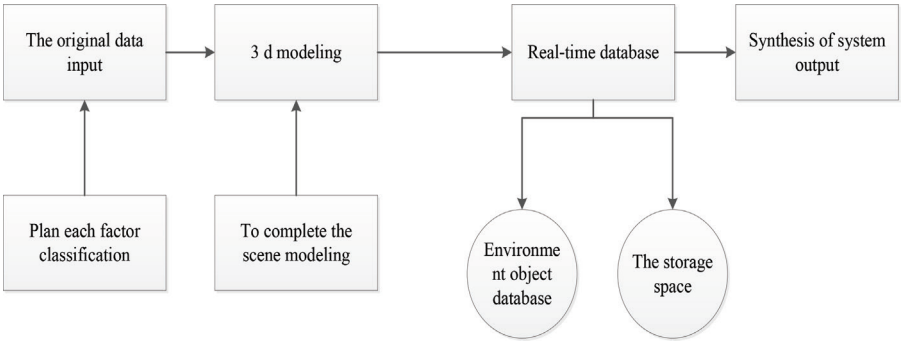

Figure 3 – Synthesis system output

2. Increase investment for practice and ensure the smooth running of practice training

To ensure that the students with enough equipment for practice training, what is needed is to increase the amount of investment in equipment, eliminate equipment which is already out-of-date, purchase new computers, and ensure independent operation of student by offering one computer to each student to cultivate their application ability. At the same time, schools should increase the access to laboratories to supply the students with additional time for training and to cultivate their ability of proficient operation.

3. Make efforts to improve the teaching methodology of teachers in the area of practice teaching, and strive to stabilize the team of teachers

Practice teaching in the new situation shoulders the responsibility of cultivating innovation talent, while a high-quality practice teaching team with an innovative spirit is the foundation for reform and innovation in practice teaching content. The formation of a practice teaching team should have the same emphasis as the formation of a theoretical teaching team. Care should be taken about teachers ideologically, and also should be offered some favorable policies in the aspects of staffing, post allocation, treatment and job classification etc, to attract and stabilize a group of teachers with high degrees of talent and experience in order to realize the reform of practice teaching. The teachers should be encouraged to combine learning and research, strengthen their connections with social enterprises and to make applications for applied research.

4. Application of virtual reality technology

The application of virtual reality technology in a digital property system has solved a series of difficulties for governments and designers. With the development of science and technology, it can predict the greater popularization of virtual reality technology. When we enjoy the convenience brought about by virtual reality technology, we also need to squarely confront its problems.

At present, there is a tendency to emphasize technology while neglecting the arts among many real estate developers. Under the motivation of high technology, they constantly strive for perfection of technology while neglecting the expression of art. Many developers stress using the most advanced virtual reality technology during the promotional stage, but when customers experience, they usually feel rigid and that the situation is not suitable, thus not reaching the expected result. Design interface and browsing systems lack a sense of beauty and attraction. The collocation of light, color and scenery is completely incompatible, which makes it more difficult for the real estate developers and agents to sell houses. This problem is based on a misunderstanding of human desires and human needs, which requires a balance of practicality and beauty, functionality and art. This needs the attention of developers as soon as possible to make a more ideal system of planning design which balances technology and art.

At present, network transmission speed is a big problem for designers. If the size of the scenery is large, the number of patches is much more, which will increase the amount of data that will be trapped by the limits of network speed and cause slow file generation. Currently, the software development of virtual reality technology is not perfect with weak usability and generality. Numerous technologies that are not compatible with each other had caused a situation of disorder. In order to realize the integration of more technologies, a technical plug-in unit must first be installed, or else, the virtual reality technology cannot be used. The presence of various technical standards and application specifications is also a problem for designers. Lacking a unified standard seriously impedes the development of virtual reality technology.

In addition, schools should strengthen the theory and teaching method training of practice teaching staff, making efforts to improve their level of teaching method knowledge and experimental skills and provide opportunities for them to pursue a higher level of education through advanced studies. They should be encouraged to go out

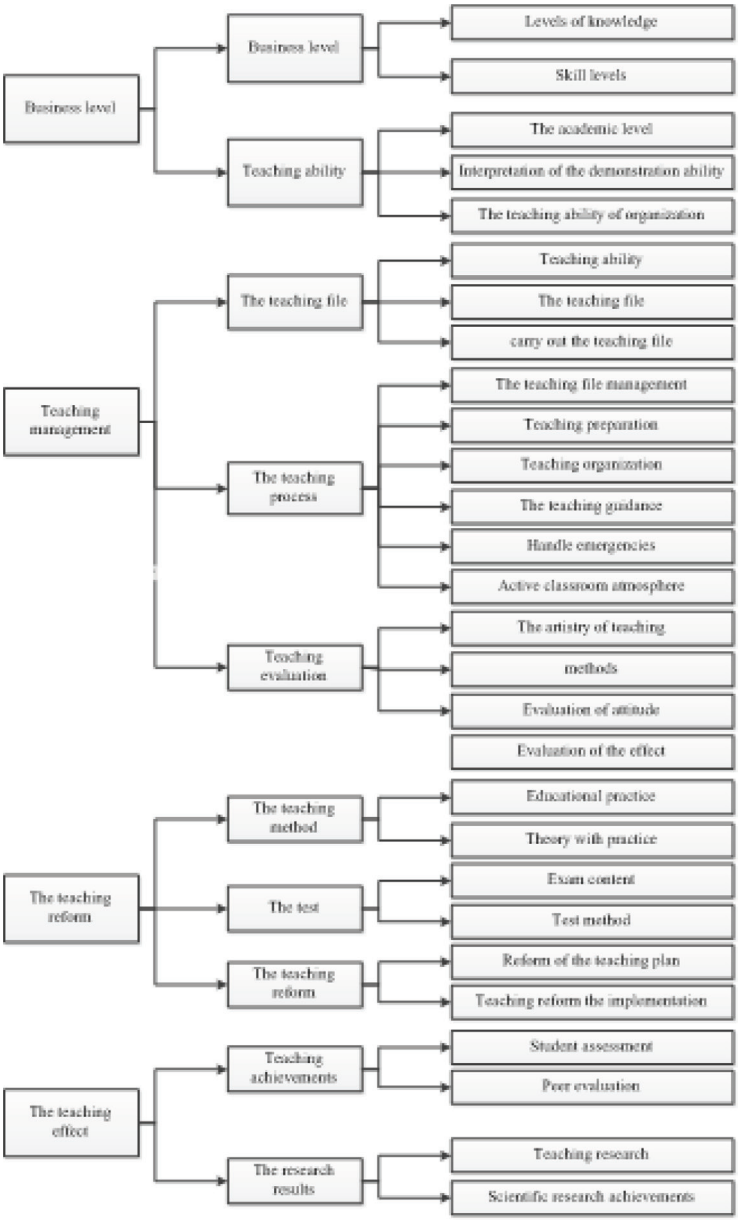

Figure 4 – Management evaluation index systems

and do advanced study in factories, design institutes and research institutes, understand the latest development and level of related science and technology development and promote the experimental teachers to improve hands-on ability and their ability to analyze and solve problems.

5. Conclusion

The competition of the 21st century is the competition for quality talent. In the era of science and technology with rapid changing and swift and vigorous advancement, the requirement for high-quality talent has become more intense. The CPC Central Committee and the State Council has pointed out clearly about the need for deepening educational reform and implementing quality education in a comprehensive way by stating, "colleges and universities needs to put emphasis on innovation ability, practice ability and enterprising spirit of college students and improve the humanistic quality and scientific literacy of college students generally." To achieve this target, the concept of education must be updated and close attention must be paid to teaching reform. Experimental teaching is an important component of the whole teaching process in colleges and universities, is an important part of whole process of cultivating high-quality talent, and experimental skills of students, developing intelligence resources, generating invention and enriching scientific knowledge. In current deepening educational reform and efforts to cultivate innovative talent, practice teaching should be given a high priority. Computer graphics is an important aspect of Urban Planning and Architectural Design, and at the same time traditional drawing by hand has gradually been replaced by computer assisted graphics.

Some new characteristics have appeared in the current city planning and design industry and the planning process as heading toward "task customization" (tailored but not simple copy), problem oriented (not pursuing "big and complete" and "comprehensive" planning), deep interaction (close interaction between planner and client) and multiple values (plural, fair and equitable principle). It is our task and challenges to cultivate the students to skillfully adapt to and become competent in their future jobs. In addition, in the competition for architectural design in the future, the reasonable adoption of new technology in this field can greatly increase the competitiveness of a design team, which will encourage them to work hard and make contributions to cultivate qualified talent for design in the future.

Experimental teaching is an important component of the whole teaching process in colleges and universities for cultivating high-quality talent. Linking theory with practice and cultivating practical abilities and creative abilities of students can only be realized by emphasizing practice teaching. Urban Planning and Architectural Design are courses with very strong practical applicability, and the practice teaching of computer graphics becomes more important. Therefore, it must lead the students to make outside the classroom on-site practice, encourage students to make more hands-on practice in class and adopt targeted special exercises. At the same time, it must handle the relationship between theoretical teaching and practice teaching in a better way, increase the investment of funds for practice, and ensure the smooth going of practice step and work hard to improve the teaching method of teachers in the area of practice teaching.

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Empirical Research of College English Teaching Mode Based on Computer Network

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Abstract: With the development of computer network, the researches of computer network in college English teaching have developed rapidly. In order to study the effectiveness of the network-based college English teaching mode, the paper firstly introduces main features and theoretical basis of the new teaching mode. The construction of online classroom of English teaching based on computer network and multimedia technology is introduced. Through empirical analysis, we show that the new teaching mode will not only help to improve the students' autonomous learning ability but also strengthen the training of English language. At the same time, the empirical analysis results show that the network-based college English teaching mode can improve the efficiency of student learning, and promote the students to develop good study habits.

Keywords: Computer Network, Autonomous Learning, College English Teaching

1. Introduction

With the rapid development of computer network technology, online teaching and learning provides a new thinking for college English teaching, computer network and multimedia technology can provide rich teaching resources and necessary software and hardware environment. Compared to traditional teaching mode, there are several distinct advantages for online teaching and learning (Martins et al., 2015).

Online teaching and learning is catalyzing a pedagogical shift in how we teach and learn. There is a shift away from top-down lecturing and passive students to a more interactive, collaborative approach in which students and instructor co-create the learning process. The teacher's role is changing from the "sage on the stage" to "the guide on the side."

Constructivism maintains that people actively construct new knowledge as they interact with their environment. This is a student-cantered approach in which students "co-create" their learning experience. This approach empowers students as active learners instead of passive recipients absorbing information and reproducing it for standardized tests.

Online teaching is a particularly close related to college English teaching reform. By using modern information technology, especially network technology, to support the new teaching model, a virtual teaching and learning environment can be created,

the environment would provide a great deal of information resources, teaching is no longer subject to the restrictions of time and space, personalized learning for students, independent learning to create the conditions.

But with the network environment support is not equal to the college English teachers will be able to successfully carry out online teaching. One of the reasons is that online teaching is not just one-way to publish online information of college English teaching, conveying college English resources, more importantly, the students and teachers, a two-way interaction and communication between the students and the students online. To achieve this purpose, the need to design and develop a network platform including interactive program for communication between the students and the teachers. However, the majority of college English teachers know little about computer and network technology, there is an urgent need to construct a network teaching platform, shielding the complexity of the program design, implementation of online teaching tools which provide concise support for college English teachers.

Network platform has played an extremely important role in the online college English teaching. So in the network environment with the case, the key to online teaching is that the construction of network teaching platform and to serve as a platform, which is a prerequisite to ensure that college English teachers to open network courses.

This work is organized as follows. Section 2 describes related work. In Section 3 we explain the concepts of autonomous learning. In Section 4 structure of online college English teaching platform is introduced and new college English teaching mode based on computer network is proposed. In Section 5 empirical analysis is given. In Section 6 we conclude this paper.

2. Related work

With the popularization and development of computer technology, the multimedia network platform provides a new technology platform for online learning. A new model of college English autonomous learning based on computer network platform was born. Students can fully enjoy the freedom of learning space (Teshia et al., 2013). The students can make their own learning choices, decide their own learning time and place and control their own learning progress and learning rhythm to meet their different needs. Moreover, through using the network monitoring platform, they can detect their own learning results.

Dai (Dai et al., 2012) thinks a student learning self-monitoring is to ensure the success of learning, improve the learning effect, and achieve the goal of learning. Learning activities in the whole process will be their own learning activities under the guide of object consciousness, active and careful planning, monitoring, inspection, evaluation, feedback, and self-control. Hu (Hu et al., 2012) believes that this kind of independent network learning is reflected in the curriculum design and classroom activities, in the common consultation between teachers and students, and in the care of students on the basis of the arrangement of teaching activities.

Intrinsic learner autonomy is the effective input of learners in the learning process. Those learners in a sense are clear about their learning objectives, and learning responsibility. They are aware of how to make decisions, and how to evaluate the learning process. Some scholars

are highly convinced that such a process of learning can cultivate learners' self-awareness. Chen (Chen et al., 2012) pointed out that the intrinsic motivation and autonomous learning behaviour are significantly higher and lasting than the external motivation. If the learner's self-efficacy is stronger, he will be more likely to self-monitor and self-regulate.

Empirical study also proved that the more intense the learner's intrinsic motivation, the more obvious the tendency of their autonomous learning. From the above research, we can draw a conclusion that in the network learning based on Multimedia, the learning motivation is the premise of the cultivation of autonomous learning. Teachers should attach great importance to the cultivation of intrinsic learning motivation and improve the students' self-efficacy, to help learners to learn positively. In short, we should make full use of the online platforms and online courses to meet the challenge of the new college English teaching mode.

Teaching model is the stable relationship between teaching and learning elements (teacher, student, teaching material and media) as well as structure of teaching process formed in one teaching environment and under the guidance of certain teaching thought or teaching theory. Teaching model is not only the concrete of teaching theory but also a systematic summary of teaching experience. As everyone knows, any teaching activity has certain target. In Jan. 2004, it has been clearly pointed out in the latest college English "curriculum requirements" in Higher Education Department of Ministry of Education of the People's Republic of China that "we should make full use of the opportunities bring about by

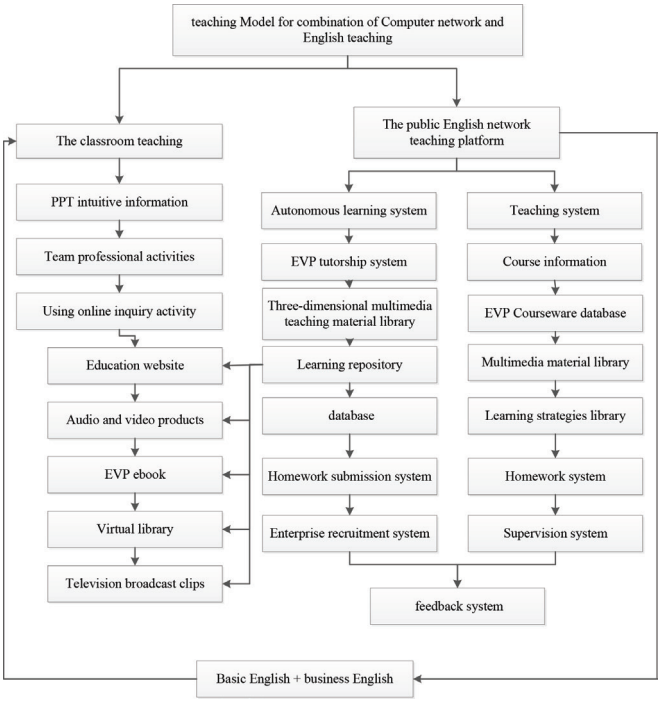

Figure 1 – The computer network course in English

multimedia and network technology and adopt the new teaching model to improve the former single classroom teaching model focusing on teacher teaching. New teaching model should be supported by modern information technology; especially the network technology and make the English teaching develop toward personalized learning, learning not restricted by time and place and active learning". In fact, it is one of the main targets of English teaching reform in colleges and universities at present to change the traditional teaching model focusing on teacher and construct one new teaching model which can not only play the dominant role of teacher but also fully play the role of student cognition. This paper has discussed multiple English teaching models from multi-media perspective, including context creativity model, independent learning model, electronic interaction model and cooperative inquiry model and looked forward to provide new ideas and perspectives to foreign language teaching practice by taking humanism theory and constructivism theory as main basis and combining the characteristics of foreign language teaching.

Constructivism learning theory believes that learning is an experience of real context. The best context for the happening of learning should not be simple and abstract and the learning can be more effective only in real context. The purpose of learning is not only making students understand some knowledge but also letting students make use of the learnt knowledge to solve the problems in real world. In some real contexts, how can the learners adopt own knowledge structure to solve practical problems is the key of measuring whether the learning is successful or not. Modern information technology has incomparable advantages in context setting. The integration of sound, image, animation, video and other multimedia can simulate the sound, color and shape in nature to a great extent; great capacity can provide a lot of context materials; the sharing characteristics can eliminate time and space obstacles and make full use of resources; interaction can motivate the enthusiasm of students and expand the thinking of students; hyperlink is in line with the way of thinking of people, which can meet the thirst of knowledge for students and expand the scope of knowledge of students as is shown in Figure 1.

2.1. Creation of visual scene

Visual scene is to record real people, real objects and real thing with multimedia technology and then present them in front of students visually based on teaching requirements. For example, in English, different vehicles are expressed with different words-van is usually a covered vehicle, coupe is a car with two doors, sedan is a car with four doors, sports car is racing car, pickup is small tonnage truck, station wagon is travel car and police car is police patrol car, which are difficult to be distinguished by students without the teacher's explanation and description. It can be understood and memorized clearly by students by adding sound to pictures and videos; students can experience the driving of various cars with three-dimensional animation and simulation technology. During teaching, some contents such as time background, famous people and buildings etc. can also be displayed with visual context. For example, it has been taught in the first lesson named THERE LIFE ON EARTH? of the second "College English" (Shanghai Foreign Language Education Press) that Venusians have launched satellite to sky of Manhattan. The reason why the author selects Manhattan is that it is the most prosperous in New York and even in the whole world and was also a place with serious pollution. Where is Manhattan, how prosperous it is, what famous buildings does it have and what is influence on the world etc. will be displayed with a video when make courseware or in

class, which not only helps students to understand the lesson deeply but also expand the scope of knowledge of college students and motivate their enthusiasm of study.

2.2. Creation of reasoning context

Reasoning is an important component of thinking process and reasoning can be divided into deductive reasoning, inductive reasoning and analogical reasoning based on different directions of reasoning process. Inductive context can be used for the teaching of words or phrases with multiple word meanings and multiple usages. Inductive situation is to create individual context to make students observe and reason the common law.

Constructivism believes that understanding depends on individual experience. Creating contexts similar or coincidental to individual experience is good for the construction of new knowledge. In specific English teaching, it is not telling the meanings of words or phrases to students directly but provides familiar examples and scenarios to students, makes students induce the meanings and usages of words and accomplishes the construction of knowledge independently. For example, when learning the word "present", it can provide the scene described by the word and phrase first:

(1) They unwrapped their Christmas presents. (2) The headmaster presented the prize to the winner. (3) Now that the sports competitions are over, he presented her with a bunch of flowers. (4) Churchill presented himself in the meeting. (5) How many people were present at the meeting? (6) I'm not going to buy a house at the present high prices. (7) She' s busy at present and can' t speak to you.

It can be learnt from the above scenes that in (1), present is noun and means "gift"; in (2), present is verb and means "issue and give"; in (3), present can be used with word "with" and combine phrase of present somebody with something; in (4), add one-self to present and mean "attend and participate in"; in (5), present is adjective and means "on the spot"; in (6), present is adjective and means "current, now"; in (7), present is noun and forms into phrase with word at and means "current". The meanings and usages of present can be understood basically with observation and induction and this is summarized based on own experience; therefore, the memorizing and usage of word can reach better effect than teaching only. We can collect and summarize these words and make multimedia teaching resource database, which provides convenience for teaching or for student checking and self-learning.

3. Autonomous Learning

Ergun (Ergun et al., 2010) formally introduced the concept of "autonomous learning" into the field of college English language teaching, the study of autonomous learning has aroused widespread concern in college English education experts, and through active exploration, many related academic terms have come into stage, such as autonomous learning, learner autonomy and open learning, etc. It is a potential in a specific environment rather than the actual behaviour of individuals in this environment. The key to this definition is to regard autonomy as an attribute of the learner, rather than the learning situation.

Pradit (Pradit, 2012) thinks learner autonomy refers to the learners responsible for all the decisions and the implementation of these decisions in the learning process, which

means learners can decide all the aspects of learning, such as self-determined learning content, self-mastery learning progress, and learning plans adjustment. He believes that autonomous learning means that learners can clearly identify the teaching objectives, knowing what they should learn, how to determine their own learning goals, how to reconstruct the teaching objectives, and how to meet the changing needs of personalization. The students can choose and use appropriate language learning strategies to make appropriate adjustments and monitor the effect of language learning. Autonomous learning is not only a kind of learning attitude, but also a kind of independent learning ability. He believes that attitude means a responsibility to make their own learning decisions, while the ability is to learn the process of decision making and reflection.

Ihfasuziella (Ihfasuziella et al., 2012) defines learner autonomy as the ability to use the knowledge, that is, the learners do not depend on the teachers.

Wedman (Wedman et al., 2005) believes that learner autonomy can be defined as three basic abilities. He believes that autonomous learning is mainly the desire and ability to make independent choices.

Oana (Oana, 2011), from the perspective of social psychology and social linguistics, explores the connotation of independent study. His definition of autonomous learning is the learning process of "self-decision and self-regulation, which is related to the process, that is, the relationship between learners and others.

Ceyhan (Ceyhan et al., 2011) believes that there may be differences between high and low performance autonomous learners. The differences may have a close relationship with the students' achievement goals. With dome learning target in mind, learners are willing to learn and overcome learning difficulties and challenges even in the relatively disturbing environment. Thus, we can draw a conclusion that learning goals are also an important factor affecting autonomous learning, especially for online courses.

As far as I'm concerned, autonomous learning not only involves learners but also the teachers. Learners' self-control and self-regulation are essential to learning, but without teachers' monitoring and guiding, such learning cannot go a long way, for sometimes they can lose their way and become confused. So autonomous online learning cannot go without teachers.

4. New college English teaching mode based on computer network

In the new college English teaching mode based on the network environment, the cultivation of autonomous learning and autonomous learning ability is put into a very important position. Cultivating student autonomy is one of the important goals of college English teaching in China. With the change of college English teaching target and teaching mode, the focus on the theory and practice of college English teaching in China has shifted from the traditional teaching mode to the study of the individual influence, such as psychological, cognitive, affective and learning styles of English students.

Usually online college English teaching platform is built on a common Internet or Intranet basis by specialized software to provide comprehensive services based on two-

way multimedia communication network teaching system. The main components are: network teaching system, courseware and teaching resources management system. The structure of online college English teaching platform is shown in Figure 2.

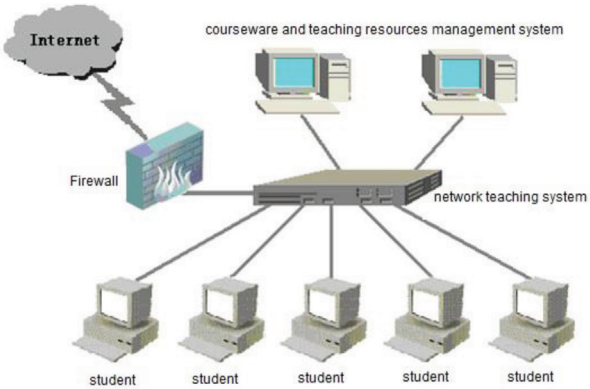

Figure 2 – Structure of online college English teaching platform

One main function of the network platform is to play audio and video courseware and synchronous playback of teachers making the speech power point or flash or other relevant information, such as: text background synchronization exercises, self-testing. The network teaching focuses on the development of high-quality network courseware through multimedia, the ideal network courseware is not only rich learning content, strong openness and interactivity, should also design comprehensive teaching management functions to monitor student learning. Because college English teachers in general do not have the ability to make high-quality courseware, one role of the network teaching platform is to provide a simple and practical network courseware development tools for college English teachers, it will reduce the courseware development technical difficulty.

The biggest advantage of online teaching than the traditional teaching is allocation of resources and sharing of teaching. Teaching resource sharing is the most important feature of online teaching. Teaching platform resource management system through the campus network connects the various learning terminal, form a huge information network.

The campus network has become a very important resource platform for college students to learn English independently. The campus network is a local area network with super interactive function. Online college English teaching platform is an important material base for college English autonomous learning based on network environment. It makes students fully enjoy the network resources across time and space. By utilizing the multimedia technology and rich and colourful language materials, the platform can make students learn English and understand the English cultures in a relaxed, pleasant and natural way. The platform can also automatically record each student's network autonomous learning situation, automatic monitoring and management of their learning process, ensuring the quality of their independent learning. It will make the students experience the infinite autonomy of learning fun in the independent inquiry learning process.

5. Empirical Analysis

In the empirical analysis of the college English teaching platform, we selected 300 students enrolled in the platform for learning college English course by autonomous learning mode, and other 300 students learn college English course by traditional classroom mode.

From the statistical results of the students using autonomous learning mode, 249 students passed the college English test band four, 51 students did not pass the CET-4, and the pass rate is 83%. At the same time, the pass rate of students by using traditional classroom mode is only 69%. The comparison results are shown in Figure 2.

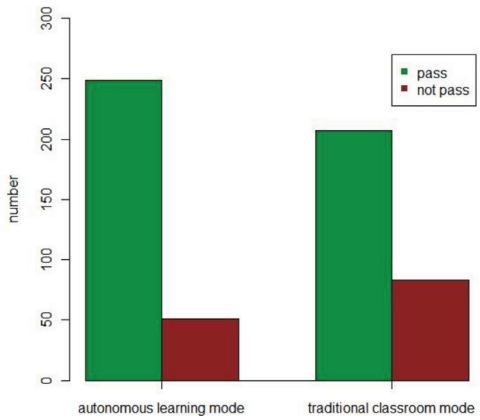

Figure 3 – Pass rate comparison of college English test Band Four

From Figure 3 we can see that the pass rate of the students using autonomous learning mode is greatly higher than those using traditional classroom mode. It is proved that the college English teaching platform can greatly improve the students' academic performance.

For the 300 students enrolled in the platform for learning college English course, the average score of the CET-4 test is 471.58. Among them, the top 25% scores ranked in the CET-4 test with the average score as 506.51; these students are defined as high-score group in the empirical study. And the bottom 25% scores ranked in the CET-4 test with the average score as 430.65, these students are defined as low-score group.

For the high score group and low score group, we make a difference analysis of college English autonomous learning under the self-monitoring mode, including two groups of students in the emotional strategy self-efficacy, learning attribution differences, as well as the differences in the ways of teacher monitoring.

According to empirical analysis, the self-efficacy of the high score group is linear with English score in CET-4, and the correlation coefficient is 0.334, which shows that the

correlation degree is low, and the significant level is 0.001, which indicates that the correlation coefficient has statistical significance. To sum up, the high score of self-efficacy and CET-4 scores are positively correlated. In low score group, self-efficacy and English scores have a linear relationship. The correlation coefficient is 0.041, indicating that they have the lowest positive correlation, and the significant level is 0.702, indicating that it doesn't have statistical significance, so the self-efficacy is not related to English scores in low-score group. The statistical results are shown in Table 1.

		Self-efficacy
English scores (high group)	Pearson correlation	0.334
	Significant (bilateral)	0.001
English scores (low group)	Pearson correlation	0.041
	Significant (bilateral)	0.702

Table 1 – Self-efficacy and English scores

Learning attribution has a linear relationship with English scores in high-score group. The correlation coefficient is 0.205, which shows that the correlation degree is a low positive correlation, and the significant level is 0.051, which reaches the statistical significance. To sum up, learning attribution and English scores are positively correlated in high score group. At the same time, learning attribution also has a linear relationship with English score in low-score group. The correlation coefficient is 0.074, indicating that the degree of correlation is low. The significant level is 0.487, indicating that it doesn't have a statistical significance. In summary, learning attribution is not related to English scores in low-score group. The statistical results are shown in Table 2.

		Learning attribution
English scores (high group)	Pearson correlation	0.205
	Significant (bilateral)	0.051
English scores (low group)	Pearson correlation	0.074
	Significant (bilateral)	0.487

Table 2 – Learning attribution and English scores

Teacher monitoring has a linear relationship with English scores in high-score group. The correlation coefficient is 0.042, indicating that the correlation degree is relatively low. And the significant level is 0.694, which indicates that there is no statistical significance between teacher monitoring and English scores. In summary, teacher monitoring is not related with English scores in high-score group. At the same time, teacher monitoring has a linear relationship with English score in low-score group. The correlation coefficient is -0.128, which shows that correlation degree is negative. The significant level is 0.228, indicating that it doesn't have statistical significance. Therefore, teachers monitoring is not related to the English score performance in low score group. The statistical results are shown in Table 3.

		Teacher monitoring
English scores (high group)	Pearson correlation	0.042
	Significant (bilateral)	0.694
English scores (low group)	Pearson correlation	-0.128
	Significant (bilateral)	0.228

Table 3 – Teacher monitoring and English scores

According to above empirical analysis, the influence of teacher's monitoring and students' self-monitoring on students' autonomous learning habit, ability and strategy was analysed. Empirical results show that self-efficacy, learning attribution and teachers' monitoring are useful for high score groups to achieve high scores, but not obvious for low score groups. So the combination of students' self-monitoring and external monitoring of teachers can have a strong effect on the cultivation of students' good learning habits and the promotion of students' autonomous learning ability.

The investigation shows that the teachers' positive intervention of students' autonomous learning and students' active self-monitoring are positively correlated with the students' learning level. At the same time, teachers should strengthen the supervision and control of the process of autonomous learning and the supervision and control of the students' autonomous learning process.

6. Conclusions

There is no doubt that the establishment of the network teaching platform of college English teaching reform, the establishment of the new teaching mode to play an important role. In the new teaching mode, autonomous learning plays a very important role. In the process of College English Autonomous Learning based on the network environment, the students are the main body of the study, but the teachers play a leading role. Autonomous learning is not equal to the students 'self-study, and the teachers should actively guide, organize and help students to study by themselves. Therefore, there are at least four concerns of online college English teaching platform as follows: First, teachers should strengthen the guidance of student learning. Second, smooth functioning of hardware and equipment should be ensured. Third, teachers should be encouraged to participate in teaching first-line to design and product educational software. Last but not least, the guidance of network technology should be strengthened.

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A comparative study on economic development in the suburbs of Shanghai: Based on computer comprehensive evaluation method

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Abstract: The strength level of a region's comprehensive economic development, the potential and the factors of development, are often the basis for local government to formulate development policies. Employing computer comprehensive evaluation method, this paper constructs regional integrated economic development strength evaluation index system, and the establishment of economic development strength index, Shanghai eight suburban county economic development strength of rank from our aspects of the regional economic growth, the core economic key elements, the economic transformation and sustainable development. The results show that the established regional integrated economic development strength evaluation index system comprehensive reflect strength and level of development of regional economy, through analysis on the index, is on the outskirts of Shanghai in the new period to accelerate the implementation of the new normal development power conversion, promoting sustainable development, to achieve the completion of a comprehensive well-off society goal, provides an important theoretical and practical significance.

Keywords: Shanghai suburbs; economic development; evaluation index system; computer comprehensive evaluation method

1. Regional comprehensive economic development strength evaluation index system

The guiding ideology for designing the regional comprehensive economic development strength evaluation index system is: reflecting the spirit of sustainable development of regional economy, leading and promoting the regional economic and social sustainable development and strengthening the region and enterprises' capacity of allocating production factors in the global scope, developing international production system and energy conservation and emission reduction. Through the indicator evaluation result of regional comprehensive economic strength, we can understand the change of Shanghai suburban counties' economic development in a timely manner and provide scientific basis to the district-level governments and enterprises' formulation of economic development strategies and measures (Wang, 2014).

The construction of the evaluation index system of comprehensive economic development strength should follow the following principles: 1. perspectiveness: it should lead and promote the sustainable development of regional economy and society and have a strong sense of period feel; 2. it should have indicators compatible with the powers and authority of district-level government; 3. it should combine the importance, comprehensiveness and main aspects; 4. the selected indicators should have good longitudinal and transverse comparability and inter-regional distinguishable differences; 5. the selected indicators should have good data availability and practical operability (Yan, 2001).

Employing computer comprehensive evaluation method, the function of evaluation index system is to visualize the evaluation objects, that is to say, to show the specific and concrete image of the evaluation content through a series of organically-connected indicators. Through the establishment of evaluation index system of comprehensive economic development strength, we can show the data vividly and build an effective basic tool for quantitatively measuring the comprehensive economic development strength.

1.1. Establishment of index system

According to the above-mentioned guiding ideology and principles, the evaluation index system we established is as defined in Table 1. From the table 1, the comprehensive economic development strength evaluation index system comprises two levels of indicators (4 primary indicators and 30 secondary indicators). The 4 dimensions of comprehensive economic development strength have been transformed into 4 primary indicators: economic growth index, core economic elements index, economic transition index and sustainable development capacity index. The content covered by the primary indicators is vast and includes many aspects. Therefore, each primary indicator has several secondary indicators to fully reflect the main aspects of the primary indicator.

Primary Indicators	Secondary Indicators	Index Attribute
Economic Growth Index	1. Regional added value	Positive indicator
	2. Per capita regional added value	Positive indicator
	3. Development speed of regional added value	Positive indicator
	4. Ratio of second industry's added value to GDP	Inverse indicator
	5. Ratio of tertiary industry's added value to GDP	Positive indicator
	6. Total volume of foreign trade	Positive indicator
	7. Develop speed of total foreign trade volume	Positive indicator
	8. Ratio of total foreign trade volume to GDP	Positive indicator
	9. Regional available fiscal revenue	Positive indicator
	10. Ratio of regional available fiscal revenue to GDP	Positive indicator
	11. Fulfilled amount of fixed assets investments	Positive indicator
	12. Total amount of the actual use of foreign capital	Positive indicator
	13. Urbanization rate	Positive indicator

Core Economic Elements Index	1. Rail transit operation length	Positive indicator
	2. Highway transit operation length	positive indicator
	3. Permanent population at the end of a year	Inverse indicator
	4. Proportion of aged population	Inverse indicator
Economic Transition Index	1. Strategic emerging industries output value	Positive indicator
	2. Ratio of strategic emerging industries' output to gross industrial output value	Positive indicator
	3. Energy consumption per RMB 10,000 turnover of industrial enterprises above designated size	Inverse indicator
	4. Authorized patents	Positive indicator
	5. Actual amount of tax paid by private enterprises	Positive indicator
Sustainable Development Ability Index	1. Ratio of land-transferring fees to regional available fiscal revenue ratio	Inverse indicator
	2. Total amount of discharge for industrial wastewaters	Inverse indicator
	3. Total amount of industrial waste gas emission	Inverse indicator
	4. Industrial solid waste yield	Inverse indicator
	5. Ratio of total environmental protection investment to regional added value	Positive indicator
	6. Growth rate of population	Inverse indicator
	7. Population density	Inverse indicator
	8. Ratio of fiscal expenditure on education to fiscal revenue	Positive indicator

Table 1 – The evaluation index system of comprehensive economic development strength

The regional comprehensive economic development strength mainly manifests itself as the region's actual ability to carry out social reproduction, including practical and potential ability; its connotation includes four aspects: production capacity, resources, economic development form and sustainable development ability (Cherchye and Kuosmanen, 2004). Therefore, the comprehensive economic development strength can be specifically manifested as economic growth, core production elements, economic transition and sustainable development ability; these four dimensions constitute the extension of comprehensive economic development strength.

1. Economic growth index. The economic growth index fully reflects the status of a region's economic growth and embodies comprehensive economic development power in the most direct, intuitive and easy way; here we choose 13 indicators to constitute the secondary indicators of the economic growth index. (1) Choosing 5 indicators of added value from the perspective of production supply concerns. "Regional added value" indicator comprehensively reflects the total amount of regional economy; "per capita regional added value" reflects the general average level of regional economy; "development speed of regional added value"

reflects the speed of national economic development; "ratio of second industry's added value to GDP" and "ratio of tertiary industry's added value to GDP" reflect whether the industrial structure is reasonable and whether it is good for economic growth. (2) Choosing 5 indicators from the perspective of application. "Total volume of foreign trade", "Develop speed of total foreign trade volume" and "Ratio of total foreign trade volume to GDP" show the true picture of foreign trade's function of stimulating the national economy from three aspects: total volume scale, dynamic development and significant proportion. "Fulfilled amount of fixed assets investments" indicator reflects the investments' influence on the national economy; "total amount of the actual use of foreign capital" indicator focuses on reflecting foreign capital's function of boosting regional economy. (3) Choosing 2 fiscal revenue indexes from the perspective of finance. "Regional available fiscal revenue" and "Ratio of regional available fiscal revenue to GDP" indicators are included in the index system; they reflect a region's economic strength from 2 aspects: total volume scale and significant proportion. (4) Choosing the "urbanization rate" indicator from the perspective of comprehensive considerations. Urbanization rate is a comprehensive indicator that reflects the economic strength and level (Cherchye et al., 2004).

2. Core Economic Elements Index. The core economic elements index illustrates economic strength from the dimension of resource. We have chosen 4 indicators to constitute the secondary indicator of the core economic elements index. (1) Natural resources. In terms of economic development in Shanghai, the function of natural resources is not for agricultural development but for the development of industry and the tertiary industry and urban construction. The amount of land is limited, its role mainly shown as the capability of realizing sustainable development and utilization of land. Therefore, we put the land resource indicator under the fourth primary indicator (sustainable development ability index). (2) Production resources. "Rail transit operation length" and "highway transit operation length" indicators directly reflect whether the equipment, raw materials, products and human resources can quickly flow into and flow out of the area at low costs; they also reflect the convenient condition of materials and personnel flow. (3) Human resource. Due to the data deficiency, we only choose "permanent population at the end of a year" and "proportion of aged population" indicators as the secondary indicators to reflect the human resource. Permanent population illustrates the number of labor force in actual production activities and potential labor force; it is the most active element in the overall economic development strength. Meanwhile, permanent population is the source of consumption demands and the motive power with which the economy can realize development through consumption pulling. Aging population is neither the actual labor force nor the potential labor force in human resources; hence the proportion of aged population is actually a discount for human resource.
3. Economic transformation index. Economic transformation index is used to reflect the comprehensive economic development strength through correctly grasping China's economic development stage characteristics. We have selected 5 indexes as the secondary economic transformation indexes. (1) "Total output value of strategic emerging industries" and "ratio of total output value of strategic emerging industries to gross industrial output value". The "ratio of total output value of

strategic emerging industries to gross industrial output value" is selected to show the strategic emerging industries' share in the whole national economy and reflect their position and role. (2) Unfortunately, due to the lack of consumption data, this index system does not contain the indicators that reflect the transformation from development momentum to consumption promotion. (3) "Energy consumption per RMB 10,000 turnover of industrial enterprises above designated size", as an indicator reflecting the energy consumption intensity, directly records the energy consumption of industrial production and the economic development's dependence on energy. It comprehensively reflects the transformation to resource-saving and low-carbon production mode, transformation of energy production and utilization to new energy resources and transformation of old production equipment and management to high-tech means. (4) "Authorized patents" reflects the number of original works with independent intellectual property rights; this indicator illustrates that the growth pattern has transformed from extensive type to intensive type and from factor driving mode to scientific and technological mode and innovation-driving mode. (5) "Actual amount of tax paid by private enterprises" reflects the transformation of enterprises' property rights organizations, that is to say, from overwhelming state-owned enterprises to common development of state-owned and private enterprises.

4. Index of sustainable development capacity. Index of sustainable development capacity reflects the sustainability of comprehensive economic development strength from the perspective of duration. We have selected 8 indicators as the secondary sustainable development capacity indexes (Mahlberg and Obersteiner, 2001). (1) "Land-transferring fees-to-regional available fiscal revenue ratio" indicator illustrates government finance's dependence on the land-transferring fees. This indicator reflects the sustainability of government finance from one point of view while indirectly reflecting the sustainability of land development. (2) "Total amount of industrial wastewater discharge", "total amount of industrial waste gas emission" and "industrial solid waste yield" indicators illustrate the situation of main pollutants and indirectly reflect the industrial production process' damage to the environment. The "ratio of total environmental protection investment to regional added value" comprehensively shows the relationship between environmental protection investment and the total production of corresponding period to illustrate the percentage of total production which is used for environmental investment and indirectly show the government's emphasis on environmental protection. (3) "Growth rate of population" reflects the natural growth speed of population and indirectly shows the amount of ultimate population. "Population density" demonstrates the per capita living space and indirectly and roughly reflects the average per capita available resources and environment on the ground and underground. "ratio of fiscal expenditure on education to fiscal revenue" directly reflects the government's emphasis on education and indirectly reflects the populace's cultivation degree.

We have constructed an evaluation index system of comprehensive economic development strength with four primary indicators and 30 secondary indicators. This index system has transformed the abstract qualitative rules in the connotation of "comprehensive economic development strength" into statistics expressed by the

statistical indicators; it has used the primary indicators to describe the overall focuses and the secondary indicators to illustrate those important and specific aspects. The four primary indicators are not in a simple parallel relationship; they have organically connected and mutually penetrated with each other and formed a systematic and holistic entirety. The whole index system can provide us a reference system to identify and evaluate Shanghai suburban counties' comprehensive economic development strength from a multi-dimensional perspective.

1.2. Establishment of evaluation model of comprehensive economic development strength

Employing computer comprehensive evaluation method, we use the comprehensive index method to prepare the regional comprehensive economic strength index to quantitatively evaluate the comprehensive economic strength of Shanghai's 8 suburban counties (Nardo et al., 2005). We also select BOD method to set the weights of comprehensive economic strength evaluation and adopt linear aggregation method to calculate the comprehensive economic development strength index of Shanghai suburban counties (Storrie and Bjurek, 2000). The computational formula is as shown below:

$$I_i = \max_{w_i \geq 0} \frac{\sum_j^n x_{ij}^n w_j}{\max_{x_j^n, j \in (1,\ldots,n)} \left(\sum_j^n x_{ij}^n w_j \right)} \tag{1}$$

The I_i is the composite index after synthesizing multiple indexes; X_i is the standardized value of various evaluation indexes; W_i is the weight of X_i .

2. Empirical evaluation of Shanghai 8 suburban counties' comprehensive economic development strength

Data sources

In order to obtain the data of economic development strength of Shanghai's districts and counties for comparison, we have collected the government financial data based on the fiscal gazettes and fiscal expenditure and government funds' final statements issued on the Finance Bureau websites of those suburban counties. Other data is from 2010-2013 Shanghai statistical yearbooks and statistical bulletins and the 8 suburban counties' statistical yearbooks and statistical bulletins.

Data preprocessing

1. The standardization of data. In order to eliminate the differences of measurement units and order of magnitude between various indicators, we adopt the extremum method to carry out dimensionless management to the original data. The process is as follows:

   Record i region j indicator as X_{ij}, the standardized value is X_n^{ij}; the minimum and maximum value of all regions' j indicators is respectively X_j^{min}, X_j^{max}. The standardized thinking of extremum method is to use the corresponding indicator value of i region to subtract the corresponding indicator of the

worst-performing region and then divide the indicator's range. Therefore, when the j indicator is a positive indicator:

$$x_{ij}^{n} = \frac{x_{ij} - x_j^{min}}{x_j^{max} - x_j^{min}} \tag{2}$$

When j indicator is an inverse indicator,

$$x_{ij}^{n} = \frac{x_j^{max} - x_{ij}}{x_j^{max} - x_j^{min}} \tag{3}$$

The variation section of indicator value after standardization is [0, 1]; 0 always corresponds to the worst performance while 1 always corresponds to the best performance.

2. The selection of evaluation weight. This article chooses BOD method to identify the weight of indicators; the basic idea is that the comprehensive index is defined as the ratio of evaluation object's actual performance and benchmark performance;

$$I_i = \frac{\sum_j^n x_{ij}^n w_j}{\sum_j^n x_j^{n*} w_j}, i = 1, \dots, m \tag{4}$$

It can be expressed in the form of linear programming:

$$I_i = \max\left(\sum_j^n x_{ij}^n w_j\right) \tag{5}$$

$$\text{St: } \sum_j^n x_{ij}^n w_j \leq 1$$

$$w_j \geq 0$$

$$\frac{1}{\alpha} \leq \frac{w_{hj}}{w_{kj}} \leq \alpha, \alpha \geq 1$$

As $\sum_j^n x_{ij}^n w_j \leq \max_{x_j^n, j\in(1,\dots,n)}\left(\sum_j^n x_{ij}^n w_j\right)$, hence I_iÎ[0,1]. Therefore, the weight selected through this way is higher than the comprehensive indicator value gained under other weight schemes.

3. The composition of indexes. First, make secondary indicators to become single index according to their weights; then composite combined index according to the weight of the primary indicators and the secondary indicators and indexes. After the above-mentioned processing, the index scores of indicators are positively related to the comprehensive economic development strength; the higher the score the stronger the regional comprehensive economic development strength and vice versa.

4. Analysis of calculation results. Based on the collected original data, we use the above-mentioned data standardization method and weight determination model and index synthesis method as well as the lingo statistical software to work out the indexes and ranks of Shanghai suburban counties' comprehensive economic development strength (as Table 1 shows); the evaluation result of Shanghai suburban counties' comprehensive economic development strength is shown as follows:

Districts and Counties	**Indicators**	**2010**		**2011**		**2012**		**2013**	
		Index	**Rank**	**Index**	**Rank**	**Index**	**Rank**	**Index**	**Rank**
Bao Shan District	*Economic Growth Index*	0.793	3	0.8122	2	0.7742	2	0.7928	2
	Core Economic Elements Index	0.5247	6	0.5219	6	0.5057	6	0.4563	7
	Economic transformation index	0.5625	3	0.6126	3	0.5529	5	0.4986	4
	Index of Sustainable Development Ability	0.2287	8	0.2607	8	0.4197	8	0.456	8
	Comprehensive economic strength index	**0.5804**	**6**	**0.6044**	**4**	**0.6053**	**6**	**0.5993**	**4**
Chong Ming County	*Economic Growth Index*	0.4286	8	0.4787	7	0.4659	8	0.4383	7
	Core Economic Elements Index	0.4046	8	0.4046	8	0.4046	8	0.4046	8
	Economic transformation index	0.3513	7	0.3475	7	0.3386	6	0.3333	7
	Index of Sustainable Development Ability	0.9708	1	0.9169	1	0.9562	1	0.9468	1
	Comprehensive economic strength index	**0.5168**	**7**	**0.5252**	**7**	**0.5262**	**8**	**0.5123**	**7**
Feng Xian District	*Economic Growth Index*	0.4333	7	0.4511	8	0.5794	7	0.3606	8
	Core Economic Elements Index	0.5657	5	0.5547	5	0.5353	5	0.5147	5
	Economic transformation index	0.3642	6	0.3999	6	0.2816	7	0.4242	6
	Index of Sustainable Development Ability	0.7556	3	0.7419	3	0.7827	3	0.7764	2
	Comprehensive economic strength index	**0.5104**	**8**	**0.5198**	**8**	**0.5517**	**7**	**0.4886**	**8**

Districts and Counties	Indicators	2010		2011		2012		2013	
		Index	Rank	Index	Rank	Index	Rank	Index	Rank
Jia Ding District	*Economic Growth Index*	0.6778	4	0.6958	4	0.7318	3	0.6779	3
	Core Economic Elements Index	0.4285	7	0.4295	7	0.4188	7	0.4569	6
	Economic transformation index	0.5512	4	0.6089	4	0.5963	3	0.5758	3
	Index of Sustainable Development Ability	0.6602	5	0.6746	7	0.6939	5	0.6822	5
	Comprehensive economic strength index	**0.5991**	**3**	**0.621**	**3**	**0.6345**	**3**	**0.6141**	**3**
Jin shan District	*Economic Growth Index*	0.5885	5	0.5332	5	0.6563	5	0.5853	5
	Core Economic Elements Index	0.7821	2	0.7797	2	0.7659	2	0.7425	2
	Economic transformation index	0.2187	8	0.2712	8	0.2587	8	0.1759	8
	Index of Sustainable Development Ability	0.7825	2	0.8378	2	0.8073	2	0.7432	3
	Comprehensive economic strength index	**0.5921**	**4**	**0.591**	**5**	**0.6289**	**5**	**0.5664**	**5**
Minhang District	*Economic Growth Index*	0.796	2	0.8195	1	0.8507	1	0.868	1
	Core Economic Elements Index	0.6373	3	0.6379	3	0.6368	3	0.6364	3
	Economic transformation index	0.8354	1	0.85	1	0.8341	1	0.8183	1
	Index of Sustainable Development Ability	0.594	7	0.729	4	0.5849	7	0.5689	7
	Comprehensive economic strength index	**0.737**	**2**	**0.7751**	**1**	**0.7556**	**1**	**0.7552**	**1**
QingPu District	*Economic Growth Index*	0.5282	6	0.5246	6	0.6456	6	0.5239	6
	Core Economic Elements Index	0.5863	4	0.5949	4	0.5774	4	0.5668	4
	Economic transformation index	0.5385	5	0.57	5	0.558	4	0.4951	5
	Index of Sustainable Development Ability	0.7282	4	0.7182	5	0.7248	4	0.704	4
	Comprehensive economic strength index	**0.5821**	**5**	**0.5874**	**6**	**0.6303**	**4**	**0.5627**	**6**

Districts and Counties	Indicators	2010		2011		2012		2013	
		Index	Rank	Index	Rank	Index	Rank	Index	Rank
Song Jiang District	*Economic Growth Index*	0.8242	1	0.7104	3	0.6768	4	0.6519	4
	Core Economic Elements Index	0.8107	1	0.808	1	0.8204	1	0.8733	1
	Economic transformation index	0.6825	2	0.6619	2	0.7363	2	0.671	2
	Index of Sustainable Development Ability	0.6494	6	0.7144	6	0.6903	6	0.6646	6
	Comprehensive economic strength index	**0.7582**	**1**	**0.721**	**2**	**0.7218**	**2**	**0.703**	**2**

Table 2 – Indexes and ranks of Shanghai suburban counties' comprehensive economic development strength

3. Suggestions on improving the regional comprehensive economic development strength

1. As these suburban counties of Shanghai have obvious differences in economic development strength, we should carry out the first, second and third groups' economic development strength evaluation and examination respectively. For Minhang and Songjiang in the first group, the focus is to enhance the level of sustainable development and mainly emphasize on the following several aspects: making full use of land resources, strengthening the enterprises' prevention and control of pollution, promoting the energy conservation and emissions reduction ability and further raise the level of industrial economy and coordinated development of environmental protection. Baoshan, Jinshan and Qingpu in the second group focus on speeding up the transformation and upgrading of economic structure and actively develop strategic emerging industries and high-end manufacturing industry; they live up to their location advantages, form suburban industrial agglomeration and realize the transformation and upgrading of industries. Fengxian and Chongming in the third group focus on raising the level of economic growth, strengthening the innovative driving, boosting the level of industrial economy and promoting the coordinated development of economy and environment.
2. Strengthen the construction of supporting system of regional comprehensive economic development strength. Currently the regional economic development and transition has insufficient creative talents and technical and financial supports; a lot of regions have the problem of needing sci-tech innovative talents and management staff and continuous innovative capital support. Banks don't provide enough credit support for technical innovation and the private capitals have insufficient innovative investment channels. We suggest that the Shanghai government shall set up innovation-driving guiding fund and increase financial support to the district-level government; the district-level governments should

focus on financial funds and promote the policy support for indigenous innovation. We should also encourage private capital to establish financial institutions of scientific and technological innovation and speed up folk capital's transformation to science and technology capital, financial capital and industrial capital.

3. Deepen the reform and innovation of the factor market, guide the innovation resources (capital, talent and technology, etc.) to concentrate in enterprises and promote enterprises to transform from investment-driven mode to innovation-driven mode. Currently the factor market competition environment of economic transformation and upgrading is incomplete and a large proportion of social capital has not been invested in technological innovation under the condition of high real estate profits and resource investment profits and severely unbalanced earnings of different types of investment. China should accelerate the reform and innovation of factor market, improve the regulatory mechanism of factor price, correctly guide the society and enterprises to invest resources and capitals into the technological innovation and economic development transformation and turn the capital advantages into technological innovation and industrial development advantages.

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Study on the Effect of Customer Participation on Innovation Performance in Chinese IT Industry

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Abstract: This paper investigated the effects of two types of customer participation (customer participation as an information resource and as a co-developer) on two types of breakthrough innovation (technology-based and market-based breakthrough) and the meditating effect of organizational learning in Chinese IT Industry. Empirical analysis from 193 firms in Chinese IT industry found that: (1) both customer participation as an information resource and as a co-developer could positively influence technology-based breakthrough; (2) customer participation as a co-developer negatively influence market-based breakthrough; (3) organizational learning mediates the relationships between customer participation and technology-based breakthrough.

Keywords: Customer participation, Breakthrough innovation, Technology-based breakthrough, Market-based breakthrough, Organizational learning.

1. Introduction

Breakthrough innovation can bring a lot of benefits to a firm, such as new market opportunities, access to new competitive advantages. Lots of studies aimed to explore the antecedents of breakthrough innovation (Chandy and Tellis, 1998; Benner and Tushman, 2003; Smith and Tushman, 2005).What is more, a majority of these literatures expounded concerned problems from the perspective of knowledge-based view (KBV). The basis of KBV theory holds that product innovation is actually a process to manage, maintain and create knowledge (Grant, 1996). Knowledge firms owned is deemed to a kind of unique resources in the process of breakthrough innovation (Fortes et al., 2016; Zhou and Wu, 2010).

Some literatures have indicated the importance of customer engagement upon product innovation. However, few studies have aimed to explore the effect of customer participation on breakthrough innovation from the perspective of knowledge-based view. The process of customers participating in new product development refers to they bring the external knowledge of market and customer to firm or develop new product with the firm together (Fang, 2008).When customers participate in the process of new product development they generally play two kinds of roles: namely, as an information resource and a co-developer. Generally, the former can extend the diverse of knowledge and the later can reinforce

the depth of knowledge. Most of literatures have suggested that customer participation has a positive effect on firm performance (Schreier, et al., 2012). Even so, some scholars argued that customers may not have enough knowledge to clearly specify what they really want, and how to effectively convey the real market information. Excessively emphasizing the knowledge customer convert to firm probably leads to the myopia and cumbersome of research and development, even undermine the innovation capability (Zhou, et al., 2005).On that account, firm should not merely relay on the customer's point of view in the process of new product development, especially for breakthrough innovation.

Innovation is generally regarded as a single variable to investigate the effect of customer participation upon innovation degree in previous concerned studies (Fang, 2008). As a matter of fact, there is obvious difference between technology-based and market-based breakthrough. Technology-based breakthrough aims to obtain totally new technology and depends on the depth and width of knowledge; Market-based breakthrough refers to pursuit new segment markets and more relies on the width of knowledge. The products on the new market can be improved (using the same technology) or be a totally new product (applying totally new technology).

In this case, how does customer participation affect breakthrough innovation? Whether information resource and co-developer have positive influence on technology-based breakthrough and market-based breakthrough respectively? This is just the point we try to explore. Based on the above analysis, we carried on the investigation to 193 Chinese IT corporations and explored the effect of customer participation on breakthrough innovation and the mediating effect of organizational leaning based on knowledge- based view and organizational learning theory. Our finding would provide practical guidance for enterprise's innovation and theoretical reference for the future related researches.

2. Theoretical Background

2.1. Customer Participation

Although there are differences in terms of the definition of customer participation, scholars basically approve that customer participation belongs to a behavioral concept that it refers to a kind of behavior related to information, resources, time and effort consumer provided in the process of service of production. Early researches on customer participation more concentrated in the service field; Scholars found that the customers can not only provide all kinds of information, but also take part in the process of product design, development and manufacturing, especially in the manufacturing industry and Chinese IT industry afterwards (Lin and Huang, 2012).

Therefore, customer participation refers to the degree of customer involvement in the process of product development, including information, resources, efforts consumer provided and co-creation with firm. Fang (2008) divided customer participation into customer participation as an information resource and customer participation as a co-developer according to the different roles customers played in the process of product innovation. The former refers to when customers participate in the activities of new product development their demand for new product, the current market dynamic and involved development information are contributed to the firm so that the firm's research & development team can carry out the

development activities of new product accordingly. The later pertains to a deeper kind of participation format that customers and firm jointly research and develop new products. Moreover, the role of customer participation has significant influence in the whole process of new product development. This classification method has been extensively accepted.

2.2. Breakthrough Innovation

Breakthrough innovation incorporates two dimensions: technology-based breakthrough and market-based breakthrough innovation. The former refers to adopting advanced technology in the existing market, improving current products, increasing the interests of customers. Market-based breakthrough innovation involves that firm transforms its current main market to new market segment and creates additional value for customers by applying new differentiated technology (Benner and Tushman, 2003). The breakthrough innovation is essential for firm's long-term survival and development and can improve organizational performance in the competitive market (Gassmann, et al., 2012).

The differences between technology-based and market-based breakthrough are two dimensions. With regard to technology, both are likely to adopt new technology, however, technology-based breakthrough usually utilize the most advanced technology and market-based breakthrough is not necessarily so. In terms of market, technology-based breakthrough mainly aims to serve the existing market and pay attention to the current customer demands. In contrast, market-based breakthrough pertains to provide service for new market segment and its products quality and performance may not as good as that of original market. In other words, the products based on market-based breakthrough may be difficult to be accepted by the customers of existing market (Adner, 2002). For example, the series of tablet device manufactured by Apple Inc, have been upgraded from iPad 2 to iPad 4, and the capacitive touch screen has been replaced by the touch screen that its resolution also rises fourfold, which realized the huge technological leapfrogging. Even so, there are not so much technical improvements from iPad 2 to the iPad mini and merely is the size changed from 9.7 to 7.9 inches. However, this shift achieved the huge market innovation and filled the gap of low-end tablet market because not only the total price of the mini iPad 4 is cheaper forty percent more than the former but it is a more portable equipment with lower configuration and smaller size.

Previous studies on customers engagement innovation used to regard product innovation as a single variable to investigate the role of customer participation on innovation level (Fang, 2008). However, different types of innovation, especially breakthrough innovation, have not been further explored. On that account, this article will examine the different effects of customer participation on two different types of breakthrough innovation.

3. Hypotheses

Knowledge-based view holds that the knowledge enterprise owned has determined the capability of breakthrough innovation (Joshi & Sharma, 2004).Knowledge can be obtained from the internal or the outside. Verona (1999) pointed out that it is difficult that merely relying on firm's internal reserves successfully carries out product innovation and the success rate of new product innovation can be enhanced only by obtaining, understanding, utilizing and integrating external resources. As an important asset of

enterprise, customers can provide firm with abundant knowledge. When customers as information provider participates in the process of new product development, they can provide firm with all kinds of knowledge, which has diversity and heterogeneity and can increase the width of the firm knowledge. When customers as co-developer take part in the process of new product development, the customers and firm will further study the certain kind of related knowledge, thereby to increase the depth of knowledge. On the other hand, the firm can transform the customer's knowledge into their own capability through organizational learning after obtaining them and this capability is difficult to imitate and copy. Therefore, customer participation is also an important source of firm's competitive advantage. Based on the knowledge-based view, this article investigates the effect and path of customer participation on two types of breakthrough innovation.

3.1. Customer Participation as Information Resource and Breakthrough Innovation

When customers as the role of information resource take part in product innovation they can provide firm with diversified knowledge and thereby increase the width of firm knowledge. Technology-based breakthrough needs to develop totally new technology and market-based breakthrough needs to identify according market opportunities. The two types of breakthrough innovation depend on the enterprise getting lots of knowledge (Zhou and Li, 2012). Arnold et al. (2011) emphasized that the diverse knowledge contribute to enterprises' breakthrough innovation. Taylor and Greverse (2006) suggested that enterprises with diversified knowledge reserve are more likely to develop cutting-edge ideas and create innovative product portfolio. Broad knowledge base combining with multi-angle observation to new market information and the potential changes can reinforce the enterprise's ability to identify market opportunities and develop advanced technology, which would be helpful to the implementation of breakthrough innovation (Chesbrough, 2003).On the contrary, if firm lacks the diversity of knowledge, it will be hard to identify customers' demands and provide corresponding solutions, and then will hinder the breakthrough innovation (Palmatier, 2008).Therefore, this article puts forward the following hypothesis:

H1: The customer participation as an information resource has significantly positive influence on technology-based breakthrough innovation.

H2: The customer participation as an information resource has significantly positive influence on market-based breakthrough innovation.

3.2. Customer Participation as a Co-developer and Breakthrough Innovation

When customer as a co-developer participates in customer innovation, it will strengthen and deepen the depth of the specific knowledge. The reinforcement of certain knowledge would offer certain direction for enterprise's product development. At the same time, the establishment of formal R&D team and system would reduce the interference of the external. The enterprise's capability of technology innovation can be improved. Zahra and George (2002) argued that the in-depth knowledge of specific areas is very important for breakthrough innovation because it contributes to the effective implementation of new ideas. The main reason that lots of companies with innovative ideas failed in the stage of innovation implementation is the lack of the knowledge and experience to solve complex problems (Katz and Du Preez, 2008).

Common development provides customers with higher customer value. However, the value is based on the knowledge of existing customers and the potential demand of other customers and future market opportunities may be ignored. Thus, the knowledge presented by the existing customers or the user leaders in the process of co-creation cannot provide guidance for new market with different preferences. Tripsas and Gavetti (2000) held that the knowledge depth of the specific areas would generate cognitive inertia, limit enterprises in current market, and ignore the new market, so it possibly has negative impact on market-based breakthrough.

Based on the above analysis, the according hypothesis are as follows:

H3: Customer participation as a co-developer positively affects technology-based breakthrough innovation.

H4: Customer participation as a co-developer positively affects market-based breakthrough innovation.

3.3. Mediating Effect of Organizational Learning

Customer participation is an important source of enterprise acquiring external knowledge. But the knowledge customers offered is often not clear, logical and orderly. Dickson (1992) stressed that the learning plays an important role in the process of external information transforming into the internal knowledge. He suggested that owning stronger learning capability than its competitors is the only source of obtaining competitive advantage in the dynamic and changing market background. Therefore, organizational learning may play a mediating role in the process of transforming the knowledge customers offered into the enterprise's internal knowledge.

Customer participation affects every part of organizational learning. Knowledge customer contributed is a significant source of breakthrough innovation of firm because the firm can discover customer demands and market situation through the knowledge. The lack of these knowledge would lead to the disconnection between firm's research and development activity and market demand or the waste of resources. Knowledge diffusing refers to every internal department of firm all can acquire the external knowledge. Different departments and personnel of the organization would have different views and opinions when they interpret these knowledge. Their feedbacks would bring more creative ideas to breakthrough innovation, thereby increase the value of information (Slater and Narve, 1994). Knowledge sharing refers to that organization agreed to the understanding of the knowledge before applying them. It will provide the new product development a unified direction and the firm's resources distribution can also be targeted. Organizational memory allows organization continuously stores and utilizes useful information and knowledge derived from the external and keep long-term learning condition. Organizational learning can absorb and digest the external knowledge and redistribute organizational resources that is conducive to the realization of the breakthrough innovation (Slater and Narve, 1994).

Based on the above analysis, we put forward the following hypothesis.

H5: Organizational learning plays a mediating effect between the customer participation and breakthrough innovation.

4. Method

4.1. Data Collection

We entrusted a consulting company to carry out the investigation in IT firms of Beijing, Shanghai, Wuhan and Guangzhou in China. The management personnel and technicians of Chinese IT industry were investigated. A total of 350 questionnaires were given out and 255 were returned, which indicates a responds rate of 72.83%. 57 ineffective questionnaires were filtered and the effective responds rate was 55.14%. In terms of company size, employees of 19 companies were each less than 200, which accounted for 9.8%. 45 companies owned 201-299 employees respectively, which accounted for 23.3%. There were 65 firms among 300-499 people, which accounted for 33.7%. There are 37 firms among 500-999 people, which accounted for 19.2%. There were 27 firms more than 1000 people, which accounted for 14%. In the aspect of company history, there were 11 firms with 4 - 6 years old, which accounted for 5.7%; There were 59 firms with 7-10 years old, which accounted for 30.6%; There are 123 firms beyond 10 years, which accounted for 63.7%. Among the responding corporations, 38 firms were collective of state-owned; 81 firms are private; 46 firms are sino-foreign joint venture; 28 firms are foreign-founded.

4.2. Measurement

Measurement items of each construct in the questionnaire all were from the English literature. In order to accurately translate all test items, this article adopted the method of Chinese-English translation to translate the items into Chinese. Afterwards, we invited two scholars to inspect the questionnaire and invited a corporate developer to answer in advance. We modified obscure and vague questions accordingly. Customer participation was measured by using six-item self-evaluation developed by Fang (2008) on a seven-point scale. Technology-based breakthrough and market-based breakthrough were assessed by using a three-item and four-item respectively adapted by Zhou et al (2005) on a seven-point scale. Organizational learning was used a ten-item scale developed by Sinkula et al. (1997) that contained information acquisition, transmission, sharing, and memorizing.

Considering the influence of other factors, we controlled firm history, firm size and company ownership. Firm history refers to the firm has experienced years old from corporate foundation. Company size is represented by the number of employees. Company ownership is divided into collective/state-owned enterprises, private/private enterprises, sino-foreign joint ventures and foreign-founded. A virtual variable was introduced to represent the four types (1 means “collective state-owned enterprises”, 0 means other types).

5. Results

5.1. Correlation Analysis

Table 1 summarizes the correlation coefficient of main variables in the study. It shows that information resource, co-developer and technology-based breakthrough were positively correlated ($r=0.538$, $p<0.01$ and $r=0.428$, $p<0.01$); To some extent, this suggests the rationality of the H1 and H3. Information resource and market-based breakthrough are not significantly positive correlation ($r=0.098$, $p>0.098$); Co-developer and market-based

breakthrough are not significantly negative correlation, which shows the rationality of H2 and H4. Information resource, co-developer and organizational learning are significantly positive correlation (r=0.517, p <0.01 and r =0.542, p<0.01); Organizational learning and technology-based breakthrough are significantly positive correlation (r=0.494, p<0.01) and organizational leaning do not have significant positive correlation with market-based breakthrough (r=0.061, p>0.061), which indicates the mediating effect may exist.

	Mean	SD	1	2	3	4	5
1. Information resource	5.814	0.6017	1				
2. Co-developer	6.230	0.5365	0.426 **	1			
3. Technology-based breakthrough	5.810	0.6567	0.538 **	0.428 **	1		
4. Market-based breakthrough	4.465	1.5858	0.098	-0.079	0.314 **	1	
5. Organizational learning	6.082	0.4377	0.517 **	0.542 **	0.494 **	0.061	1

Note: N=193, *p<0.05 **p<0.01

Table 1 – Correlation Coefficient Matrix

5.2. Reliability

The internal consistency of the scale is tested by Cronbach' α value. The Cronbach's α values (reliability coefficient) of customer participation, technology-based innovation, market-based innovation and organizational learning are 0.706, 0.703, 0.934 and 0.773, respectively. All of which exceed the 0.7 threshold for acceptable composite reliability (Fornell and Larker, 1981).

5.3. Hypotheses Testing

As shown in table 2, Model 1 tests H1 and H3 that indicates the coefficient of information resource is positive (b=0.421, p<0.01) and the coefficient of co-developer also is positive (b=0.208, p<0.01), which proves that information resource and co-developer have significant positive influence on technology-based breakthrough. H1 and H3 are supported. Model 2 tests H2 and H4 that the coefficient of information resource is 0.116 (p>0.05), which indicates H3 is not supported. The coefficient of co-developer is -. 0189 (p<0.01) that supports H4.

According to the method Baron and Kenny (1986) developed, we carried out regression analysis with three steps to test the mediating effect: First, we tested the effect of information resource and co-developer on technology-based breakthrough and market-based breakthrough respectively; Second, the effect of information resource and co-developer on organizational learning was tested; Finally, after introducing mediating variable, we investigated the influence change of information resource and co-developer on technology-based breakthrough and market-based breakthrough respectively. As company size, company history and ownership are likely to have a certain influence on main variables, these factors needed to be controlled when the hierarchical regression was used to verify mediating effect. The analysis results are shown in table 2.

	Organizational learning	**Technology-based breakthrough**		**Market-based breakthrough**	
	M3	M1	M4	M2	M5
Independent variable					
Information resource	.335**	0.421***	0.34**	0.116	0.095
Co-developer	.391**	0.208**	0.113	-0.189*	-0.213*
Organizational learning			0.243**		0.061
Control variable					
Company age	0.057	0.140*	0.127*	0.262**	0.258**
Company size	-0.082	0.035	0.055	-0.188*	-0.183
Company ownership	-0.063	0.095	0.111	-0.028	-0.024
F value	25.475**	22.628***	21.722***	4.122**	3.5**
Adjusted R2	0.39	0.36	0.39	0.07	0.07

Note: N=193, *p<0.05 **p<0.01 ***p<0.001

Table 2 – Standarded Regression Coefficient

Model 3 investigates the effect of information resource and co-developer on organizational learning. Result shows that the coefficients of information resource and co-developer all are positive (b= 0.335, p < 0.01; b= 0.391, p < 0.01).Model 4 examines the mediating effect of organizational learning between the two dimensions of customer participate and technology-based breakthrough. Results show that the coefficient of information resource is 0.34 (p<0.01), the coefficient of organizational learning is positive 0.243 (p<0.01), and the coefficient of co-developer is not significant (b= 0.113, p>0.05), which indicate that organizational learning partially mediates the effect of information resource on technology-based breakthrough and completely mediates the effect of co-developer on technology-based breakthrough. Model 5 tests the mediating effect of organizational learning between the two dimensions of customer participation and market-based breakthrough. Result shows that the coefficient of organizational learning is not significant (b=0.061, p>0.05), which suggests that organizational learning does not mediate the effect of customer participation on market-based breakthrough. The results of Model 3, Model 4 and Model 5 indicate that H5 is partially supported. Figure 1 shows the study findings.

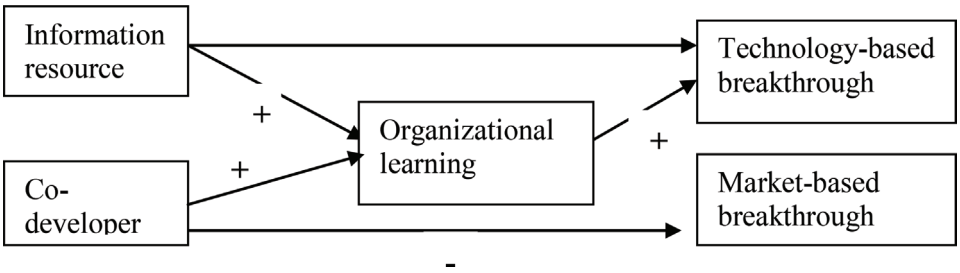

Figure 1 – Study Model

6. Conclusions and Discussions

The results show that customer participation as an information resource has significant positive effect on technology-based breakthrough but no significant impact on market-based breakthrough. The reason perhaps lies in that customers participating in product innovation are the existing consumers in the market and the knowledge they provided is partial except diversity because they are more concerned about product's attribute for themselves use rather than whether it will be favored by other customers. On the other hand, customer participation as a co-developer has a significant positive effect on technology-based breakthrough, but it has significant negative effect on market-based breakthrough. This perhaps lies in when customer and firm co-develop new product the depth of the knowledge related to their own demands is increased and there is a big deviation between their demands and those new customer demands. As a result, the more new product meets the demands of existing customers, the more it will deviate from the potential customer demands. It also reveals the limitations of customer participation: hindering company's market-based innovation, impeding company to develop new market and potential customers. Companies with high level of customer participation will invest more resources to meet the demands of existing customers. However, they will therefore lose the opportunity to get more potential customers. This conclusion also confirms that the company with customer orientation would hinder the breakthrough innovation (Arnold et al., 2011).

The results also suggest that organizational learning plays partial mediating effect between information resource and technology-based breakthrough completely mediates the effect of co-developer on technology-based breakthrough. It indicates that customer participation cannot spontaneously promote the company's breakthrough innovation and innovation has to be achieved through the organizational learning and practice.

Our findings provide valuable guidance for corporate strategy. Firstly, company can improve the capability of technology innovation by promoting customer participation level. Customer participation allows company better to discover the potential demands of current customers and meets these demands to gain competitive advantage through the technological innovation. Secondly, as the increase of customer participation as a co-developer would hinder market-based innovation, company should trade off the effect of co-developer on technology-based and market-based innovation. In order to deal with this problem, company should arranged a special team to research the customer demand in emerging markets, but not all of the resources are invested to research and development new product to meet existing customer demand. So as to avoid "marketing myopia". Especially for the IT industry, the market-based innovation is particularly important because market and customer demands change rapidly. A firm is likely to suffer a devastating blow if it only aims to meet the demands of existing customers.

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Design of the Information Service Push System for Prevention and Control of Fruit Trees Diseases and Insect Pests

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Abstract: Aiming at the critical period of the prevention and control of fruit trees disease and insect pests and combined with personalized push technology, this paper proposes the service push mechanism of prevention and control information of diseases and insect pests and discusses the key technology of information service push. This system adopts B/S structure and conducts design based on ASP.NET development language. Through the mining of user log, the interest characteristics of users are established and the prevention and control scheme of fruit trees disease and insect pests is formulated. The prevention and control information of diseases and insect pests is pushed specifically according to cultivar and critical period of management of fruits trees, realizing the service mode of "service for you only". This system provides personalized active information service for users and bears the characteristics of precise service, vivid information, simple inquiry and active service, which has strong universality and usability in the field agricultural information service.

Keywords: fruit trees; diseases and insect pests; prevention and control information; push technology; user interest model

1. Introduction

China has a long history in the cultivation of fruit trees and the planting structure is diverse. Fruit tree planting is the third largest industry in planting industry, which is of great significance in improving peasants' income and developing modern agriculture. Diseases and insect pests severely compromise fruit tree yield and fruit quality. Every year famers invest large amount of energy and money into the prevention and treatment of diseases and insect pests. With the development and popularization of computer network, farmers started to obtain prevention and control information of diseases and insect pests through the Internet (Leite et al., 2016). However, the information obtained has a lot of varieties and poor pertinence various, which cannot effective solve the diseases and insect pests issue in orchards. Therefore, it is an urgent need to establish the information push system of fruit trees diseases and insect pests to collect and analyze the new technology and new reagent of prevention and control of fruit trees diseases

and insect pests. The interest and behavior model of famers needs to be established to actively push the optimal prevention and control scheme of diseases and insect pests, realizing personalized information push service of fruit trees diseases and insect pests and promoting the information sharing.

In recent years, the research on personalized agricultural information push service has made some progress in our country. RSS agricultural information push service (Li et al., 2006) and the user interest model of RSS personalized information service (Guo et al, 2010) can be adopted to achieve convenient and quick push of latest information. The ontology-based personalized push model of agricultural information service (Qiao et al, 2013) and the personalized recommendation algorithm based on ontology user interest model (Yan et al., 2010; Prieto et al., 2014) can improves the accuracy of personalized recommendation. Aiming at the problems of low sharing rate of agricultural scientific and technological information and dispersed distribution, modified K-means clustering method to establish user access model and studied the personalized service push model of agricultural scientific and technological information (Xiao et al, 2013), the targeted agricultural information service according to the factors like region and time and created personalized multimedia agricultural information push system (Chen et al., 2014). The above mentioned researches promote the spread and development of agricultural scientific and technological information in our country.

2. System Framework

This system adopted B/S structure, realizing the automatic acquisition of prevention and control information of fruit trees diseases and insect pests and personalized information push. On the client side, farmers can access the information resources in this system through browser and they can choose different push methods like SMS, RSS and e-mail. On the server side, focused crawler technology is utilized to automatically

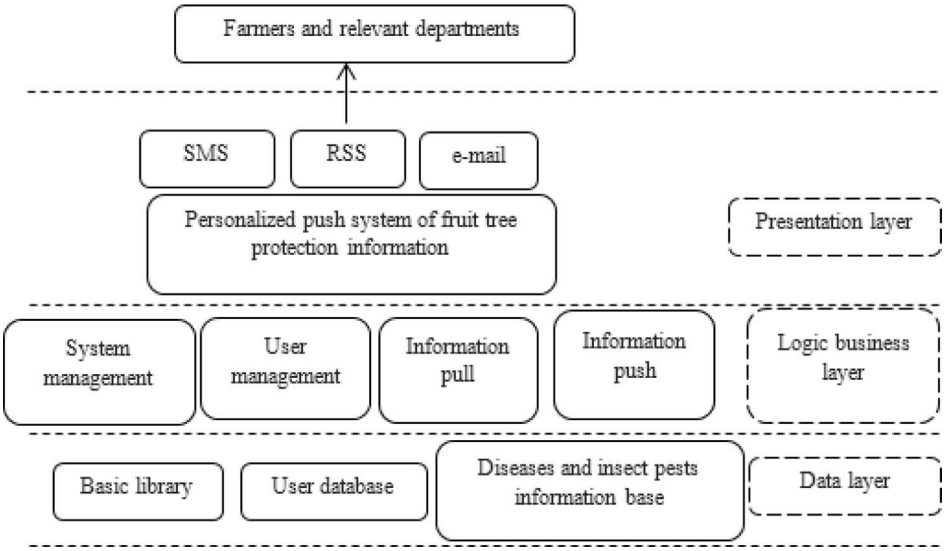

Figure 1 – System Functional Structure Chart

acquire the information diseases and insect pests and store it into local database; data mining technology is adopted to analyze user logs and Cookies. Combined with the user registration information, the interest orientation of users is determined to establish user interest model and push the prevention and control information to farmers based the model. This system is classified into data layer, logic business layer and presentation layer and the system functional structure is shown in Figure 1.

3. Key Technology of Personalized Push

3.1. User Interest Model

In general, user interest can be classified into short-term and long-term interest. Short-term interest is stimulated by environmental conditions and the long-term interest is produced by subjective tendency. The acquisition modes of user interest can be classified into explicit and implicit acquisition. This research adopts the way of combining explicit and implicit acquisition to build user interest model. Explicit building of interest model can be obtained mainly through user registration information and the inexplicit upgrading interest model can be obtained mainly through the mining of the content and behavior in browsing the web of users (like logs, Cookie). Through the analysis of user preference, combined with the feedback of users to the push information, conduct upgrading of user interest model, the flowchart of user interest model building is shown in Figure 2.

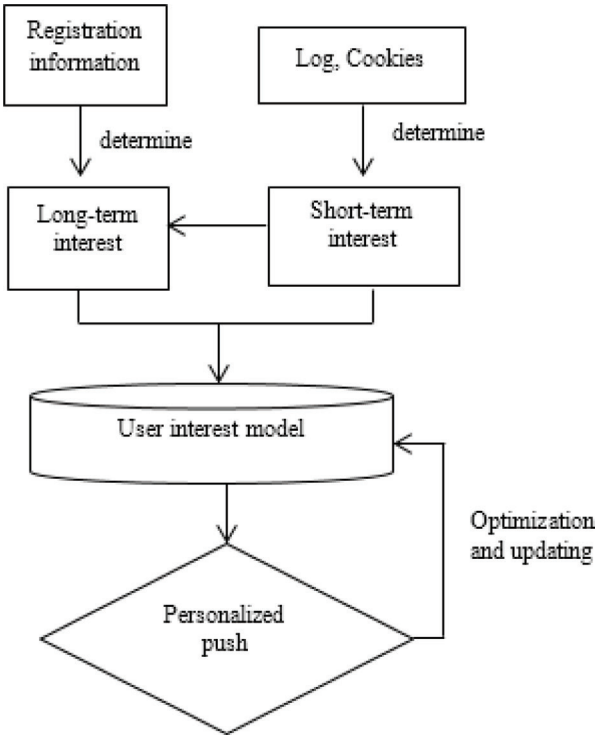

Figure 2 – Flowchart of user interest model building

3.1.1. Building of User Interest Model

The user interest model consists of the objects representing user interest and the interest level of users in this information can be expressed by weighted value. The user interest model in this research is represented by key words and the vector space model of weight. TF-IDF algorithm is adopted to calculate the weight of key words in the document. The formula is as follow:

$$\mathrm{w} = \mathrm{TF}(k_i, d)\log_{DF(k_i)} n \tag{1}$$

$\mathrm{TF}(k_i, d)$ is the number of occurrences of key word k_i in document d; $DF(k_i)$ is the number of documents containing the key word; n is the total number of documents. After the calculation of the weight of key words, the topic vector of user interest can be obtained.

Use a group of interest key words I_1, I_2, ⋯ I_n to represent n interest models of users. The weighting w_i of each interest model I_i can be conducted based on user interest level. The user interest can be expressed as the weighted vector model of $((I_1, w_1), (I_2, w_2), \cdots (I_n, w_n))$.

3.1.2. Upgrading of User Interest Model

The upgrading of user interest model mainly considers from short-term upgrading and long-term upgrading (YI Wen-wen et. al,2010). The upgrading strategy of short-term upgrading is that: I_1, I_2, ⋯ I_n are all leaf node sets in the user interest model and P represents the page that users access. When satisfying the following conditions, P belongs to interest type I_i.

$$S(P,\ I_i) = \frac{1}{|I_i|}\sum_{I_i \in I} S(P,\ I_j) \tag{2}$$

$$S(P,\ I_i) > S(P,\ I_j)\ j = 1,2,\cdots,n, j \neq i\ 9 \tag{3}$$

$S(P, I_i)$ represents the similarity of page P and interest I_i. When the similarity of page P and interest I_i reaches its maximum, add the vector of P into the I_i and upgrade the information of all nodes from the root node to the leaf node.

3.1.3. Introduction of Forgetting Mechanism

When upgrading the user interest model, we not only need to add the newest interest feature words of the users, but adjust the existing weight of feature words in the model. We need to introduce forgetting factor K_x to modify, which is to multiply the weight of feature words with K_x to improve the accuracy of recommendation. The forgetting K_x is:

$$K(x) = e^{-\frac{log2}{Tnow - Tupdate}}(Tnow - Tcreat) \tag{4}$$

$Tnow$ is the current date; $Tcreat$ represents the date of first appearance of the interest feature word in the model; $Tupdate$ is the update time of interest feature word; $Tnow - Tupdate$ is the half-life period (half period of user interest).

3.2. Information Push Technology

Information push technology is a kind of information acquisition technology, which is a new-type information transmission system that the information service company or network company can obtain the information from the information resource or the information processor through certain technical standard or protocol and then send SMS through fixed channel. Information push technology possesses the characteristic of initiative, individuation, convenience, effectiveness and intelligence. The working flow chart is shown in Figure 3.

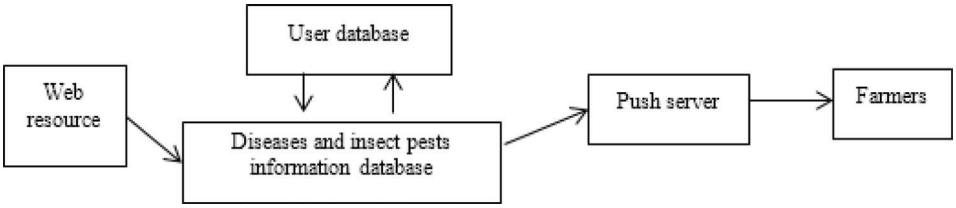

Figure 3 – Flow Chart of Information Push

3.2.1. Prevention and Control of Diseases and Insect Pests Push According to Fruit Tree Species

China has a great variety of fruit trees, mainly including banana, apple, orange, pear, grape, pineapple, jujube and persimmon. In 2010, the planting area of fruit trees covered 11,543,900 hectares and the yield reached 128,652,000 tons. Every year, the yield reduction due to diseases and insect pests is 25% and the direct economic loss reaches up to billions of Yuan (Du, 2005). The prevention and control of diseases and insect pests is dominated by chemical pesticides. Farmers use pesticides blindly, lacking scientific guidance. Aiming at the diseases and insect pests of different fruit tree species, based on the record of browsing system page of famers, the potential interest information of users is mined and user interest models are built to push the prevention and control information of diseases and insect pests effectively and precisely, improving the personalized level of push service.

3.2.2. Pushing Prevention and Control Scheme According to the Critical Period of Fruit Tree Management

Fruit tree planting has obvious seasonal and periodic characteristics and the occurrence of diseases and insect pests is closely related to the growth period of fruit trees. In different seasons, the objects, schemes, reagents, and key technology of diseases and insect pests prevention and control are different. According to the occurrences of diseases and insect pests in the key management period of fruit trees, combined with the accessing time of farmers, farmers' prevention and control information of interest of diseases and insect

pests is determined and corresponding prevention and control schemes are pushed, improving the pertinence and effectiveness of information push of the system.

4. Design and Realization of the System

4.1. System Function Design

4.1.1. User Access Analysis Module

This module is mainly used for the analysis of user access information. Through the analysis and reorganizing of access logs on the client-side, combined with page key words, Html document information is extracted and user interest model is built applying TF-IDF method to calculate the weight. Upgrading of user interest model is conducted according to the method in 2.1 to provide basis for user classification.

User classification model can be defined as $\text{User} = \{\text{F,I,DI,T,CT}\}$. F represents fruit tree species, like banana, apple, pear; I represents the set of user interest information and $I = \{I_1, I_2, \cdots I_n\}$; DI represents users' interest level of the information; T is users' attention level of the information and 0,1,2,3 is applied to represent no attention, little attention, attention and much attention; CT represents the documents and images of interest of users.

4.1.2. Information Acquisition Module

This module is mainly used for the acquisition of fruit tree prevention and control information of diseases and insect pests. Crawler technology is applied to acquire the pages related to the occurrence, prediction and forecast, prevention and control, reagent of fruit tree diseases and insect pests from relevant information source websites, then download them and save on the local server. Web information extraction technology is adopted and html document is parsed into DOM tree. And then, the delimiter of the target data item is determined based on nodes of DOM tree. The data item is determined and the information needed is extracted, which is later transformed into XML document of form. In addition, remove irrelevant html tag and CSS style. Finally, transform it into the XML document and store it into the information database of diseases and insect pests.

4.1.3. Information Push Module

This module is mainly used for the processing of user access requests. According to the interest information inputted by the user, obtain implicit feedback information by tracing the access operation of and mining the visited pages of the user. Based on user interest need, formulate relevant prevention and control schemes of diseases and insect pests and push the information to terminals including computer, smartphone through push approaches like e-mail, SMS and RSS to provide sound information service to users.

E-mail push is to send the prevention and control information source of diseases and insect pests to the computer and cellphone of farmers by the e-mail push on a regular basis. SMS push is to send the customized prevention and control information of diseases and insect pests to the cellphone of farmers by the SMS push on a regular basis. RSS channel push is

to provide famers with the RSS channel satisfying their interest and the information is sent in the form of metadata abstract. These three push approaches can accept the feedback information of users and then adjustment of push content can be conducted.

4.2. Implementation Process of the System

This system adopts B/S structure to facilitate maintenance and upgrading. Visual studio2005 is adopted to build the development environment based on .net; SQL Server 2005 is adopted as the background database; and ASP.NET is taken as development language. The system obtains the diseases and insect pests information receiving much attention of farmers through information acquisition module and then stores it into the information database of diseases and insect pests. The system can obtain the latest access record of famers when they visit this system. The interest and hobby of famers are recognized and predicted intelligently and contrast is conducted according to famers' requirement and the related information in the information database of diseases and insect pests. The customized information is searched automatically, and the prevention and control information of diseases and insect pests is pushed to farmer through information push module on a regular basis, thus satisfying personalized needs.

5. Discussion and Conclusion

In recent years, China has gained a series of scientific achievements in the field of fruit tree planting protection. However, some achievements have not been popularized and applied widely, the reason of which is the lacking of effective popularization mechanism and information push method, so the achievements cannot be pushed to the base. This research aims at the issue of prevention and control information push of diseases and insect pests and builds the user interest model adopting the combination of explicit and implicit approach through the mining of web logs and Cookie. The prevention and control schemes of diseases and insect pests are pushed according to fruit tree species and critical period of management. Combined with personalized push technology like e-mail, SMS and RSS, the information service push system for prevention and control of fruit tree diseases and insect pests suitable for the interest needs of farmers is built, improving the quality of information service and promoting the development of modern agriculture.

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A Stochastic Dominance Test for the Efficiency of Program Trading Algorithm

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Abstract: This paper investigates stochastic dominance relations among the program trading strategies. The empirical results show that the application of program trading strategies are still efficient in China's stock market and the six active algorithms are superior to the passive buy-and-hold strategy before and after the transaction cost. Meanwhile, the stochastic oscillator strategy has the most outstanding performance in the stochastic dominance test, followed by Bollinger Bands and the relative strength index. The results will provide references for investors in portfolio decision.

Keywords: stochastic dominance, technical analysis, efficient market hypothesis.

1. Introduction

Technical analysis refers to the prediction of the future stock price trends in form of charts based on the past stock price movements and the relevant knowledge of statistics. Due to the advantages of easy comprehension and application, the program trading strategies have been widely adopted by the investors in the stock market. However, (Fama, 1970) thought that the investors couldn't gain excess returns continuously through technical analysis if the capital market was efficient. Therefore, technical analysis goes against the efficient market hypothesis. Theoretically, for a weak-form efficient market, technical analysis will be meaningless (Chiang et al., 2012; Crespo and Santos, 2015; Faria, et al., 20015). So, whether the program trading strategies are profitable and whether a specific stock market is efficient are the two inevitable questions in the studies on stock market efficiency.

In this paper, the stochastic dominance theory is applied to test the dominance relations among program trading strategies and select the optimal program trading strategy for investors, judge the profitability of program trading strategies and thus verify the efficiency of China's stock market indirectly. The findings have enriched the theoretical studies for program trading strategies and expanded the application of stochastic dominance theory in China's stock market.

Unlike traditional methods, e.g., the double sample mean T test and the bootstrap method, the stochastic dominance theory is just a comparison of cumulative distribution functions of random variables based on the expected utility theory, which avoids many restrictive assumptions, features relatively good applicability and generality, and thus is

a distribution-free method. The adoption of the stochastic dominance theory to evaluate the relations among different program trading strategies is a brand-new attempt for the study of efficiency of China's stock market.

2. Literature Review

As a non-parametric oriented method with weak hypotheses and a few restrictions, the stochastic dominance theory was suggested by (Fishburn, 1964), which offers a simple tool for selection of risky assets, attracts close attention of scholars from different fields and has been widely used for various research purpose.

In terms of the theoretical studies of stochastic dominance, (McFadden, 1989) tested the stochastic dominance relation of independent samples with Kolmogorov-Smirnov (K-S) method based on the independent identical distribution. (Anderson, 1996) proposed a footprint method by constructing T statistics (Anderson test) to test two mutually-independent samples. (Davidson and Duclos, 2000), based on the test of unequal constraints, proposed Davison and Duclos (DD) test and strictly proved three dominance relations FSD$\subseteq$SSD$\subseteq$TSD. On the basis of early literature, (Barrett and Donald, 2003) proposed Barrett-Donald KS test method featuring consistency and derived p-values via Monte Carlo simulation.

The empirical studies of stochastic dominance have been applied to a wide range of fields, including economic welfare, market efficiency, insurance, risk preference and so on, such as (Levy, 1992; Fong et al., 2008; Chiang et al., 2011; Olmo and Sanso-Navarro, 2012).

This paper intends to apply stochastic dominance method to test the efficiency of program trading rules. There has always been disputes regarding the studies on technical analysis. (Fama and Blume, 1966; Jensen and Benington, 1970; Lee et al., 2001) found that technical principles could neither reliably predict the future returns nor produce significant and positive profits. However, other studies led to opposite conclusions. (Brock et al., 1992) found that program trading strategies were capable of predicting the changes of Dow Jones Industrial Average Index. (Lo et al., 2000) studied the efficiency of "the forms of technical analysis" and the results showed that most program trading strategies could provide useful information for the prediction of stock prices. Metghalchi et al. (2008) found that the program trading rules were superior to the buy-and-hold strategy. Chiang et al., (2012), with the trading data of Taiwan stock index futures market from 1998 to 2008, tested the performances of active and passive trading strategies with the stochastic dominance theory and the results showed that eight active program trading strategies outperformed the passive buy-and-hold strategy before and after the transaction cost.

3. Research Methods

The stochastic dominance has no requirements for the distribution of return rates on risky assets and the only hypothesis is that the investors pursue the utility maximization, risk averse and the decreasing absolute risk averse, and there are no uncertain parameters in the test model. In spite of the rather complex algorithm, the stochastic dominance theory has easy practical applications and it is just a comparison of accumulative distribution

functions of continuous random variables in nature. In case there exists the stochastic dominance relation, the expected utility of dominant assets held by the investors is higher, and rational investors won't hold non-dominant assets. The stochastic dominant relations have three types, i.e., the first-order stochastic dominance (FSD), the second-order stochastic dominance (SSD) and the third-order stochastic dominance (TSD). These three stochastic dominance have the forward conduction relation FSD⊆SSD⊆TSD, that is to say, SSD and TSD exist as long as the existence of FSD is proved, not vice versa.

During the assessment of optional assets or asset portfolios in line with the results of stochastic dominance tests, the stochastic dominance theory believes that all optional investments can be divided into two mutually-exclusive sets according to the given criteria, namely the efficient and inefficient sets, which contain the investments that meet the requirements of rational investors and that are chosen by irrational investors, respectively.

Further, according to the progressive relation among three stochastic dominance relations, the second-order inefficient set can be separated from the first-order efficient set and the third-order inefficient set can be separated from the second-order efficient set. In the end, the third-order stochastic dominant investments shall be the final efficient set.

Many stochastic dominance test methods have been reported in existing literature, including Anderson T test, Davidson and Duclos (DD test), Barrett-Donald KS test, etc. In Anderson T test and DD test, finite-point segmentation is carried out for the return rates and the integral results are approximated based on finite points, but the selection of finite points for segmentation is subjective and arbitrary, which may lead to the inconsistency of test results. However, Barrett-Donald KS test, which is based on Kolmogorov-Smirnov test, has no restrictions on the number of tests and the integral values are calculated on all segmentation points in an interval, so the test results are accurate, effective, consistent and feasible in practical applications. Meanwhile, Barrett-Donald KS test gives p-value for the stochastic dominance test. Therefore, Barrett-Donald KS test has effectively made up the shortcomings of Anderson test and DD test mentioned above. In this paper, Barrett-Donald KS test is chosen to carry out the stochastic dominance test.

Suppose there are two optional risky assets for investors, i.e., X and Y. Their accumulative distribution functions of the return rates are $F(X)$ and $G(Y)$ respectively, and are mutually independent. The return rates of samples are distributed in the same interval $[a, b]$. $\{X_i\}_{i=1}^{N}$ and $\{Y_i\}_{i=1}^{M}$ are random samples from X-distribution and Y-distribution.

Hypothesis 1: (1) F and G share a supporting set $[a, b]$ and $b < \infty$,

(1) F and G are continuous functions in the interval $[a, b]$.

Hypothesis 2: (1) $\{X_i\}_{i=1}^{N}$ and $\{Y_i\}_{i=1}^{M}$ are mutually independent random samples from two different distributions.

(2) The sample system is N/(N+M)→0 as N and M approach zero, and 0<λ<1.

In line with the definition of stochastic dominance above, it can be found that the jth order $(j = 1,2,3)$ stochastic dominance relation between the risky assets X and Y can be defined through a comparison of $j - 1$ order integrals of accumulative distribution

functions of the return rates on the risky assets X and Y only. Hence, the $j-1$ order integrals of accumulative distribution functions of the return rates on the risky assets X and Y are denoted as $I_j(z, F)$ and $I(z, G)$. For $z \in [a, b]$,

$$\begin{aligned} &I_3(z, F) = \\ &\int_a^z I_2(z, F)dt = \\ &\int_a^z \int_a^t I_1(t, F)dtds = \\ &\int_a^z \int_a^t Fdtds \end{aligned} \tag{1}$$

If $I_j(z, F) \le I(z, G)\left(z \in [a,b]\right)$ is true, it can be inferred that X dominates Y by the j order stochastic dominance. To compare $I_j(z, F)$ and $I_j(z, G)$, the hypothetical test method is chosen, and the hypotheses are presented as follows according to fundamental principles of the hypothetical test method:

Null hypothesis H_{0j} : $I_j(z, F) \le I_j(z, G)$ (all $z \in [a,b]$)

Alternative hypothesis H_{1j} : $I_j(z, F) > I_j(z, G)$ (a certain $z \in [a,b]$)

According to the empirical distributions (Davidson and Duclos, 2000),

$$I_j(z; G_N) = \frac{1}{N}\sum_{i=1}^{N} I_j\left(z; 1_{X_i}\right) = \frac{1}{N}\sum_{i=1}^{N} \frac{1}{(j-1)} 1(X_i \le z)(z - X_i)^{j-1} \tag{2}$$

$$I_j(z; G_M) = \frac{1}{M}\sum_{i=1}^{M} I_j\left(z; 1_{Y_i}\right) = \frac{1}{M}\sum_{i=1}^{M} \frac{1}{(j-1)} 1(Y_i \le z)(z - Y_i)^{j-1} \tag{3}$$

For discrete variables, the event probability equals to the event frequency, and the accumulative distribution functions are constructed as follows:

$$F_N(z) = \frac{1}{N}\sum_{i=1}^{N} 1(X_i \le z),\ G_M(z) = \frac{1}{M}\sum_{i=1}^{M} 1(Y_i \le z) \tag{4}$$

The test statistics are constructed according to (Barrett & Donald, 2003):

$$F_j = \sqrt{\left(\frac{NM}{N+M}\right)} \sup_z \left(I_j(z; F_N) - I_j(z; G_M)\right) \tag{5}$$

For $j = 1$, p value is $P(S > c)$ (C is the designated critical significance level, i.e., $\left(-\frac{1}{2}\log \alpha\right)^{1/2}$) through the statistical method. For $j \ge 2$, it is necessary to simulate the statistics S_j in order to derive p value, namely KS_j value which is defined as the probability of a refusal to the mistakes of H_{0j}, because the enclosed limiting distribution is impossible for the return rates. At the same time, p value of the hypothetical test can be simulated and calculated by referring to the procedures and methods proposed by

(Barrett & Donald, 2003). In the end, a comparison is made between p value and the significance level of the critical value C_j of statistics derived in simulation, and $\alpha(C_j)$ can be freely chosen according to the preferences of investors.

$$\lim_{N,\, M\to\infty} P\left(\text{reject}H_o^j\right) \le P(S_j^F > C_j) \equiv \alpha_F\left(C_j\right) \tag{6}$$

$$\lim_{N,\, M\to\infty} P\left(\text{reject}H_o^j\right) \le P(S_j^{G,F} > C_j) \equiv \alpha_{G,F}\left(C_j\right) \tag{7}$$

Therefore, when $P \le \alpha\left(C_j\right)$, H_{oj} can be rejected. When $P > \alpha\left(C_j\right)$, H_{oj} cannot be rejected.

It is noteworthy that a reverse hypothetical test should be conducted to make sure whether Y outperforms X by the j order stochastic dominance because it is a weak hypothesis that X dominates Y by the j order stochastic dominance. In the end, the j order stochastic dominance relation between X and Y can be derived through comparative analysis. The result is as follows: X is superior to Y by the j order stochastic dominance, Y is superior to X by the j order stochastic dominance, or there doesn't exist the stochastic dominance relation between X and Y.

4. Empirical Analysis

According to (Chiang et al., 2012), this paper is aimed to study the stochastic dominance relations of program trading strategies in China's stock market and tests the efficiency of program trading strategies. The program trading strategies are classified into two groups. One is the passive buy-and-hold strategy (BH), which believe that it is useless trying to predict the stock price trends through analysis and the best way is to buy and hold. The other includes the active trading strategies, and the investors who support active trading strategies consider that technical analysis is helpful and the stock price trends are predictable. This paper studies the active trading strategies, including Bollinger Bands(BB), Stochastic Oscillator (SO), Moving Average (MA), Moving Average Convergence and Divergence (MACD), Relative Strength Index (RSI) and On Balance Volume (OBV), which analyze the fluctuation pattern of stock market and forecast stock price trends through charts or indicators of past stock price changes. These seven trading strategies are simple and easy for operation and have been widely employed in stock markets.

To test the efficiency of program trading strategies and provide references for the quantification of investment strategies, this paper takes the transaction cost into consideration from the perspective of actual investment. The stock transaction cost refers to the sum of taxes and fees payable by the investors for commissioned stock purchases and sales and generally includes the stamp tax, securities trading supervision fee and brokerage, securities traders commissions, transfer fee and other fees. For the convenience of calculation, it is assumed that the stock transaction cost includes the bilateral trading expenses and the unilateral stamp tax only and is determined

as 0.5‰ and1‰ respectively, that is to say, the buying price should be the closing price*1.0005, and the selling price should be the closing price*0.9985.

4.1. Data Sources and Descriptive Statistic

Jointly released by Shanghai Stock Exchange and Shenzhen Stock Exchange on April 8, 2005, Shanghai-Shenzhen 300 Index are important indicators which reflect the general status of China's stock market, reveal stock price fluctuations and serve as "a barometer" for the overall trends of Shenzhen and Shanghai stock markets as well as the evaluation criteria for investment performance. In this paper, the trading data of Shanghai-Shenzhen 300 Index components are chosen, including the opening prices, high prices, low prices, closing prices and the trading volumes. The sample period covers from January 4, 2010 to December 31, 2014 and there is a total of 1,210 trading days.

Generally, the stock return rate can be calculated in two ways, i.e., the simple arithmetical return and the continuous logarithmic return. In this paper, the latter is adopted, namely $R_t = \ln(P_t / P_{t-1}) \times 100\%$, in which P_t and P_{t-1} denote the close prices on the t and t-1 trading days for corresponding indexes.

Table 1 presents the descriptive statistics of the return rates of seven trading strategies. It can be found that the six active program trading strategies are superior to the passive buy-and-hold strategy and the average return rates of the six active program trading strategies are larger than that of the passive buy-and-hold strategy before and after the transaction cost. The average return rate of the buy-and-hold strategy is positive before the transaction cost but becomes negative

		BH	BB	SO	MA	MACD	OBV	RSI
Before Transaction Cost	Min. (%)	-6.52	-4.59	-6.52	-4.59	-4.70	-6.42	-3.47
	Max. (%)	4.93	4.93	4.93	4.93	4.93	4.51	4.93
	Mean (%)	0.01	0.21	0.28	0.14	0.11	0.02	0.17
	Median(%)	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
	Std.	0.0136	0.0093	0.0109	0.0091	0.0097	0.0098	0.0090
	Kurt.	1.9705	5.0191	4.4838	5.7374	5.1074	6.3660	5.4388
	Skew.	-0.1258	1.2612	0.1341	1.1211	0.8578	0.1163	1.2589
After Transaction Cost	Min. (%)	-6.72	-4.79	-6.72	-4.79	-4.90	-6.62	-3.67
	Max. (%)	4.73	4.73	4.73	4.73	4.73	4.31	4.73
	Mean (%)	-0.19	0.11	0.15	0.04	0.00	-0.08	0.08
	Median(%)	-0.21	0.00	0.00	0.00	0.00	0.00	0.00
	Std.	0.0136	0.0091	0.0108	0.0090	0.0097	0.0098	0.0088
	Kurt.	1.9705	5.1433	4.8842	5.6915	5.0056	6.2758	5.4658
	Skew.	-0.1258	1.0147	-0.0591	0.8232	0.5687	-0.1935	0.9707

Table 1 – Descriptive Statistics of Return Rates of Trading Strategies

after the transaction cost. The average return rate of OBV also drops below zero (-0.08%) after the transaction cost, but is still larger than that of the buy-and-hold

strategy (-0.19%). The six trading strategies have good performances during the study period, that is to say, the average return rates of those trading strategies are positive, among which Stochastic Oscillator, Bollinger Bands and RSI have the most outstanding performances. The average return rates of Stochastic Oscillator, Bollinger Bands and RSI are 0.15%, 0.11% and 0.08% respectively after the transaction cost.

It can be also observed from Table 1 that all the kurtosis of the return rates of six active program trading strategies are larger than 3 before and after the transaction cost, which suggests that the return rate series are highly concentrated at the center and the probability distribution curve is soaring. The skewness of the return rates of the trading strategies can be both positive and negative, which implies that the return rates of the trading strategies are asymmetrically distributed and characterized by sharp peaks and fat tails in comparison with the normal distribution. However, the return rates of six active trading strategies mostly skew to the right, indicating there is a relatively large possibility to obtain higher return rates when the six active trading strategies are employed.

4.2. Kolmogorov-Smirnov (K-S) Test

K-S test is a test of goodness of fit based on accumulative distribution functions, which can be used to test the consistency between the actual distribution and a designated theoretical distribution and to examine whether two samples come from the same distribution or have significant differences. Therefore, K-S test is adopted to test the normality of return rates of program trading strategies in this paper. P-values of the return rates of different trading strategies in K-S test are shown in Table 2. At the 5% significance level, the null hypothesis is rejected, which suggests that the return rates are not in accordance with the normal distribution. Hence, a conclusion can be drawn that the nonparametric-oriented stochastic dominance theory has the least restrictive hypothesis for preference, i.e. the investors are rational and risk-averse. It is rather realistic and generic and also an appropriate tool to test the efficiency of program trading strategies.

K-S Test Results		BH	BB	SO	MA	MACD	OBV	RSI
Before Transaction Cost	p-value	0.0008	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
After Transaction Cost	p-value	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 2 – K-S Test Results of Trading Strategies

4.3. Stochastic Dominance Test

4.3.1. Stochastic Dominance Test before Transaction Cost

It can be known from the descriptive statistics and analysis above that Stochastic Oscillator has the highest average return rate, followed by Bollinger Bands and RSI,

and OBV has the relatively poor performance. However, but they are all superior to the buy-and-hold strategy. The stochastic dominance test is carried out in order to test the accumulative distribution functions of continuous variables. Whether there exists the first-order stochastic dominance should be tested first. If not, the second-order and third-order stochastic dominance should be successively tested.

In this paper, the accumulative distribution functions of the buy-and-hold strategy, Bollinger Bands and Stochastic Oscillator before the transaction cost are plotted in Figure 1. On the whole, the accumulative distribution curve of Stochastic Oscillator is to the right of the accumulative curves of the buy-and-hold strategy and Bollinger Bands, which means Stochastic Oscillator may be superior to the buy-and-hold strategy and Bollinger Bands.

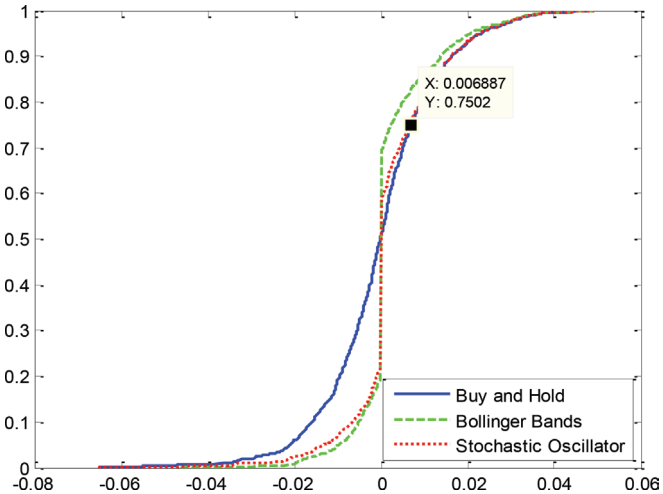

Figure 1 – Accumulative Distribution Functions of Trading Strategies before Transaction Cost

Nevertheless, it is worth noting that three distribution curves intersect at the return rates of 0.016%, 0.689% and 2.83%, which suggests that there doesn't exist the first-order stochastic dominance relation among them. However, it can be clearly observed that the areas enclosed by the horizontal axis, an arbitrary return rate and the distribution curves of Bollinger Bands and Stochastic Oscillator respectively are larger than the area enclosed by the horizontal axis, the same return rate and the distribution curve of the buy-and-hold strategy. Therefore, in line with an intuitive observation, Bollinger Bands and Stochastic Oscillator outperform the buy-and-hold strategy by the second-order stochastic dominance.

At the significance level of $\alpha(C_j) = 0.05$, K-S test is carried out for stochastic dominance relations among Bollinger Bands, Stochastic Oscillator and the buy-and-hold strategy, and p-values are derived in Table 3:

p value	BH ≥ BB	B B ≥ BH	BH ≥ SO	SO ≥ BH
KS1 Method p-values				
	0.0000	0.0000	0.0000	0.0008
	0.0000	0.6920	0.0000	0.6920
	0.0000	0.6590	0.0000	0.6590
KS2 Method p-values				
	0.0000	0.0000	0.0000	0.0008
	0.0000	0.6940	0.0000	0.6910
	0.0000	0.6490	0.0000	0.6580

Table 3 – Stochastic Dominance Test Results for Three Trading Strategies before Transaction Cost

P- values of the first-order stochastic dominance test should be observed first. p values of the first-order stochastic dominance of the buy-and-hold strategy over Bollinger Bands are 4.4343E-49, which is far smaller than the significance level of 0.05, so the null hypothesis is rejected. At the same time, a reverse hypothetical test should be performed, and p values are 0.0000 and still smaller than 0.05, so it can be inferred that there doesn't exist the first-order stochastic dominance relation between the buy-and-hold strategy and Bollinger Bands. Then p values of the second-order stochastic dominance of the buy-and-hold strategy over Bollinger Bands are 0, so the null hypothesis is rejected. However, p values of the reverse hypothetical tests are 0.6920 and 0.6940, which are both larger than 0.05, so the null hypothesis is not rejected. Therefore, Bollinger Bands is superior to the buy-and-hold strategy by the second-order stochastic dominance. Likewise, Stochastic Oscillator outperforms the buy-and-hold strategy by the second-order stochastic dominance as well.

To save space, we do not present p-value results of stochastic dominance tests among of different trading strategies. The stochastic dominance relations among trading strategies before the transaction cost can be derived through data analysis and the results are shown in Table 4 (the stochastic dominance relations of the return of trading strategies in rows to the return of trading strategies in columns). In Table 4, FSD, SSD and TSD denote the first-order, second-order and third-order stochastic dominance relations respectively, while NSD means there doesn't exist the stochastic dominance relation.

	BH	BB	SO	MA	MACD	OBV	RSI
BH		NSD	NSD	NSD	NSD	NSD	NSD
BB	SSD		NSD	SSD	SSD	FSD	NSD
SO	SSD	FSD		FSD	FSD	FSD	FSD
MA	SSD	NSD	NSD		TSD	SSD	NSD
MACD	SSD	NSD	NSD	NSD		SSD	NSD
OBV	SSD	NSD	NSD	NSD	NSD		NSD
RSI	SSD	NSD	NSD	NSD	SSD	FSD	

Table 4 – Stochastic Dominance Relations among Seven Trading Strategies before Transaction Cost

It can be found in Table 4 that six active program trading strategies are superior to the passive buy-and-hold strategy by the second-order stochastic dominance. The active trading strategies have less risks than the passive trading strategy and the program trading strategies are profitable. Further, different active trading strategies have different performances. To be specific, Stochastic Oscillator outperforms the other five active trading strategies by the first-order stochastic dominance, which indicates Stochastic Oscillator helps to gain a higher expected utility than the other strategies. MA is superior to MACD by the third-order stochastic dominance and MA has smaller downside risks in comparison with MACD.

When Stochastic Oscillator is set aside, it can be found that OBV is the first classified into the inefficient set because of the first-order stochastic dominance of Bollinger Bands and RSI over OBV. In the second-order stochastic dominance tests, the buy-and-hold strategy, MA and MACD are classified into the inefficient set. No trading strategies are classified into the inefficient set in the third-order stochastic dominance tests. Bollinger Bands and RSI stay in the efficient set and have outstanding performances.

4.3.2. Stochastic Dominance Test after Transaction Cost

After the transaction cost, the accumulative distribution functions of the buy-and-hold strategy, OBV and RSI are plotted as follows.

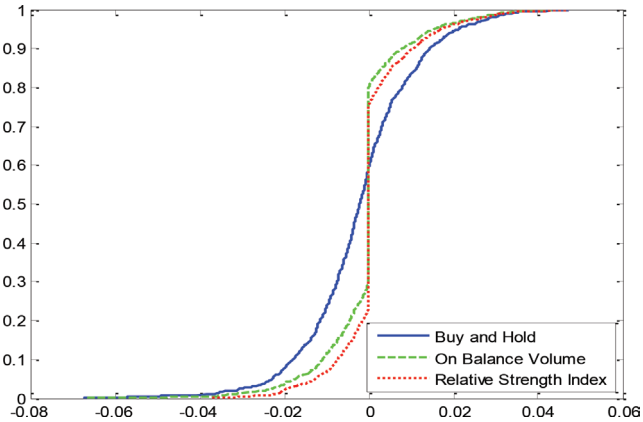

Figure 2 – Accumulative Distribution Functions of Three Trading Strategies after Transaction Cost

It can be found in Figure 2 that the accumulative distribution curves of OBV and RSI intersect with that of the buy-and-hold strategy and there doesn't exist the first-order stochastic dominance relation after the transaction cost. However, the area enclosed by the accumulative distribution curves before intersection is larger than the area enclosed after intersection, and the accumulative distribution curves of OBV and RSI are almost to the right of the accumulative distribution curve of the buy-and-hold strategy. Therefore, as long as the investors' requirements for risk aversion are satisfied, OBV and RSI outperform the buy-and-hold strategy by the second-order stochastic dominance.

At the same time, it can be found that under no circumstances is the return rate of RSI lower than that of OBV. Hence, for the investors who pursue the maximization of utility, RSI is superior to OBV by the first-order stochastic dominance.

The stochastic dominance relations among different trading strategies after the transaction cost are tested, and p values of the test results are ignored to save space.

The stochastic dominance results obtained through the analysis of p values of the forward and reverse hypothetical tests are in Table 5.

	BH	**BB**	**SO**	**MA**	**MACD**	**OBV**	**RSI**
BH		NSD	NSD	NSD	NSD	NSD	NSD
BB	SSD		NSD	SSD	SSD	FSD	NSD
SO	FSD	FSD		FSD	FSD	FSD	FSD
MA	SSD	NSD	NSD		TSD	SSD	NSD
MACD	SSD	NSD	NSD	NSD		SSD	NSD
OBV	SSD	NSD	NSD	NSD	NSD		NSD
RSI	SSD	NSD	NSD	TSD	FSD	FSD	

Table 5 – Stochastic Dominance Relations among Seven Trading Strategies after Transaction Cost

It can be found through Table 5 that Stochastic Oscillator is superior to the all other trading strategies by the first-order stochastic dominance for the investors who pursue the maximization of utility after the transaction cost, which means that under no circumstances is the return rate of Stochastic Oscillator lower than those of the other trading strategies. As the investors' marginal utility is diminished, the other five active trading strategies still outperform the passive buy-and-hold strategy by the second-order stochastic dominance. It is worth noting that there doesn't exist the stochastic dominance relation between RSI and MA before the transaction cost but RSI outperforms MA by the third-order stochastic dominance after the transaction cost. Furthermore, RSI is superior to MACD by the second-order stochastic dominance before the transaction cost but by the first-order stochastic dominance after the transaction cost.

When Stochastic Oscillator is set aside, MACD and OBV are the first classified into the inefficient set in the first-order stochastic dominance test. The buy-and-hold strategy and MA are classified into the ineffective set in the second-order stochastic dominance test, while Bollinger Bands and RSI stay in the efficient set. MACD is classified into the inefficient set in the second-order dominance tests before the transaction cost but classified into the inefficient set in the first-order stochastic dominance test after the transaction cost, which suggests that the transaction cost may offset the profitability of MACD. However, OBV, the buy-and-hold strategy and MA are classified into the inefficient set in the same sequence, and Bollinger Bands and RSI stay in the efficient set before and after the transaction cost, which reflects that the transaction cost has relatively weak offset effects.

To sum up, it can be found that the stochastic dominance relations of the program trading strategies after the transaction cost are similar to those before the transaction cost, which indicates that the transaction cost has limited effects on the results of stochastic dominance tests. It can be also drawn that six active program trading strategies are superior to the passive buy-and-hold strategy, and the program trading strategies are profitable in China's stock market. Furthermore, when Stochastic Oscillator is set aside, it can be found that only Bollinger Bands and RSI stay in the efficient set, which reflects that Stochastic Oscillator has the most outstanding performance among seven program trading strategies, followed by Bollinger Bands and RSI.

5. Conclusion

The stochastic dominance test has unique advantages for its simple assumptions and restrictions in comparison with other theoretical methods. The analysis of stochastic dominance relations among program trading strategies can be conducted as long as the investors' requirements like non-negative utility function, risk averse and decreasing absolute risk averse are satisfied. Therefore, in this paper, the stochastic dominance theory is employed to test the efficiency of program trading strategies for Shanghai-Shenzhen 300 Index before and after the transaction cost, figure out the stochastic dominance relation among different trading strategies are examined, and the optimal investment strategy can be found according to our approach. Through the empirical analysis of stochastic dominance tests above, the research findings are as follows:

1. The six active program trading strategies are superior to the passive buy-and-hold strategy both before and after the transaction cost. This means the active program trading strategies can be used to create profit or reduce fortune losses for investors. On the other hand, program trading strategies can help to create excess returns for investors if properly applied, and so China's stock market is still imperfect and inefficient.
2. The results of stochastic dominance tests show that Stochastic Oscillator has the most outstanding performance among seven program trading strategies, followed by Bollinger Bands and RSI, which suggests that trading strategies have different performances and not all active program trading strategies have the same performance. It is essential for investors to choose an appropriate trading strategy.

This paper mainly studies the stochastic dominance relation among the program trading strategies in China's stock market. Results show that the active trading strategies are apparently superior to the passive buy-and-hold strategy which and provide evidence that China's stock market hasn't reached the weak efficiency yet. However, in this paper, the stochastic dominance tests are simply carried out for trading strategies before and after the transaction cost, while some other influential factors, including the spatial structure and time period of data, are not taken into account. Hence, the reliability of the research findings is weakened to some extent. Moreover, the investors usually take advantage of multiple program trading strategies alternatively rather than apply a single one in actual investment practice. Thus, there still exist differences between this study and the practical situation.

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Primary Education Major Curriculum System of New Universities

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Abstract: Teachers are the key to popularize primary education. New universities primary education should accurately position the training objectives, survey the current situation of primary education curriculum provision in the normal universities for primary teacher education, get to know its problems and establish a scientific and rational primary education curriculum system to train primary teachers under the background of universal primary education.

Keywords: primary education curriculum system – Unreasonable course structure

1. Introduction

In 2000, Chinese pedagogical education was changing from grade three to grade two, in order to meet changing needs, the government, according to local situations, started to distribute universities in circumferentially-class cities in a large scale through combining to upgrading, upgrading independently and other ways. However, after the establishment of local universities, the primary problem encountered is the training objectives positioning of variety of majors. Primary Education is no exception. First, primary education of the new universities is different from the previous moderate childhood teacher's education; it belongs to the category of higher teacher education, so its academic level, talent specifications and course requirements have to be done for high-quality, high-level personnel training. Furthermore, its training objectives is no longer to train the teachers for the middle children normal schools, but to cultivate application-oriented primary school teachers. Position of training objectives is to solve the problem of talents, that is to say a problem: what kind of primary education talents can meet the needs of the primary education? Qualified science curriculum should be built to achieve the talents standards. Although primary education curriculum system in new universities has been adjusted according to the training objectives and talent standards, due to the rooted effect of traditional primary curriculum system, its curriculum system cannot satisfy the training objectives, resulting in "not good teachers" for primary school (Quiñonez et al., 2016).

2. The primary education curriculum system in new universities problems

Through the analysis of information collected from primary school staff, primary graduates and the entire new universities primary curriculum, the current new universities primary curriculum is with the following problems:

2.1. Unreasonable course structure

1. Of general education curriculum, humanities, natural sciences occupied lower proportion. Primary students of new universities should be different from the secondary school students, that is to have the characteristics of a university student, well-education and noble qualities. Such noble qualities can be formed by the combination and integration of comprehensive (Drigas et al., 2015).
   However, the current general education curriculum is basically part of the political theory in social sciences category and tools courses, such as computer courses, English courses, the courses reflect the humanistic and natural sciences occupied lower proportion, which is not helpful for the training of high-quality talents.
2. There are fewer new programs in basic courses. Aimed at training the students for basic philosophy of education and laying the foundation for subsequent learning professional courses, basic courses are the specialized basic course for teachers. With the development of eras, basic courses are also evolving. Currently, the basic courses of primary education of new universities basically follow the courses of traditional secondary schools, such as Introduction to Education, Child Development Psychology and so on, but the new programs reflect the requirements of the times, such as Education Psychology, Educational Research Methods are fewer.
3. Professional courses focus on theory instead of skills. New universities are application-oriented universities, therefore, primary school curriculum system should also be consistent with the school's applied talents training target, in addition to help students with high professional quality and sustainable development potential through some theoretical courses (Lai, 2015), it should also try to highlight the status of skills courses, focus on the various skills of students to enable students to have a strong applicability. However, the study of primary education curriculum showed that the theory courses titled " primary school " accounted for an important part, the courses highlight the student skills are too few. Even in the implementation of courses, some skill courses are changed to theory coursed, such as music theory and sight-singing, and other very strong skills courses are arranged together in a large hall classroom, students of several classes stay in the same classroom, teachers often focus on theories.
4. Of the practice courses, the proportion of practice courses is low, the timing is too concentrated. Practice courses of curriculum system aimed at helping students to change the indirect knowledge learned from the class into practice through a series of practical activities, meanwhile, students can keep thinking as a participant to adjust personal learning, growth path, and then get professional development. Currently, the new universities practical courses include pre-professional military

Primary title	Training plan according to other	Frequency of usage	Combined with the item
The guiding ideology	Guiding ideology, principles, or fundamental principles	3	3
Professional introduction or training characteristics	Professional introduction	2	12
	Professional code and name	6	
	Similar professional	1	
	Training characteristics	3	
Training goal	Professional training target, training target	35	35
Cultivating specification	Cultivation requirements, specific requirements, business requirements and develop basic requirements	20	39
	Cultivation specifications, business specifications, basic specifications	16	
	Specifications or basic specifications	3	
the main subject	Subject areas, the main subject	3	9
	The main course, main course, core curriculum	6	
Graduation requirements or get a degree	Educational system, academic year, semester, length of schooling	21	84
	Awarded the degree or degree	15	
	Get a degree or the degree requirements, graduation conditions	11	
	Study demands or course study, professional requirements	9	
	Total credit or credit, credit, credit of lowest of graduation of requirements, graduate credits	3	
	Period or the total hours	24	
The curriculum or teaching plan	The curriculum, the curriculum system	26	74
	Curriculum structure proportion	19	
	Credits proportion	16	
	School proportion	3	
	Teaching plan or teaching lesson plans or schedule or the teaching process	1	
	Education teaching time schedule arrangement or teaching activities	9	
Practical teaching link	The main practice teaching links, focus on practical teaching link, concentrated practice teaching link, the main practice	7	7
Course introduction	Main course introduction, professional course description, description	17	17
Training mode	Basic training mode, training mode, or professional training mode	4	13
	Teaching mode	6	
	The main measures for professional training	3	
minor	minor	21	21
Others	Professional skills training project schedule	23	40
	Major professional experiment	10	
	For guidance or instructions	7	

Table 1 – 36 training project main content words and frequency statistics

Statistic element	The specific content	Normal university	Normal college	Comprehensive university	Comprehensive college	Independent colleges	Total
Professional knowledge	Basic knowledge of education in psychological science	5	1	3	2	5	16
	Primary education theory and professional knowledge	15	10	6	2	4	38
	Teachers' knowledge of laws and regulations	1	2	9	5	__	17
	Knowledge of primary education policies and regulations	2	6	__	3	3	14
	Primary education research trend	4	__	2	__	9	15
Professional ability	Conservation capacity	9	3	5	3	6	27
	Teaching ability	8	9	8	6	1	32
	Education ability	4	8	7	__	4	35
	Organization and management ability	5	4	3	9	2	23
	Ability to communicate	2	3	6	2	9	22
	Education for teaching and scientific research ability	10	__	9	1	1	21
	Children education products design, development ability	11	2	__	2	2	17
Professional quality	Professional ideal and faith	__	1	__	7	10	18

Table 2 – 36 primary education undergraduate professional training scheme "to cultivate specifications" content breakdown statistics

training, school labour practices, mainly in winter and summer social practice and practice courses. Among them, the professional practice courses to form the students' teaching ability have small number of classes, and the time schedule is unreasonable. Practical courses generally include professional trainee and internship. Professional trainee usually should be finished within three years, most schools arrange once every year, 1 to 3 days and up to 1 week once. Most professional practice is arranged at the last semester, usually for 6 to 8 weeks, the two are added up to about 8 to 10 weeks. This timing is both concentrate and small-quantified, it has not got rid of the shackles of the traditional university training objectives. Furthermore, the new pre-professional teachers of new universities mostly grew up with the training of the traditional teacher-cantered mode; they are still instilling knowledge and theories, lack of practice awareness.

2.2. Lack of communication between various courses and communion

Currently, primary education curriculum system of new universities has a same problem in terms of both setup concepts and specific implementation, they do things by their own ways, tell their own stories, lack of communication and communion between each other. For example, for the course structure, general education courses, academic foundation courses, professional courses and comprehensive courses four modules or each course put too much emphasis on their own independence (Lai and Li, 2014), ignored the logical relationship among each other, lack of proper communication and dialogue (Abreu et al., 2015); for the course content, too much emphasis are put on the systematic disciplines of knowledge, ignored the mutual support of the theory and practice discipline, lack of the combination of curricular and extracurricular. Which led to the students be lack of comprehensive quality, competence and other issues.

Course category	Course structure	The number of school	Number of categories
Two types	General education courses, specialized courses	3	3
Three types	1. General classes, specialized courses and practice	11	12
	General courses, subject courses, professional class	1	
Four types	General courses, subject courses, professional class, the teacher education curriculum	2	13
	General courses, subject courses, specialized courses and practice	5	
	General class, the teacher education courses, specialized courses and practice	6	
Five types	General courses, subject courses, specialized courses, practice, teacher education curriculum	14	14
Totle	A total of 4 kinds of classification methods, seven kinds of curriculum structure	42	42

Table 3 – 36 primary education undergraduate professional training curriculum structure statistics

3. Suggestions for primary education curriculum system of new Universities

Courses are the specific of training objective; curriculum structure determines the structure of the quality of teachers. Primary school of new universities should pay attention to both the high-quality, high-level requirements of students and solid foundation and professional discipline, so as to form the development power of the field, besides, the students' ability and skills structure as the future primary teachers should also be considered. Therefore, following assumptions can be made for pre-school curriculum of new universities:

3.1. Broaden the general education curriculum

General education curriculum refers to the university general education curriculum corresponding to the professional education courses. It focuses on shaping the overall quality of students, building the sound knowledge and ability structure, expanding knowledge background and capacity base. According to the current situation of that general education courses of primary education in new universities are mainly the political theory courses belong to the social science and English, computer courses and other tools, while, the humanities and natural science courses students need so as to be future teachers are few, universities can take comparative advantages of multi-disciplinary, multi-disciplinary to expand curriculum categories, add the humanities, natural science courses for selective courses to gradually achieve the combination of humanities and science literacy for students.

3.2. Put more new programs in basic courses

Professional Basic Courses are the basic courses of teacher's profession, so the new courses adapt to the times should be selected on the condition of guarantee the basic, systematic premise for the "Foundation" curriculum philosophy. Even the traditional academic foundation course content should be focused its time and cutting-edge.

3.3. Enrich professional courses and strengthen the integration of theory and skills

If the general education curriculum and basic curriculum subjects are roots and trunk, then the curriculum are branches and leaves. On the rich, solid foundation of general education courses and professional basic courses, setting up professional courses with a large number of categories students can highlight professional features of students, broaden students' employment options, and broaden their growth horizons. Professional courses are the core curriculum of primary school teachers' profession. It can be divided into professional basic courses and professional skills courses. Professional basic courses emphasize the students' ideas of children education and the knowledge of education. Professional skills courses should emphasize the formation of professional skills of primary school teachers. The implementation of these two types of courses should aim at the application of professional knowledge and skills in educational practice, for the promotion and integration of knowledge and skills. Such as: guiding students to use comprehensive practical activities expertise what they have learned in school to design primary school activity arrangement;

use primary school psychology expertise learned to design children activity management, family counselling strategies; use primary school activities design expertise they have learned to design integrated primary school and other activities to enhance students' professional accomplishment, help students with orbit professional development.

3.4. Increase the proportion of Practice Course

Practice activities is not only the way for primary students to connect the theory with practice, but also an important part to shorten the distance from dream of students to the reality. Therefore, practical courses should be throughout the entire learning process of students, and the proportion of Practical Course should be increased. First, increase and rational allocate the time of Practical Courses. Education probation time can be extended to one week from the old symbolic 1 to 3 days for every year. The first semester of each academic year students should be organized to practice for one week in different types of primary school to lay a good foundation for the follow-up study and research of students; educational practice time can be extended to 10 to 12 weeks from the previous six to eight weeks, it can be arranged respectively in the 6th and 8th semester to ensure students with adequate educational opportunities to practice, and time for students to go over the knowledge, skills and personal development growth. Second, enrich content of Practical Course. Increase the content to know the nature outdoors. Organize students to go out of the campus, go into nature, understand nature, cultivate awareness of students to love nature, respect nature, protect nature, form the scientific view of nature harmonious development between man and nature to lay a good foundation for future students to develop science education in primary school. Second, increase the form of practical courses. Allow students to form a group and go into the primary school for scientific research; organize students to conduct social surveys on primary education hotpots and difficult problems; ask students to observe local primary school in winter and summer vacation. New universities Primary Education should use their brains for brainstorming, build types, content-rich practice curriculum.

3.5. Achieve the communication and communion of various courses

According to the integrity and unity of New Universities Primary Curriculum system, mutual communication and communion during the construction and implementation of the curriculum must be considered. First, the relationship of the general education curriculum, discipline basic courses, professional courses and practical courses should be clear. Second, the various courses should mutually support each other on the content, theoretical courses, skills courses, practical courses should be interdependent, in the specific implementation, theoretical courses are derived of practical courses derived skills, and study of skills courses and practice courses should be guided by theoretical courses, so that theory and practice, curricular and extracurricular can be combined to reflect the high-level and application of personnel training.

4. Conclusion

In order to build New Universities Primary Curriculum system, it is necessary to consider not only the type of colourful courses, but also the flexible curriculum implementation;

not only the relative independence of each course, but also the similarities of the various courses; reflect not only the overall development of students, but also the individual differences of students, only in this way, can a harmonious and unified curriculum system be established.

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EGG signals recognition based on LMD and relevance vector machine

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Abstract: This paper is aimed to realize the automatic extraction and recognition of Electrogastrographic (EGG) signals. Firstly, empirical mode decomposition (EMD) algorithm is used to decompose the original signal. After reconstruction, denoised EGG signals can be obtained. Then according to the characteristics of the waveform modal, local mean decomposition (LMD) method is utilized to extract feature further. The method of reducing wave data dimensionality with fractal dimension is applied, reducing the amount of feature data greatly. Finally, RVM classifier is selected to analyze the processed feature data of EGG signals, realizing the automatic recognition of EGG signal. Experimental results demonstrate that this algorithm needs less feature data but gets higher recognition rate than other related methods.

Keywords: EMD, LMD, RVM, EGG

1. Introduction

Electrogastrogram (EGG) is the electrogastrographic signals recorded from the surface of stomach by surface electrode. EGG will reflect the condition of the gastric electrical activity, providing some clinical diagnosis value (Rosana, 2001). Deriving from the signal source in organs, it is highly susceptible to noise interference, like slight movement during breathing and measurement process, electrical activity of small intestine or the heart, etc. The waveform can't be utilized directly without processing due to its low signal-to-noise ratio. In the time-frequency transform theory, for non-stationary signal, wavelet transform or HHT is used to process original signal. Reconstruction is helpful to obtain the data having less noise but representing gastric electrical information better. Then a variety of intelligent algorithms for processing EGG signals are used to complete the classification of gastric electrical information with a computer, facilitating the clinical diagnosis by doctors.

2. Denoising and reconstruction of EGG signals

The raw and unprocessed signal is shown in figure 1. Due to the low signal-to-noise ratio, the waveform can't be utilized directly without any processing. A common practice is using wavelet transform or HTT method to process and obtain the reconstructed signal.

Given the deficiencies in reconstruction with wavelet signal in (Norden, 2003), EMD is adopted to reconstruct the signal in this algorithm.

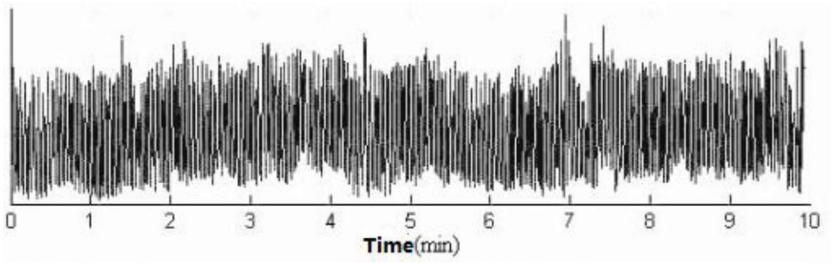

Figure 1 – The raw EGG signals

2.1. Introduction on EGG signals

2.1.1. Category of EGG signals

The main frequency of gastric electrical signal for a normal person is relatively stable. A gastric electrical record may be composed of signals with normal frequency or dysrhythmia. Patients with dysrhythmia often undergo the motor disorder of stomach. Dysrhythmia of the stomach includes tachygastria, bradygastria and arrhythmia (shown in table 1), which can be connected with the motor disorder of stomach and corresponding clinical symptoms together in (Shah and Rodriguez, 1999).

Components	Freq(cpm)	
Normal	2.0~4.0	Max.freq.of constraction
Tachygastria	4.0~9.0	Absence of constractions
Bradygastria	0.5~2.0	Controversial
Arrhythmias	-	Motility disorder

Table 1 – Frequency zone and its clinical value

2.1.2. Noise sources of EGG signals

Theoretically, EGG signals can be captured and diagnosed by the expert and have a good effect on the patient diagnose. Actually, EGG signals will be affected by other signals' interference in the acquisition process. Because they are weak, making separating them from the noisy weak signals become a challenging problem. The main interference sources of EGG signals are: respiratory noise, friction noise between electrode and the skin, the city noise and electrical activity from other organs. The recording instruments will filter out some noise when recording EGG signals. But most of EGG signals belong to low-frequency components, having weak energy and poor quality. Without processing

with powerful signal analysis tools, EGG signals can't be used for clinical diagnosis directly. The main noise sources are shown in Table 2:

Components		Freq(cpm)
Signal	2.0~4.0	0.5~9.0
Noise	Respiration	12~24
	Small Bowel	9~12
	Motion Artifacts	Whole Range

Table 2 – Main noise sources of EGG signals

3. Feature extraction based on LMD and fractal dimension for EGG signals

Local mean decomposition (LMD) is also a decomposition algorithm in nature, which is evolved from EMD. LMD has the advantage of decomposition, while EMD is dominant in signal reconstruction. The algorithm proposed in this paper will adopt HTT method to implement decomposition and reconstruction, but apply LMD decomposition algorithm when extracting features (Wang et al., 2009).

3.1. Brief introduction about LMD

LMD, which is proposed by Smith in (Jonathan, 2005), has taken good results when it used for processing EEG signals. LMD is evolved from EMD. Wang Yanxue made a thorough comparative study from solving local mean, calculating instantaneous frequency, decomposing component and filtering performance. LMD solves the issues of overshoot, undershoot faced in EMD, and complete solving instantaneous frequency and decomposing signal simultaneously (Norden, 1998; Gonçalves et al., 2015). The flow chart of LMD is shown in figure 3.

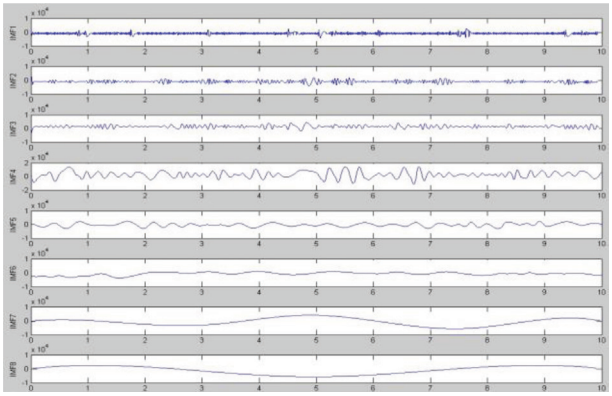

Figure 2 – The EMD decomposition after eight IMF component

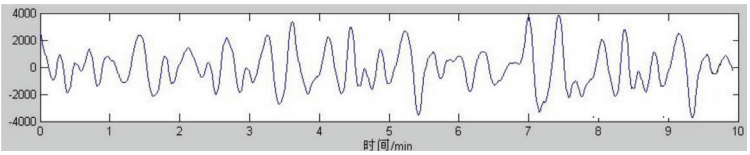

Figure 3 – The EMD reconstruction after eight IMF component

3.2. Decomposition of EGG signals based on LMD

After obtaining the denoised EGG signals, certain analysis can be done to determine which category the EGG signal belongs to. From figure 2, the resulted waveform has a large amount of raw data. In order to facilitate the calculation, the waveform data must be handled properly in advance. Unlike the general algorithms which reduce the dimensionality using the combination of PCA and LDA, LMD is utilized to reduce the dimensionality according to the characteristics of the waveform data in this section. The processed signal after LMD is shown in figure 4:

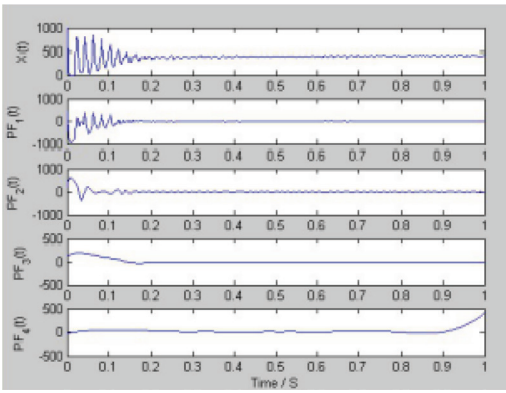

Figure 4 – Waveform after LMD processing EGG signals

3.3. Feature representation of EGG signals based on fractal dimension

In order to describe the decomposed waveform further and classify the EGG signals easily, this algorithm uses fractal dimension algorithm proposed by Katz (Kartz, 1988), to process the waveform obtained by decomposing the EGG signals, thus obtaining the fractal weft of sub waveform. The definition of fractal weft is as follows:

Where L is the total length of signal waveform curve, namely the distance summation between two points. d is the distance between the first point and another point who has the maximum distance in the sequence, namely d=max(dist(s1-s2)). n=L/a is numbers of steps of signal waveform, a is mean distance of two successive points.

After solving the fractal dimension from the above sub waveform, five eigenvalues will be obtained from every EGG signal sequence. Meanwhile, by solving fractal dimension from the raw signal, a 6-dimensional feature vector X=[x1, x2 .... x6] will be gotten.

Classification of EGG signals based on RVM

The common classification algorithms are ANN, KNN, SVM, etc. SVM is a famous algorithm based on a small amount of samples. While RVM, proposed by Tipping, can overcome the following shortcomings of SVM in (Branco et al., 2016):

1. RVM can get a probability prediction. Sometimes we wish to get a probability distribution of possible values under one classification result.
2. RVM doesn't need a given error parameter C. In SVM, C has a great influence on the outcome and it must be tried a variety of possible values to achieve a good result.
3. RVM is faster in processing large-scale data than SVM.

Meanwhile, some domestic literature has done some comparisons on the classification accuracy and time consumption between SVM and RVM. RVM has more sparsity than SVM, making it have faster speed but the same accuracy with SVM, especially suitable for on-line learning and rapid diagnosis, improving the efficiency of equipment and training the classifier rapidly when new samples are imported. The theoretical model of RVM which is on the basis of Bayesian framework can be as follows:

$\{x_i\}_{i=1}^{N}$ is the eigenvalue in the training set, $t=[t_1,t_2,...,t_n]^T$ is the desired value. Assume t_i is a Gaussian distribution whose mean value is y:

$$\mathrm{p}(t_i)=N(t_i\,|\,y(x_i;\omega),\sigma^2);\ y(x;\omega)=\sum_{i=1}^{M}\omega_i k(x,\ x_i)+\omega_0 \tag{1}$$

Where $K(x,x_j)$ is the kernel function, ω_j is weight. To acquire the sparse solution, make ω_j become the Gaussian distribution with mean value 0, namely:

$$p(\omega_i\,|\,\alpha_i)=N(\ \omega_i\,|\,0,\alpha_i^{-1}) \tag{2}$$

The likelihood function of training sample set is:

$$p(\mathrm{t}\,|\,\omega,\sigma^2)=(2\pi\sigma^2)^{-N/2}\exp\left[-\frac{1}{2\sigma^2}||t-\Phi\omega||^2\right] \tag{3}$$

Where $\mathrm{t}=(t_1,...,t_N)^T$ and $\omega=(\omega_1,...,\omega_N)^T$. Φ is a matrix whose rows are corresponding to the responses acquired from all the kernel functions to the input x_i.

From the priori probability and likelihood distribution theory, the weight's posterior probability distribution calculated by Bayes formula is:

$$p(\omega\,|\,\mathrm{t},\alpha,\sigma^2)=\frac{p(\mathrm{t}\,|\,\omega,\sigma^2)p(\omega\,|\,\alpha)}{p(\mathrm{t}\,|\,\alpha,\sigma^2)} \tag{4}$$

And this distribution is a Gaussian distribution with multivariable:

$$p(\omega \mid \mathbf{t}, \alpha, \sigma^2) = N(\mu, \Sigma) \tag{5}$$

Where $\Sigma = (\sigma^{-2}\Phi^T\Phi + \boldsymbol{A})^{-1}$ is the covariance, $\boldsymbol{A}$ is the diagonal matrix of $(\alpha_0, \ldots, \alpha_n)$, $\mu = \sigma^{-2}\Sigma\Phi^T\mathbf{t}$ is the mean value.

The likelihood distribution of desired value can be acquired by integrating the weight variables:

$$p(\omega \mid \mathbf{t}, \alpha, \sigma^2) = \int p(\mathbf{t} \mid \omega, \sigma^2) p(\omega \mid \alpha) d\omega \tag{6}$$

The marginal likelihood distribution of hyper-parameters is:

$$p(\mathbf{t} \mid \alpha, \sigma^2) = N(0, C) \tag{7}$$

$$\text{Where } C = \sigma^2 I + \Phi A^{-1}\Phi^T \tag{8}$$

The maximum posteriori estimate of weights is determined by the hyper-parameters α and noise variance σ^2. And the estimate $\hat{\alpha}$ and $\hat{\sigma}^2$ are calculated by the maximum marginal likelihood distribution. The posterior distribution expresses the uncertainty of the most optimum weight or the prediction model. At a given input value $\boldsymbol{x}^*$, corresponding probability distribution is:

$$p(\mathbf{t}^* \mid \boldsymbol{x}^*, \hat{\alpha}, \hat{\sigma}^2) = \int p(\mathbf{t}^* \mid \boldsymbol{x}^*, \omega, \hat{\sigma}^2) p(\omega \mid \mathbf{t}, \hat{\alpha}, \hat{\sigma}^2) d\omega \tag{9}$$

The above formula belongs to Gaussian distribution:

$$p(\mathbf{t}^* \mid x^*, \hat{\alpha}, \hat{\sigma}^2) = N(y^*, \sigma^{*2}) \tag{10}$$

The predicted mean value and variance can be calculated by the following formulas:

$$y^* = \mu^T \Phi(\boldsymbol{x}^*) \qquad \sigma^{*2} = \hat{\sigma}^2 + \Phi^T(\boldsymbol{x}^*) \sum \Phi(\boldsymbol{x}^*) \tag{11}$$

5. Experimental results

After gathering the EGG signals and recognized by more than three doctors who confirm the same result, we obtain 800 data sets containing 20 persons with 4 classes (slow, fast, disorder, normal). Each class has 10 waveforms for 20 minutes. Seven EGG records of each class in every person are taken as training data set, the rest three records are testing data set. The following three methods were used to extract features:

1. Morlet wavelet is used to decompose the original EGG signals. A 16-dimensional feature vector will be constituted by solving the fractal dimension of the decomposed wavelet waveform.
2. After decomposing the original EGG with EMD, a 8-dimensional feature vector will be formed by solving the fractal dimension of the decomposed wavelet waveform.
3. Process the decomposed EMD wavelet with Hilbert transform, and use the method put forward in section 2 to get a 6-dimensional feature vector.

RVM is used to train and test the above three kinds of feature data respectively. Three algorithms are: Morlet+RVM, EMD+RVM, EMD+LMD+RVM

The final recognition rates of the three algorithms are shown in figure 5:

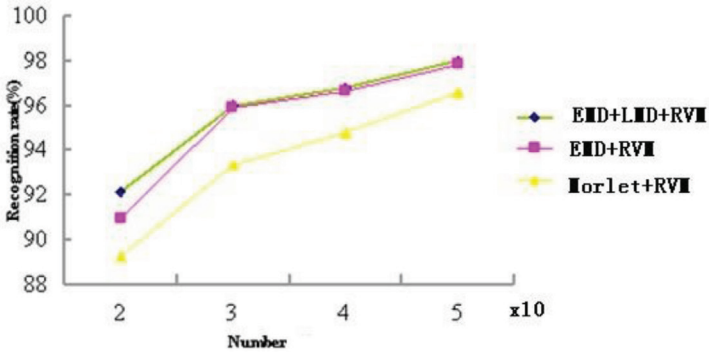

Figure 5 – Results analysis

From Figure 5, using Morlet to extract feature will get the lowest recognition rate. While employing EMD and LMD to accomplish feature extraction can get the highest recognition rate. Applying EMD to extract feature will get a middle recognition rate. Experimental results demonstrate that EMD is more efficient in denoising than wavelet transform. Because LMD has a less amount of feature data than Morlet and EMD, LMD has a faster speed. Also the algorithm of reconstructing original signal using EMD to remove noise and extracting feature with LMD, applies a minimum data (6-dimension) but gets the highest recognition rate. All these show that the proposed method is feasible and effective.

Conclusion

The purpose of this paper is to realize the automatic extraction and recognition of EGG signals. In this algorithm, EMD is firstly used to reconstruct to obtain the denoised EGG signals, then LMD and nuclear identification method are utilized to extract feature and reduce the dimensions respectively, finally RVM is selected to process the feature data to accomplish the auto analysis of EGG signals. This paper introduces the method of reconstructing gastric electrical with EMD, uses LMD to do further feature extraction especially for the characteristics of the waveform modal. Then the combination of the

kernel discriminant dimensionality reduction makes the amount of feature data reduced greatly. In the last phase, to achieve the automatic recognition, RVM is used to analyze the processed feature data of EGG signals. Comparisons with other methods show that this algorithm maintains high recognition accuracy but less time consumption when dealing with EGG signals with small samples.

The reconstructed signals acquired by EMD decomposition filter noises better, solving the problem of baseline drift. LMD algorithm avoids the overshoot caused by decomposed signals when used for classification. RVM classifier will get a high recognition precision and improve the response speed, which is contribute to real-time online monitoring.

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Research on Chinese Word Segmentation Based on Matrix Restraint

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Abstract: The recognition of word segmentation and disambiguation are the vital factors of the precision of information retrieval. This paper proposes a Chinese word segmentation algorithm with the restraint matrix based on the grammar and the semantic. The algorithm improves the accuracy of word segmentation by combining morphology and syntax from language situation. The input of continuous character bunch can be segmented and output the word bunch cut apart, and then obtain a dictionary. After that use the Modern Chinese Grammar Information Dictionary carry on the processing. Experimental result shows that the accurate rate of the segmentation can be enhanced to about 6.7%.

Keywords: Chinese word segmentation, matrix restraint, disambiguation, system of word segmentation

1. Introduction

According to the report of the meeting held in Boston in April 2000, the 5th Annual Meeting of the search engine pointed out, the number of pages has been more than 10 billions. Internet has become the largest information repository and how to use the computer to extract useful information from the web effectively and quickly is kept to be the exploring issues. Although the search engines can help users to find the information they need in a broad array of network information, the ever-changing nature of language bring great difficulties in understanding natural language for computer and also for the effective retrieval of search engine. Chinese automatic segmentation is one of the key technologies of the search engines, especially for the processing applications of a great mass of information. Based on Chinese word segmentation based syntax and semantics of the constraint matrix Chinese word segmentation algorithm and design and a segmentation system. This thesis proposes an algorithm of Chinese word segmentation based on the constraint matrix of syntax and semantics on the basis of the technology of Chinese word segmentation, designing and realizing a segmentation system.

2. Background Knowledge

2.1. The Concept of Chinese Participles and Words

By definition of the Rules of the Information Processing of Chinese Word Segmentation: Word is "the basic unit of the determined semantic or grammatical function used for Chinese information processing, including the specification of rules defined of the words and phrases". Word is also the smallest language ingredients with independent activities and also an important knowledge carrier and basic operating unit of the natural language processing system. Chinese word segmentation is the process of the text word boundary by computer recognizing automatically; it is the most important part of the Chinese information processing. Segmentation can regroup the continuous sequence of words to the process of word sequences according to certain specifications (Nazzi, 2014). Recognized Chinese word belongs to the context of natural language processing techniques and a part of the understanding of the semantics of the process and derives the composed core word for the semantic analysis module. How to improve the accuracy and speed of the word is a key issue in the field of information processing during the segmentation process.

2.2. The Methods of Chinese Participles and Words

The existing segmentation algorithm is divided into three main categories: (1) mechanical segmentation, basing on the matching techniques of dictionary and thesaurus; (2) word frequency statistics, basing on the lexical frequency statistics; (3) intelligent key lexical technology, lying in the understanding of knowledge. The basic idea of the a mechanical sub-lexical: first create a thesaurus, give the string Chinese character word, cut the substring word in some way, continue cut the rest stars if the substring word match a dictionary word, otherwise the substring is not a word and re-cut to the Chinese character string to give the substring match. According to the direction of the word, a mechanical sub-lexical is divided into maximum matching method, reverse maximum matching method, least syncopation, two-way matching, and signs segmentation method, etc. Generally, the accuracy of the reverse maximum matching is higher than that of maximum matching, which the error rate of maximum matching is 1/132, while the reverse maximum matching is 1/245. Take a two-way matching method can take the advantages of both sides and get the best results. Currently, this algorithm has been used in most of the segmentation system.

Word frequency statistics is built on the basis of the mathematical theory of probability, whose basic idea is: to reflect the credibility of the word based on the adjacent probability between words, make the statistical tabulation from the probability of combination of the word adjacent and calculate their mutual information. Mutual information is defined as follows formula:

$$\mathrm{I(A,B)}=\log\frac{P(A,B)}{P(A)P(B)} \tag{1}$$

Wherein, P (A, B) represents the probability of A and B that Chinese character string appears at the same time. P(A) is the probability of the character string A, P(B) is the probability of a character string B. Assuming the number of occurrences of A and B in

the Chinese character string are respectively n (A), n(B), n(AB), n is the total number of the set Frequency, then

$$P(A,B)=\frac{n(A,B)}{n}, P(A)=\frac{n(A)}{n}, P(B)=\frac{n(B)}{n} \quad (2)$$

There are formulas that set a field value in advance, and if I(AB) is greater than the set threshold, the A, B is a word, otherwise it can't be cut into words. It's also called sub-lexical dictionary as a dictionary need not use in this word segmentation method.

Besides these mainstream algorithms, there are some other segmentation algorithms with their own strengths, such as syntax analysis, artificial neural network method and dictionary sub-lexical, etc.

2.3. The Difficulties of Chinese Participles and Words

Although modern Chinese participles have made a great progress, The Chinese is totally difficult and cannot easily adapt to human's thoughts and have further development. So we are supposed to have a full views above all kinds of difficulties, which are included with "standards of participles and words, ambiguities distinguish and unlisted words distinguish.

The standards of participles and words: The biggest problem in Chinese participles and words is the concept of words is confusing. What kinds of words can be called participles? It's hard to answer. Among the Table Sound Words, they are defined by the tradition and have no questions of standards of participles and words. The Chinese written words are united by the words and is the kind of ideograms, which has no strict limitations and form changing. Therefore, there are special difficulties in Chinese participles and words.

Ambiguities distinguish: ambiguities distinguish refers to a special sentence has many segmentation methods and different method has different meanings. So it leads to combinational ambiguity and cross ambiguity. The important problem of Chinese participles and words is how to select a correct result from the Chinese sentences through the legal word sequences. This is called ambiguities distinguish.

Unlisted words distinguish: Unlisted words refer to the words aren't included in the dictionary but can be called "words". Unlisted words include the new general words, technical nouns and so on. Chinese words system is an open system. With the time goes by, it is changing continuously. So more new words can be produced. In order to syncopate the Chinese sentences correctly, the Chinese words system is required to have to ability to distinguish the unlisted words.

3. Identification of Chinese Word Segmentation Ambiguity

Chinese is a very complex language and difficult for computer to understand, the unambiguous identification is one of the keys. The generation of Chinese word segmentation ambiguity mainly has two types: combination ambiguity and overlapping ambiguity. The combination ambiguity means that the part of a word is a complete word, such as "the People's Republic of China", "China", "People" and "Republic" are separate words, but their combination is also a word. The overlapping ambiguity word

refers to the overlapping parts of the two adjacent, such as “he is to study the way of life”, “graduate” is a word, “life” is a word, they reuse the same word. Study shows that overlapping ambiguity is a key point of generating ambiguity, which accounting for about 90% of the entire word ambiguity.

3.1. Segmentation Field of Overlapping Ambiguity

Definition 1: Segmentation field of overlapping ambiguity (intersection field), a string $T=a_1, a_2... a_n$ is not word, $a_1, a_2... a_n$ as an individual Chinese characters, if exists in the integer $i_1, i_2...i_m$ and $j_1, j_2... j_m$ (m or 2), it meets: (1) $Y_1=a_{i1}... A_{j1}$, $Y_2=a_{i2}... A_{j2}$,..., $Y_m=a_{m1}... a_{jm}$ is made into words respectively, and T does not contain the words that present in Y_1, Y_2, Y_m;(2) Y_1, Y_2, Y_m constitute cross with each other, i.e., $1 = i_1< i_2<= j_1<j_2$, $i_2<i_3<=j_2<j_3$, $i_3<i_4<=j_3<j_4$, 。。。 $i_{m-2}<”i_{m-1}<=j_{m-2}<j_{m-1}$, $i_{m-1}<i_m<=j_{m-1}<j_{m=n}$. Then the field T is called intersection type of the ambiguity segmentation fields (referred to the intersection field).

Definition 2: In the intersection field $T=a_1, a_2... a_n$, $Y=a_i... a_j$ is a clause of T, and it meets: (A) Y is the word, (B) T does not include the words that present in Y, then Y is called an intersection factor of T.

Definition 3: The biggest intersection type of ambiguity that cut molecular section (maximum intersection field) set $T = a_1, a_2... a_n$ is the any string, $T=a_i... a_j$ is a clause of T (1<=i<j<=n), and T1 is the intersection type of ambiguity segmentation field. If T does not contain the intersection type of ambiguity segmentation field that bigger than T1, it says the T1 is the biggest intersection type of ambiguity segmentation field of T (hereinafter referred to as the biggest intersection field). Of course, also there exists a true ambiguity.

Definition 4: In the intersection field $T=a_1, a_2... a_n$, $Y_i=a_i... a_j, a_{j+1}... a_k, a_{k+1}...$ al is a clause of T, $Y_j=a_{j+1}... a_k, a_{k+1}... a_l$ is a clause of T, $Y_j=a_{j+1}... a_k$ is a clause of T, then T is the true ambiguity, and Y_i, Y_j are the true ambiguity field of Y. For example: “the way of life” can be cut into “graduate/live/mode and also “research/life/way”. “life” here cannot be judged as a word if there is no related context sentence. In the real text, most of the intersection field belongs to the uprising of a machine form and it is false ambiguity from the point of view of person.

3.2. The Biggest Intersection Field Classification

Definition 5: Ste the largest intersection string $T = a_1, a_2... a_n$ the intersection factor of an are: $a_{i1}... a_{j1}$, $a_{i2}... a_{j2}$,... , $a_{im}... a_{jm}$, $(1=i_1<i_2...<i_m, j_1<j_2...<j_m=n)$, then T can be classified according to the position of the intersection factors in T. The T macro structure can be obtained and denoted: $(i_1, j_1 - i_1 + 1)$ $(i_2, j_2 - i_2 + 1)$... $(i_m, j_m - i_m+1)$. The first digital in the bracket represents the enlightenment position of the corresponding intersection factor in T, and the second number indicates the length of the intersection factor. For example: the macro structure type of “what is the character set” denoted (0, 2) (2, 2) (3, 4) (4, 2), the macro structure type of “life”denoted (0, 2), (1, 2).

Definition 6: The two macro structure W_1: (i_1, k_1) (i_2, k_2)... (i_m, k_m), W_2: (j_1, l_1) (j_2, l_2)...(j_m, l_m), called $W_1> W_2$. If there is: $1\le x\le m$, $1\le x\le n$, $k_1 =l_1$, $i_2+k_2=j_2+l_2$..., $i_x+k_x=j_x+l_x$, $i_{x+1}+k_{x+1}\rangle j_{x+}1+l_{x+1}$.

To illustrate the rationality of the classification processing type of ambiguity, two concepts needed: static frequency and dynamic frequency of the biggest intersection field.

Definition 7: Set the complete works of the maximum intersection field (section type) for I = {T_1,..., T_i,... , T_n}, among which, the occurrence number (period of time) of the field Ti in the corpus is Freq (T_i),and make C is the collection of some maximum intersection fields (sets of section $_{type}$). C = {T_{i1},..., T_{im}}, C is defined about static frequency and dynamic frequency of I as formula.

Static frequency=, and dynamic frequency is 2.

Wherein, |C| and |I| represent the size of the set respectively. Perruchet (2014) according to the distribution of the intersection field type, the macro structure is more concentrated, which makes it's possible for the classification processing. The collection of the biggest intersection field set by cutting the Chinese character string is the premise of the classification processing, which use the method of testing gradually from head to deal with the string, dividing them into the single biggest intersection field, and then extract the maximum intersection field gradually.

3.3. The Principles of Chinese Participle Algorithm Design

The size of particle size is the bigger the better: the text segmentation which is used to semantic analysis is required to be of a bigger particle size. Analysed because the bigger it is, the amount of the words it is included and can express its meaning more exactly (Katharine, 2015). For instance, "the president of the student union" can be divided into "the student union" and "president". But also can be divided into "student" "union" and "president". These three methods are all correct. But when we analyze these three methods form the semantic analysis point of view, the first one is the best among the three methods.

Recognized the words in result of segmentation should use non-dictionary words the more the better and use the single character dictionary words the less the better (Li, 2015). Also studied the non-dictionary words here refer to the words which aren't included in the dictionary. And the single character dictionary words can be used independently, such as "owned", "did", "and", "you", "I" and "he" (Qiu, 2015). For instance, "technique and service" can be divided into "technique and serve task" and "technique" and "service". The word "service" cannot be found in the dictionary, but the word "and" can be used independently. So between the two words "technique and service", there is a non-dictionary word but the words "technique" and "service" are independent words. So we use the later one.

Recognized the total number of words in participle is the less the better. In the condition of the same total of words, the number of dividing words is the less the better (Kurumada, 2013). The less it can be, the semantic elements it includes, it can be more important and exact.

3.4. The Standards of Chinese Participle Algorithm

The aim of Chinese participle algorithm system is to establish an open and general modern written Chinese participle algorithm system. Also studied the standards of automatic algorithm system are correct rate and speed.

$$\text{Correct rate of algorithm}\alpha=\frac{\text{Segmentate the number of words correctly}}{\text{total number of corpus}}\times 100\% \quad (3)$$

Correct rate of identifying unlisted words

$$\beta=\frac{\text{The total number of identifying words}}{\text{total number of unlisted words}}\times 100\% \quad (4)$$

Recall rate of unlisted words

$$\gamma=\frac{\text{total number of identifying unlisted words}}{\text{total number of unlisted words}}\times 100\% \quad (5)$$

Among these elements, the correct rate is of great importance. Recognized it is affected by the problems of ambiguity and identifying unlisted words. So how to select a proper algorithm model and to solve problems of ambiguity and identifying unlisted words is necessary to improve the correct rate of participle algorithm.

Presently, recognized there are some kinds of algorithm models which are often used. They are Word-based Trigram language Model, Hidden Markov Model, Expectation Maximization Algorithm and Noise Model and so on.

4. Text Word Matrix

4.1. Definition of A Text Word Matrix

Definition 8: if there is a length (word) for the M text, you need to select the n words of the characteristics of n-grams. Build a n m+n-1 mhatrix, and the discipline of matrix elements of the distribution is that: set the former n–k matrix elements of the kth line and the k-1 elements behind to 0.m elements in the middle array according to the order of the text of all words or punctuation. According to this rule, the matrix is the matrix of the text, and the concrete structure is as follows (Grigori, 2014):

$$\begin{pmatrix} 0 & 0 & \cdots & word_1 & word_2 & \cdots & word_{m-1} & word_m \\ 0 & \cdots & word_1 & word_2 & \cdots & word_{m-1} & word_m & \vdots \\ \vdots & \ddots & \ddots & \ddots & \ddots & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & \ddots & \ddots & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & \ddots & \ddots & \ddots & \ddots & \vdots \\ word_1 & word_2 & \cdots & word_{m-1} & word_m & 0 & \cdots & 0 \end{pmatrix}_{n\times(m+n-1)}$$

The structure of the text word matrix is shown in algorithm 1:

Algorithm 1: text word matrix construction algorithm

Input: text t{w1, w2, ...,wm }, the value of N in the Chinese language model to be screened.

Output: array of matrix representation of arr[n] [m+n-1], subscript starting from 1.

```
1: begin
2:   for each i: 1 to n
3:    for each j: 1 to n-k
4:        arr[i][j] = 0;
5:   end for
6:    for each j: m+n-k+1 to m+n-k
7:      arr[i][j] = 0;
8:    end for
9:    for each j: n-k+1 to m+n-k
10:     for each k: 1 to m
11:       arr[i][j] = t[k];
12:     end for
13:     end for
14:  end for
15: return arr;
16: end
```

According to the experimental study of Zhou and others, the Chinese text that have the best classification effect are 2-, 3-grams and 4-grams. In this paper, the generation of the word matrix is divided into three categories (Liu, 2013).The basic form of 2-grams matrix:

$$\begin{pmatrix} 0 & 0 & \cdots & word_1 & word_2 & \cdots & word_{m-1} & word_m \\ 0 & \cdots & word_1 & word_2 & \cdots & word_{m-1} & word_m & \vdots \\ \vdots & \ddots & \ddots & \ddots & \ddots & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & \ddots & \ddots & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & \ddots & \ddots & \ddots & \ddots & \vdots \\ word_1 & word_2 & \cdots & word_{m-1} & word_m & 0 & \cdots & 0 \end{pmatrix}_{n\times(m+n-1)}$$

The basic form of 3-grams matrix:

$$\begin{pmatrix} 0 & 0 & word_1 & word_2 & \cdots & word_{m-1} & word_m \\ 0 & word_1 & word_2 & \cdots & word_{m-1} & word_m & 0 \\ word_1 & word_2 & \cdots & word_{m-1} & word_m & 0 & 0 \end{pmatrix}_{3\times(m+2)}$$

The basic form of 4-grams matrix:

$$\begin{pmatrix} 0 & 0 & 0 & word_1 & word_2 & \cdots & word_{m-1} & word_m \\ 0 & 0 & word_1 & word_2 & \cdots & word_{m-1} & word_m & 0 \\ 0 & word_1 & word_2 & \cdots & word_{m-1} & word_m & 0 & 0 \\ word_1 & word_2 & \cdots & word_{m-1} & word_m & 0 & 0 & 0 \end{pmatrix}_{4\times(m+3)}$$

According to the theory of Chinese single and double word recognition: in Chinese text, more than 95% of the words are single and double word. By giving up a small number of multi - words, using a large number of single - and double - word to construct n-grams features, deform the basic form of the above word matrix (Sun, 2013).

4.2 Transformation of The Text Word Matrix

Definition9: the double word in the text T are constituted with two adjacent single words that arranged in the sequence of text (Goldberg, 2013). Assuming that there is a text $t\{w_1, w_2, ..., w_m\}$.

There are two forms of the double words in text T: $word_1\{(w_1w_2),(w_3w_4),.....,(w_{m-1}w_m)\}$ and $word_2\{w_1, (w_2w_3),(w_4w_5),...,(w_{m-2}w_{m-1}), w_m\}$. According to the nature 1.

Because of the unsless of the redundant words and the double words which have no semantic meaning in the process of combination (such as: “de ren” and “le mei”), so we filter the redundant elements and none semantic words by calculating the correlation of elements T, word1 and word2 in the collection to assure the constitute way of the single words in the text. in combination is finally determined a single word in a text in t. Correlation can be defined using the mutual information between elements and categories, and the computing method is shown in the formula 6,7 and 8:

$$r(w,c_i) = p(w,c_i)\log_2^{\frac{p(w,ci)}{p(w)p(ci)}} \tag{6}$$

$$\mathrm{avg}(w,c_i) = \frac{1}{m}\sum_{i=1}^{m} r(w,c_i) \tag{7}$$

$$\sigma(w) = \sqrt{\frac{1}{m}\sum_{i=1}^{m}(r(w,c_i)\text{-}\mathrm{avg}(w,c_i))^2} \tag{8}$$

$r(w,c_i)$ is the relationship between the single word(or a constituted double word) W and the categories. $avg(w,c_i)$is the average value of the correlation between W and each class. Sigma σ(w) is the final results.if sigma σ(w) value is large, indicating that W was only associated with one or few categories, and it has large contributions to the classification, be retained; if the sigmaσ(w) is small and less than the threshold value, then W and each class or most categories are related,and it is attibuted to the reduntant unrelated elements.

In the process of text word matrix transformation, we can obtain the set of correlation calculated values of every element in T, word1 and word2: $Vt\{v_1, v_2,.....\}$, $Vw_1\{v_1, v_2.....\}$, $Vw_2\{v_1, v_2.....\}$. To set smaller than the correlation threshold delta δ elements to 0, merge the three collections.

If the correlation value between v_1, and v_1 the correlation is greater than V_1, replace the w_1 in T with (w_1, w_2) in Vw_1 or Vw_1 in Vw_2. In the process Vw_1 and Vw_2 consolidate into Vt, there will be a conflict of the same location, so before the merger to compare Vw_1 and Vw_2 corresponding V value, take a larger correlation value.

In the merger, the non 0 elements V_k in V_{w1} and V_{w2} V_K are consolidated into the V_t,instead of the zero elements in the Vt or the elements whose correlation value is small.The calculation of the combined position of v_k in the V_t, as shown in the formula (9):

$$\mathrm{pos}(v_k)=\begin{cases} k\times 2-1 & (v_k\in V_{w1}) \\ (k-1)\times 2 & (v_k\in V_{w2}) \end{cases} \tag{9}$$

The specific transformation of the word matrix is shown in algorithm 2:

Algorithm 2: word matrix transform algorithm

Input: text t{w_1, w_2....., w_m},correlation threshold δ and n (the value will be screened in n-grams)

Output: arr (the representation form of the matrix elements after the transformation matrix) and arr_{value} (the representation form of the array of the value), subscript from 1.

1: **begin**
2: Combine the all single words in the text of the t{w_1, $w_{2,}$ ....., w_m} from front to back, and gain $word_1${(w_1w_2),(w_3w_4),.....,($w_{m-1}w_m$)} and $word_2${w_1, (w_2w_3), (w_4w_5), ..., ($w_{m-2}w_{m-1}$), w_m}
3: Calculate the correlation value, σ, of each element in the T, word1 and word2 .
4: **for each** i : 1 **to** m
5: **if** s (t[i]) < δ
6: V_t[i]=0 ;
7: **else** V_t[i]=s(t [i]);
8: **end for**
9: **for each** i : 1 **to** ?2 / m û
10: **if** s ($word_1$ [i]) < δ
11: V_{w1}[i]=0 ;
12: **else** V_{w1}[i]=s ($word_1$ [i]);
13: **end for**
14: **for each** i : 1 **to** ?2 / m û
15: **if** s ($word_2$ [i])< δ
16: V_{w1}[i]=0;
17: **else** V_{w1}[i] =s (word1[i]) ;
18: **end for**
19: **for each** i : 1 **to** ?2 / mû
20: **if** V_{w1}[i]> V_{w2}[i]
21: **if** V_{w1}[i]> V_t[i]
22: t[2i-1]=$word_1$[i];
23: V[2i-1]=V_{w1}[i];
24: **end if**
25: **else**
26: **if** V_{w2}[i]> V_t[i]
27: t[2i-2]=$word_2$[i];
28: V[2i-2]=V_{w2}[i];
29: **end if**
30: **end if**

31: **end for**
32: Using algorithm 1, Vt and T are constructed in the form of word matrix, and the ARR and arrvalue are obtained.
33: **end**

The transformed set is a single word and two word irregular rows: merge {(w_1w_2), (w_3w_4), w_4, w_5,..... }.The value of merge is the correlation value and the irregular arrangement of 0: V_m{v_1, v_2, v_5, 0,.....}.Through the method of text word ,matrix elements are combined to get the mixed matrix of single words and double words. In the case of 2-grams, 3-grams, and 4-grams, the representation of the deformation matrix is as follows:

After the transformation of 2-grams text word matrix, the representation form of the various elements of the matrix:

$$\begin{pmatrix} 0 & (w_1,w_2) & (w_3,w_4) & w_5 & w_6 & \cdots \\ (w_1,w_2) & (w_3,w_4) & w_5 & w_6 & \cdots & 0 \end{pmatrix}$$

After the transformation of 2-grams text word matrix, the representation form of the various elements value of the matrix:

$$\begin{pmatrix} 0 & v_1' & v_2' & v_5 & 0 & \cdots \\ v_1' & v_2' & v_5 & 0 & \cdots & 0 \end{pmatrix}$$

After the transformation of 3-grams text word matrix, the representation form of the various elements of the matrix:

$$\begin{pmatrix} 0 & 0 & (w_1,w_2) & (w_3,w_4) & w_5 & w_6 & \cdots \\ 0 & (w_1,w_2) & (w_3,w_4) & w_5 & w_6 & \cdots & 0 \\ (w_1,w_2) & (w_3,w_4) & w_5 & w_6 & \cdots & 0 & 0 \end{pmatrix}$$

After the transformation of 3-grams text word matrix, the representation form of the various elements value of the matrix:

$$\begin{pmatrix} 0 & v_1' & v_2' & v_5 & 0 & \cdots \\ v_1' & v_2' & v_5 & 0 & \cdots & 0 \end{pmatrix}$$

After the transformation of 4 grams text word matrix, the representation form of the various elements of the matrix:

$$\begin{pmatrix} 0 & 0 & (w_1,w_2) & (w_3,w_4) & w_5 & w_6 & \cdots \\ 0 & (w_1,w_2) & (w_3,w_4) & w_5 & w_6 & \cdots & 0 \\ (w_1,w_2) & (w_3,w_4) & w_5 & w_6 & \cdots & 0 & 0 \end{pmatrix}$$

After the transformation of 4-grams text word matrix, the representation form of the various elements value of the matrix:

$$\begin{pmatrix} 0 & 0 & 0 & v_1' & v_2' & v_5 & 0 & \cdots \\ 0 & 0 & v_1' & v_2' & v_5 & 0 & \cdots & 0 \\ 0 & v_1' & v_2' & v_5 & 0 & \cdots & 0 & 0 \\ v_1' & v_2' & v_5 & 0 & \cdots & 0 & 0 & 0 \end{pmatrix}$$

5. Matrix Constraint Method of Word Segmentation Technology

5.1. Matrix Constraint Method

Bhatti (2014) studied the basic idea of matrix constraint method is: first create a grammatical constraint matrix and a semantic constraint matrix, whose elements show respectively that whether the adjacent between enjoying the syntactical word and another syntactical word in compliance with the rules of grammar and the adjacent between belonging to a semantic kind word and another kind of word is logical or not. Machine finishes in the constraint of word segmentation when make the segmentation.

Set TCN = (T, C) is a string function, among which, T = $\{g_0, g_1, \ldots, g_{n-i}\}$, the geometric constraint words method matrix P = (p_{ij}) is a n order matrix and C is the Modern Chinese Grammar Information Dictionary. By definition, constraint matrix is a Boolean matrix and expresses the constraint condition of the constraint system. For the elements of the matrix pij, if the geometric entity inihas the corresponding constrained to the geometric entities in j, the elements of the value is 1; otherwise, the element value is zero. The constraint matrix can be generated according to the constraint network.

The grammar rules in the matrix use the Modern Chinese Grammar Information Dictionary and it is an electronic dictionary prepared for the realization of Chinese analysis and Chinese generation of computer. The dictionary has 32 database files, which contains the one head bank of all words, 23all kinds of word bank. In addition, the verb library sets up six depots and pronoun library sets up two depots. The head bank sets up 13 attribute fields, noun library sets up 27 attribute fields, verb library sets up 46 attribute fields and the total information of the whole library is up to 2520026. The storage space of the amount of information needed is about 16681B. The electronic dictionary is widely applied in the field of language information processing.

Similarly, use the same method for semantic constraint matrix and here the unnecessary details are no longer gave. Recognized semantic rules adopt the Modern Chinese Grammar Information Dictionary (SKCC), which is a semantic knowledge base of Chinese information processing finished at the end of 1998, containing the word 48835. It can provide strong support for computer semantic analysis (Freixo, 2014). It analysed use the grammar and semantic constraint matrix P to constraint every phrase that separated from the segmentation system, remain the same if it is 1, otherwise make the resegmentation until all the words are grammaticality constraint matrix.

5.2. Principles of Chinese Word Segmentation

Principle 1 Make words as far as possible, i.e. if the whole intersection field is a word, do not do the segmentation; otherwise make segmentation results as far as possible to put each part into a multiple character to constitute a word, try to avoid condition that the segmentation result is composed of multiple characters of the word.

Principle 2 Phrase and idiom first. If the waiting segmentation field contains phrases and idioms, try to ensure to make this part into words.

Principle 3 Conform to the grammar rules. Segmentation results must comply with the rules of grammar and the situation such as “adjective + verb” are not allowed.

Principle 4 Conform to the semantic rules. Segmentation results must meet the semantic rules and the obvious semantic errors are not allowed.

Principle 5 Positive maximum matching first, applying to the situation that appears several reasonable segmentations.

Although these principles are not strict, sometimes must depends on conditions and the situation of several principles can be used at the same time also appears when dealing with ambiguous field, which makes the system is more flexible to realize and facilitate to improve rules by dealing with the uncertain methodology in the future.

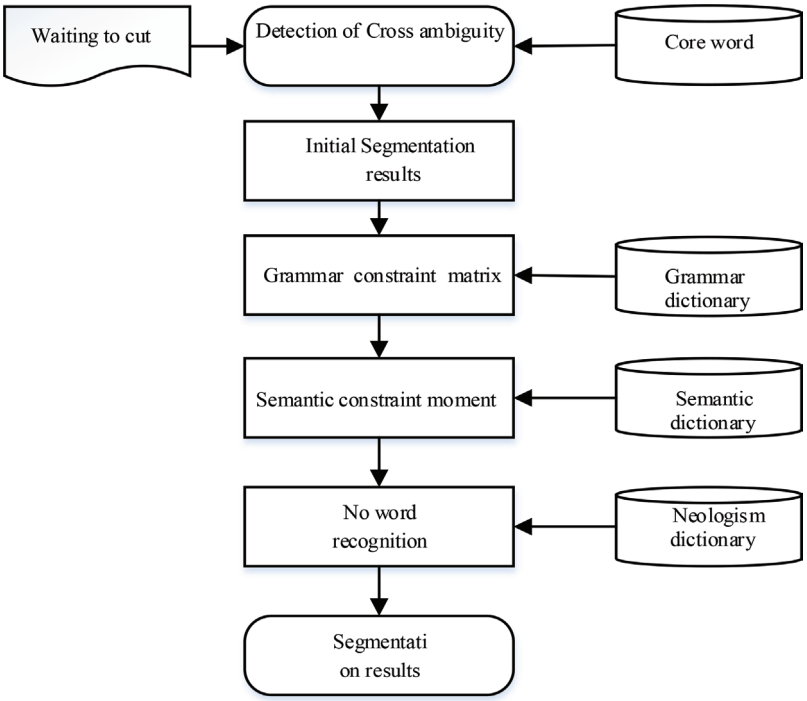

Figure 1 – Word segmentation system and the segmentation function module

6. Process of The System Segmentation

The basic process of word segmentation system as shown in figure 1. First pretreat the text flow with finite automaton (FSA), identify the English and Chinese digital with obvious characteristics (including the cardinal numbers, ordinal numbers, fractions, decimals, percentage, etc.), address name, date, person name, etc.; Then input pretreated segmentation text and obtain further segmentation results through the cross ambiguity detection of the core dictionaries and go into the next round of testing. Adopt the constraint by the grammar constraint matrix, if it's right, go to the next round, or make new segmentation. Use the Modern Chinese Grammar Information Dictionary through the semantic constraint matrix in the next round, if right, go to the next round, or resegmente. If the whole conform to the rules, recognize the unknown words by the new words in the dictionary, complete a segmentation after recognition and get the segmentation results. Practice proves that effect of the participle treatment is remarkable and the accuracy can be increased by 6.7% or so from the simulation results.

7. Conclusion

Word segmentation is the basis of a computer to process information and it's the inseparable participle either in the information retrieval or in text classification. The paper processes the Chinese word segmentation based on the Modern Chinese Grammar Information Dictionary and Modern Chinese Semantic Dictionary, inspect the segmentation results on the basis of the understanding of grammar and semantic and improve the ability of elimination ambiguity. In addition, the system introduces the constraint matrix, which improve the accuracy of segmentation system and has reference value for further Chinese information processing and information mining.

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Research on the Precise Design of Green Buildings Based on BIM Technology—taking the ecological sponge exhibition center of Yuelai new town of Chongqing City as an example

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Abstract: There exists disadvantages in conventional design of green buildings, like reverse design process, lack of profession cooperation, loss of information transmission, which results in the decrease of practical energy efficiency ratio. BIM technology runs through the full life cycle of buildings and bears the characteristics of realizing the coordination design and data concentration of different types of work and on single data platform, thus possessing the application value of aiding the precise design of green buildings and reaching predetermined sustainable target. This paper takes the green buildings in the ecological sponge exhibition center of Yuelai new town of Chongqing City and the collaborative design of BIM technology and makes further exploration on the application of BIM technology in the precise design of green buildings.

Keywords: BIM technology, green buildings, precise design.

1. Introduction

Since the issue of Evaluation Standard of Green Building in 2006, the development of green buildings has entered into the steady rising period. By the end of Dec. 31st, 2015, the total area of green buildings reaches 460 million $m^3$and altogether 3979 projects obtain the evaluation label of green buildings (China Society for Urban Studies, 2016). The State Council government work report of 2016 proposes that we are going to promote green buildings and building materials, reinforce the energy saving reconstruction of building and insist on green development and the strategic requirement of energy conservation and emission reduction in the 13th Five Year Plan (The State Council of the People's Republic of China, 2016). The development of the number of green buildings promotes related new technologies and new materials towards the maturity stage. Therefore, the design of green buildings will transfer from routinization to precision, thus realizing the enhancement in quality.

2. Difficulties in the Precise Design of Green Buildings

Green buildings emphasize the full life circle of design, construction, operation and maintenance and bear the characteristics of various fields, strong profession, high comprehensive integration and incremental cost (Liao et al., 2016). The complexity of the process for managing all of information related to this industry has resulted in tremendous inefficiencies, leading to massive money and time losses (Pereira-Rama et al., 2012). In precise design, restrictions will be posed by the following factors:

The first is that technical consultants, building material providers and specific technique manufacturers all need to participate in the design process, but the intervening time and definition of working of participants are ambiguous (Liu and Tian, 2014).

The second is the single and linear "reverse" process of first building design and last technology consulting, lacking collaborative design.

The third is that the feedback of each field is delayed. Problems like backward information transit mode, delayed transmission, severe loss and ineffective sharing of information lead to the design period extension (Fan and Zeng, 2015).

Meanwhile, existing design of green buildings adopt traditional two-dimension design and the defects are as follow:

The first is that precise and quantitative prospective analysis of specific index requirement like energy and water conservation of green buildings is difficult to conduct, resulting in the disjunction of design and implementation.

The second is that the space design of complex shape of green buildings cannot be expressed precisely, like irregular shaped members and curved curtain wall. It is very difficult to conduct precise localization of details, leading to the incomplete of design information.

The third is that the non-visual docking of technical drawings of different fields like pipeline collision can only be found until construction phase, resulting in reworking or redesign and the consumption of materials and personnel.

3. Advantages of Precise Design of Green Buildings Supported by BIM Technology

Building information modeling can achieve the full life cycle integrated management of buildings applying digital modeling technology; this modeling can provide new prediction methods, management mode, performance-based analysis and environmental monitoring method for the precise design of green buildings through the characteristics of visualization, simulation, optimization, drawable.

3.1. Perpetual Object

BIM technology focuses on the full life cycle of buildings, enhances the scientific and technical level of the planning, design, construction and operation of green buildings and supports the precise design of green buildings from four dimensions of project planning, material selection, project construction and post-stage operation.

3.2. Information Management

BIM model, as the carrier of building information, achieves the centralized management of each phase and each piece of profession information, which benefits the sharing of information and the checking of error, leakage, collision and loss, providing more intuitive data for sustainable design; the information extracted through the BIM model has integrity, veracity, consistency and controllability, making the information statistics of building materials and equipment more reliable, providing relevant reference for the calculation of incremental cost of green buildings and making the realization of green targets become more controllable; the rich information of design, production, construction, operation and maintenance in BIM model provides strong data support for the design and evaluation of precise design of green buildings.

3.3. Research Method

BIM model, as the foundation of simulation analysis of precise design of green buildings, brings forward the performance-based analysis of green buildings to the preliminary design phase of buildings and provides certain reference for architects in the comparison and selection, optimization and improvement of scheme, which benefits relevant decisions of green buildings (Editors of Green Building, 2016) and saves the modeling time of relevant performance analysis software greatly.

4. Project Overview

The ecological sponge exhibition center is located in the northeast of Yuelai new town of Chongqing City. The building land use is 17577 m², the capacity building area is 9993.58 m² and the building height is 21.15m, the function of which covers exhibition, experience, publicity and education. This center applied technical measures of ecology, intelligence and sponge bearing mountainous characteristics of Chongqing City in expectation to reach the three-star rating of national green buildings, becoming the landmark building taking "ecology, intelligence and sponge" as the theme of Chongqing City (Figure 1 and Figure 2).

Figure 1 – General Layout

Figure 2 – Aerial View

The altitude difference of land use of Yuelai ecological sponge exhibition center is 50m and the topographic slope mainly concentrates in 30%—50%. The complex terrain makes the rational utilization of land more and more difficult (Figure 3). Meanwhile,

this landmark building has complex architectural image, exterior elevation is irregular curved surface (Figure 4).

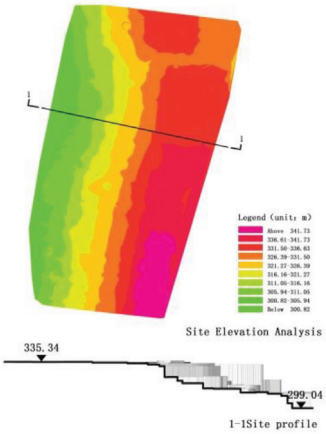


Figure 3 – Terrain Analysis of the Land

Figure 4 – Irregular External Elevation of Yuelai ecological sponge exhibition center

To reach the three-star rating design criterion of national green buildings, achieve the collaborative design of each field, formulate appropriate technology strategies for green buildings and express the modeling space of buildings precisely, the key and difficult point in this precise design of green buildings is the precise statistics of the utilization amount of all kinds of materials. Therefore, this research will adopt BIM technology to conduct precise design of green buildings on Yuelai ecological sponge exhibition center.

5. Technological Rout

The integrated design platform based on BIM technology can conduct the integration and optimization of traditional linear design process, clear the integrated design requirements of various professions and fields in green building design at the same time and establish logical structure.

5.1. Process of Collaborative Design

Bentley proposed the collaborative design, which is to complete the same design project following the same set of standard under the same environment for project members; in the design process, each profession is design concurrently, which guarantees timely and accurate communication. The structure of “taking

application as the core and modeling to complement” based on BIM technology transfers the “mixture” design of each profession to the “collaborative” design based on BIM platform (Figure 5), making the green buildings in Yuelai ecological sponge exhibition center concentrate on four elements of “people, mechanism, material, environment” to achieve the mutual participation of all professions.

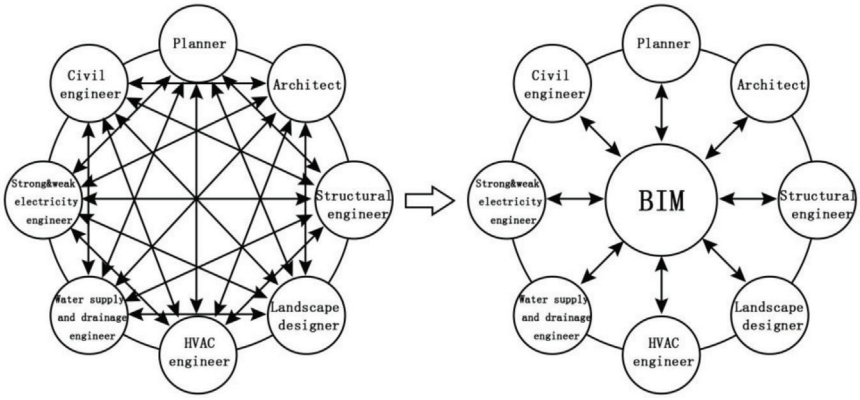


Figure 5 – Architectural Diagram of Transferring from "Mixture" to "Collaborative" Design

5.1.1. Assembling Green BIM Work Team

Speaking of the element of "people", we refer to the construction of green BIM work team. Profession green building design team need to be added in Green BIM team on the basis of original BIM team. Green BIM team consists of BIM director, profession engineers of building, structure, electromechanical, steel structure and curtain wall, green building designer director, and profession engineers of building materials, building environment, performance-based analysis and building energy conservation (Figure 6).

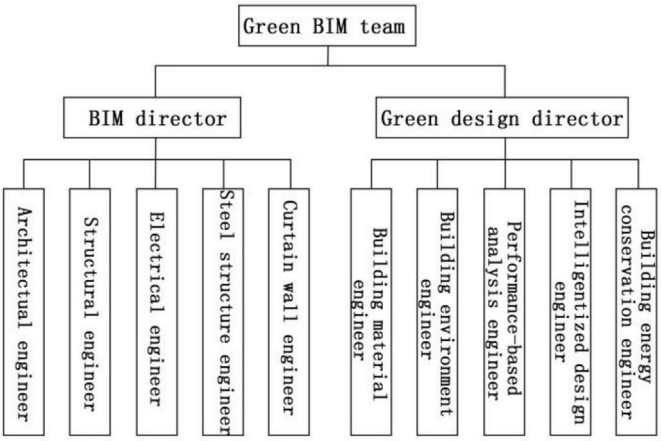


Figure 6 – Structure of Green BIM Team

5.1.2. Writing Green BIM Collaborative Manual

The element of "mechanism" refers to the establishment of supporting mechanism of green BIM application. Referring to the new working mode of collaborative design in the Guidelines of BIM Implementation Standard for Design Enterprise (BIM Research

Group of Tsinghua University, & BIM Research Group of is BIM, 2013). Compiled by the research group of Tsinghua University, supporting green BIM collaborative manuals are compiled according to the actual project requirement of Yuelai ecological sponge exhibition center to regulate the template, collaborative standards, model precision, data exchange standard, drawing standard of each profession of the BIM project execution plan (Wang and Liu, 2015). Each standard content of cooperative work is strictly formulated.

5.1.3. Building Green BIM Collaborative Platform

The element "material "refers to the software and hardware equipment needed in the building of BIM application. A platform should be built for the collaborative work of each profession, ensuring the real-time updating of all kinds of data. The green BIM collaborative platform consists of software platform and the sharing platform based on cloud computing and mobile Internet technology.

Revit collaborative platform is adopted at this time, including a series of Revit software like Revit Architecture, Revit Structure, Revit MEP and Navisworks and local secondary development is conducted at the same time. Based on BIM model, information is imported in corresponding green building software through format conversion to conduct performance-based analysis and optimization design, realizing the synergistic effect of design among each civil engineering profession. Meanwhile, the cloud collaborative management platform (Figure 7) consisting of data storage layer, access layer and palliation service layer is built to achieve the functions of document management,

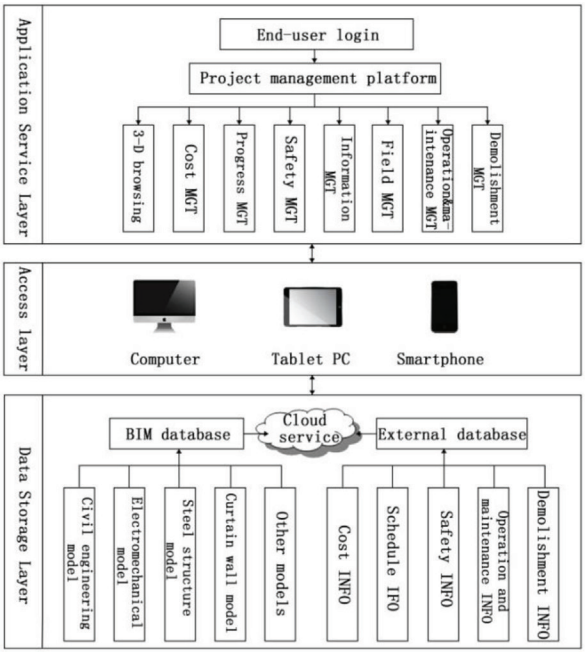


Figure 7 – System Frame of Collaborative Management Platform

task distribution and online browsing and realize the seamless joint among designers, owners and constructors. Each participant of the project conducts data access through computers, tablet PC and smartphones, logins the BIM cloud platform system through network access, user authentication and privilege management interface and makes inquiry and modification of the related information of the project (Table 1).

Project Participant	BIM Cloud Platform Operation Application
owner	record research information and establish basic project information database; manage the project schedule; inquire the project report; release and trace project events timely
designer	upload the BIM model recorded with design information; standardize drawing expression; check the discrepancy between design and obstruction information; statistics of change information
constructor	obtain revised design model; build details of construction model; upload the cost, schedule and security of the construction; manage project documents

Table 1 – BIM Cloud Platform Operation Application of Each Project Participant

5.1.4. Application of Green BIM execution Project

The element of "environment" refers to the construction of the project. In Yuelai ecological sponge exhibition center, green BIM platform is built and BIM model is established (Figure 8), conducting the collaboration of each profession and practicing the sustainable precise design target.

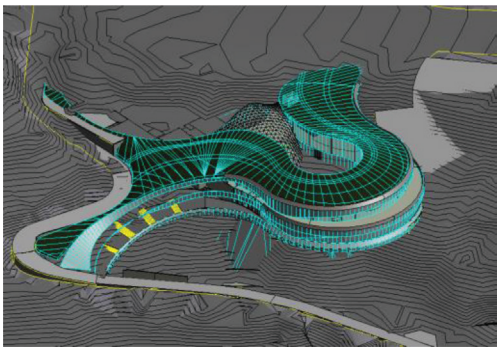


Figure 8 – Project BIM Model of Yuelai ecological sponge exhibition center

5.2. Application of BIM Technology

The core of BIM technology is the establishment of virtual 3-D model, applying digitalization technology to form the integrated, accurate and consistent information database containing full life cycle of buildings. Designers can conduct the recording and extracting of information on the center model at any time and can realize the exchange

and sharing of model information of each profession, which effectively solves the "fault information" of communication of each participant based on 2-D design mode in traditional design and the "information island issue" among application systems. Meanwhile, the related information extracted through the BIM model is beneficial for the proposal and implementation of green technical strategies, realizing the precise design requirements of green buildings.

5.2.1. Application of BIM Technology in Different Design Phase

Compared with the traditional design era of 2-D CAD, BIM model can provide better information carrier. Meanwhile, the co-movement of flat vertical profile design guarantees the integrity and reliability of information transmission at each phase. With comprehensive and integrated information system (Sá et al., 2012), BIM model contains rich spatial and temporal information (Yi and Wei, 2014). The complete engineering information description (Table 2) provides a good access point for the detailed building materials, device parameter, statistics details of each phase in the design green buildings.

Information Classification	Description of Engineering Information
design information	structure type, building materials, engineering performance, member size, fire rating
production information	product codes, type specification, functional application
construction information	construction procedure, schedule information, cost information, quality information, human resources, mechanical resources, material resources, engineering practice
operation &maintenance information	engineering security performance, durability performance of materials, replacement cycle, maintenance mode, service condition
associated information	engineering logic relationship among objects

Table 2 – Description Table of BIM Model Engineering Information

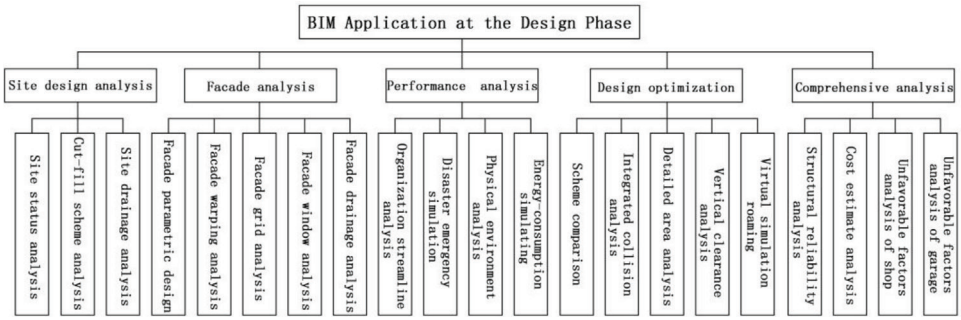


Figure 9 – Application of BIM Technology at the Design Phase of Yuelai Ecological Sponge Exhibition Center

To reach the goal of three-star rating of national green buildings, at the beginning of the planning, the Yuelai ecological sponge exhibition center adopted BIM technology to conduct the modeling, analysis and optimization of the scheme and applied visualized presentation (Figure 9) to cooperate with the goal of green buildings proposed at the beginning of the project, truly achieving the green BIM application at the beginning of the planning.

1. Schematic Design Phase

Propose green targets, establish initial model, complete site analysis, building performance simulation analysis, comparison and selection of designing schemes. In this phase, positioning and analysis at the scene is the main factor influencing the building layout and BIM model is applied to record related engineering information. Evaluation of the scene and surrounding conditions is conducted to organize transportation streamline and building layout. In this phase, BIM model can output some macro controlling parameters as the boundary conditions of the preliminary performance-based analysis of green buildings. Sustainable analysis tools are applied to conduct rapid evaluation of the energy consumption of different schemes, thus conducting the comparison and selection of schemes.

Two design schemes were proposed at the schematic design phase of Yuelai ecological sponge exhibition center, scheme 2 was selected to conduct detailed design after the comparison and selection of mould, plane layout, vertical design, ecological analysis, preliminary performance-based analysis (wind, light, heat, sound environment) (Figure 10).

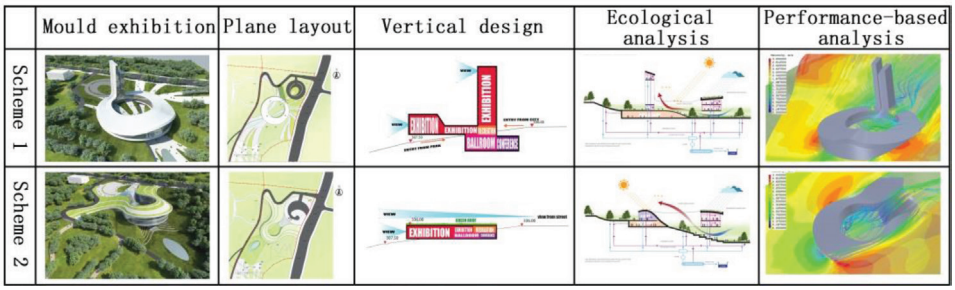
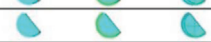
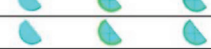


Figure 10 – Scheme Comparison and Selection of Yuelai Ecological Sponge Exhibition Center

Figure 11 – Several Rounds of Optimization of Yuelai Ecological Sponge Exhibition Center Scheme

2. Preliminary Design Phase

Perfect green targets, optimize BIM model, putting particular emphasis on various functions and performances of single building (Figure 11). In preliminary design phase, center model is established on the server-side; corresponding model information of each profession is recorded; ensure the integrity of data and information of the center model through collaborative sharing. The information contained in the BIM model is taken as the foundation of the performance-based analysis software of green buildings to conduct energy conservation design, sunlight analysis, energy efficiency evaluation, natural ventilation design, HVAC design and calculation and water supply and drainage calculation and analysis.

	Light spot area on indoor floor(m²)			Shadow effect contrast of direct sunlight with different sun-shading design	Building external sunshade shadow effect
Time	No sunshade	Horizontal sunshade	Integrated sunshade	No/horizontal/integrated sunshade	
08:00	85.98	54.81	0		
09:00	60.02	29.49	0		
10:00	45.55	15.14	0		
11:00	36.56	4.87	0		
12:00	27.89	0	0		
13:00	33.52	0	0		
14:00	87.95	0	0		
15:00	159.07	60.13	8.79		
16:00	247.01	155.62	47.89		
17:00	369.42	288.77	112.81		
18:00	579.15	516.05	234.09		

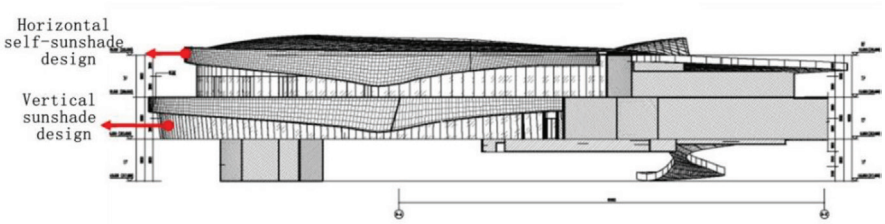


Figure 12 – Parameterized Design Sun-shading System of Yuelai ecological sponge exhibition center

After selecting scheme 2 to conduct detailed design, designers conducted several rounds of optimization design on Yuelai ecological sponge exhibition center combined with the design strategy of green buildings, applying BIM technology and parametrization design methods and taking performance-based analysis results into consideration. Based on the recorded local climate and building physical environment information, applying parameterized technology, conduct logical scheme modeling and adjustment and optimization of through parameter adjustment; meanwhile,

conduct rapid sunshine and daylighting calculation of buildings applying the built BIM model to guide the production of external shading members. Through the analysis, we can know that the control rate of direct solar radiation is 35% when designing horizontal shading; and the number is 75.5% when adding vertical design. Therefore, the mode of the combination of horizontal and vertical shading is applied (Figure 12). With the help of visualization, simulation, and coordination of BIM, functions of mesh generation, height detection, roof scheme adjustment, daylighting roof mesh generation, spiral stair setting-out and internal space analysis are completed and the precise design of building space is realized (Figure 13), thus completing the optimization of the selected scheme.

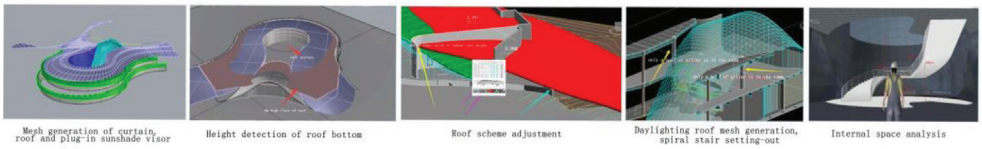


Figure 13 – Precise Design of Yuelai ecological sponge exhibition center

3. Construction Drawing Design Phase

Implement green targets and deepen BIM model. In this phase, detailed design of each profession is completed and material information, device parameters are recorded in detail. After the establishment of 3-D models of each profession, collision detection is conducted and optimization of devices and pipelines is conducted to reach the optimal condition of spatial layout. Meanwhile, in terms of steel structure, mechanical and electrical installation, BIM model is adopted to conduct detailed design. Problems may exist in the design are anticipated and detailed construction drawing and member list are generated, reducing material wastage and improving the material preparation rate of factories. Meanwhile, detailed member information is extracted from the BIM model, making it possible to do member prefabrication in other places and improving the return on investment of the whole project to a great extent (Harvey et al., 2015). The drawable nature of BIM technology can be utilized to complete the drawings of related professions. BIM model data is extracted based on different needs and each profession can form the evidentiary material according to the selected green building technology as the basis for green building evaluation.

4. Joint Point of BIM Technology and Green Building Design at Each Design Phase

At different design phases, the design information in BIM model can provide certain reference for relevant parameters of green building design, provide certain quantitative basis for the implementation of green building targets and effectively expand the application value of BIM in green building design at the same time (Table 3).

	BIM design information	Design parameter of corresponding green building	Analysis of BIM application value
scheme design	project information (project name, address, code, weather, surroundings); initial landform within site scope; outdoor ground and roads; architecture quantity and main fender members; outdoor pipeline layout and determination of equipment room position; outdoor mechanical equipment, structures; simulation survey and earth volume calculation (depth of modeling: LOD 100);	balance of excavation volume; reasonable orientation; shape coefficient; indoor natural ventilation; external sunshade; preliminary analysis of energy consumption; outdoor view; parking space; outdoor noise; outdoor wind environment;	(1)green building strategy and primary location; (2)performance analysis of green buildings, realizing the comparison and selection of plan and design schemes; (3)initial scheme is more scientific
preliminary design	outdoor design sites, roads and structures; building maintenance members and various indoor members: structure column, beam, floor layout and material type, stairs ramp, various vertical shafts, enclosure structure layout and material type (door, window, wall, roof); main function room and furniture layout; main room name and area; indoor and outdoor main pipelines, structures (location, size, material, depth); fire hydrant and pump room; water tank room and other equipment room; luminaire, electrical apparatus and the 3-D model of the device; air duct and its accessories; pipeline and its accessories; tuyere and 3-D modeling of air conditioning equipment; completing the collision coordination of each profession (depth of modeling: LOD 200);	barrier free design; structural optimization; ratio of green space; adjustable external sunshade; public auxiliary facilities; public transportation; outdoor permeable ground, outdoor wind environment; roof greening, vertical greening; reasonable rain scheme; rainfall runoff; indoor noise, member sound insulation; roof, east and west external wall internal surface temperature; indoor wind speed, humidity, temperature, air pollutant concentration, lighting coefficient; simulation analysis—wind, sound, light, heat, sunlight, energy conservation;	(1) conducting wind, sound, light, heat, sunlight, energy conservation simulation utilizing BIM model, verifying green building technology; (2) realizing modification of parameterized modeling technology, intelligent change of associated content; (3) integrated design of pipelines, find the error, leakage, collision, loss through the collision checking of each profession, reduce the reworking and waste of construction;
construction drawing design	detail design (local 3-D detail drawing); various detail statistic lists of building profession (usable area, curtain wall, total building area, room, material, area of fire compartment, enclosure structure); detailed design of steel structure (detailed information of member detailed drawing, detail node information, steel volume, number of high-strength bolt), detailed design of curtain wall (unit plate, embedded part, accurate positioning of keel); air duct, pipeline pressure loss report; water supply and drainage pipeline attachment detail list (name and type, size, number of measurement, manufacture factory, note); detail list of mechanical and electrical profession (electromechanical device, pipeline fittings, fire alarm equipment, lighting equipment, electrical equipment, electrical apparatus) (depth of modeling: LOD 300)	foundation basis; structural system; optimization of structural members; prefabricated member design; daily water consumption; pipeline leakage prevention; no overpressure of water supply; water-saving appliances; water-saving and cooling technology; high-strength reinforcement; ratio calculation of high-strength concrete; indoor lighting area ratio of window to floor, open area ratio of natural ventilation, welded steel, mechanical connection; usage of 3R building materials; content of harmful matter; usage rate of recyclable building materials; parameter of ventilation, air conditioning and illuminating system; per capita land area index; ratio of green space, per capita public green area; rational utilization of underground space; thermal performance of enclosure structure	(1) exporting civil engineering, detail statistical report by the BIM model as the evaluation basis for green buildings; (2) improve the drawing efficiency of construction drawing, ensure the consistency of flat vertical profile and effectively reduce the error of 2-D construction drawing; (3) conduct precise prefabrication and field installation of a large number of members through rich member information of the BIM, reduce the cost and improve the efficiency

Table 3 – Application and Value Analysis of BIM Model Information in Green Building Design Phase

5.2.2. BIM Technology Application of Green Building Performance-based Analysis

To create the optimal indoor and outdoor space and environment enjoyment, designers must conduct the performance-based analysis of various fields, which is a very important part in green building design. At the moment, various software is applied in the performance-based analysis of green buildings in China, and the modeling of each profession needs to be conducted again according to the design drawings to conduct software analysis, resulting in the problem of high talent cost in designing institutes. BIM model contains various member information of buildings, like material, weight and heat resistance, which can provide necessary parameters for performance-based analysis (Liu and Wang, 2015). Therefore, with the help of BIM model, it can be imported into related performance-based analysis software (Figure 14), which can conduct analysis and evaluation of wind, light, heat, sound environment of single building, saving the modeling time of each profession greatly and providing relatively accurate building information at the same time.

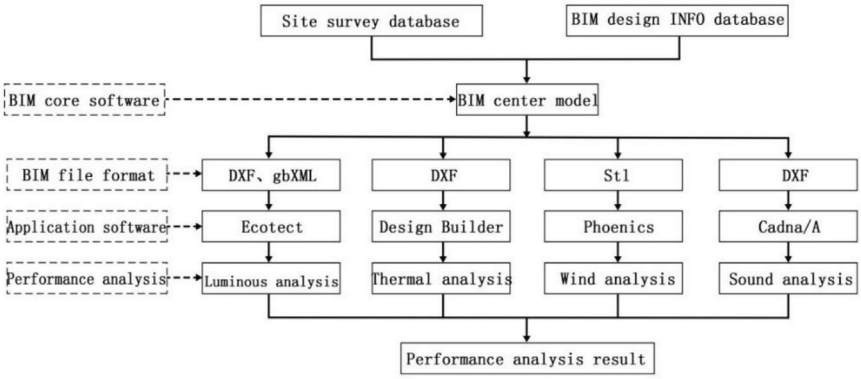
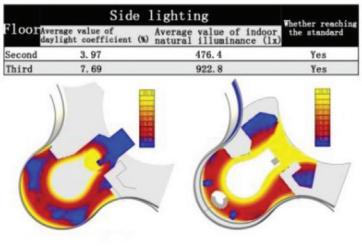


Figure 14 – BIM Technology Application Framework in the Performance-based Analysis

Based on engineering principles such as architectural physics, heat transfer theories (Amos et al., 2016; Halima et al., 2016; Seyed and Sadeghiazad, 2016), and fluid mechanics, the Yuelai ecological sponge exhibition center takes meteorological data, site characteristics, and engineering costs as boundary conditions, and uses advanced computer simulation software and analysis method based on a BIM model to achieve main goals such as green building, energy conservation, environmental protection, high quality, and high cost effectiveness, thereby realizing quantification and visualization of technology application effects.

Analysis of luminous environment: export files in a DXF format from the BIM model; import the files in Ecotect software; and perform simulation analysis for light environment on main function rooms on second and third floors to obtain average lighting coefficient values, 3.97% and 7.69%, and obtain standard illuminance values of indoor natural light, 476.4lx and 922.8lx, which meets design standards for indoor lighting (Figure 15), where the average lighting coefficient values and the standard illuminance values are corresponding to the main function rooms on the second and third floors. During design of a parking garage, natural lighting of a sunken square is adopted in some

area of the parking garage. In addition, measures of using medium transparent glass, whitewashing an inner wall, or the like are adopted to improve lighting environment. An average lighting coefficient value and a maximum lighting coefficient value of the garage are obtained by means of Ecotect analysis, where the average value is 2.09%, and the maximum value is 40.4%. Most parking area and roadways have a poor lighting condition. To achieve a comfortable lighting environment, five sets of D530 light guides are used in the design for aided lighting (Figure 16).



Side lighting			
Floor	Average value of daylight coefficient (%)	Average value of indoor natural illuminance (lx)	Whether reaching the standard
Second	3.97	476.4	Yes
Third	7.69	922.8	Yes

Figure 15 – Daylight Analysis of Main Function Rooms in the Second and Third Floor

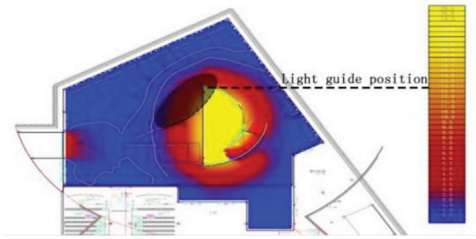


Figure 16 – Daylight Analysis of Garage

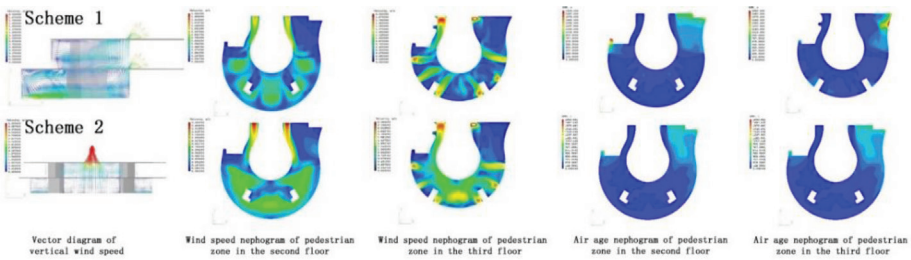
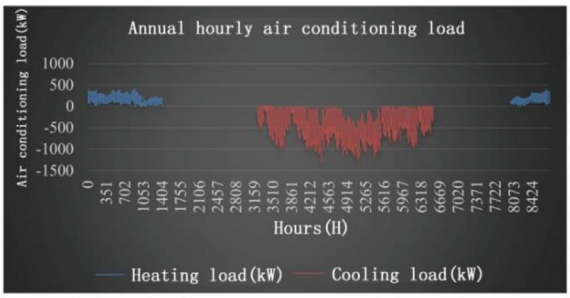


Figure 17 – Wind Environment Simulation Analysis

Analysis of wind environment: Yuelai ecological sponge exhibition center forms the natural ventilation flow in transition seasons and promote the natural ventilation in transition seasons through southwestern floor openings and opening design of louvers inside the atrium building. Simulation comparative analysis is conducted on these two ventilation schemes utilizing Phoenics software (Figure 17) and we can obtain that the

average wind speed of the second floor is between 0.1 to 0.8 m/s and the number is 0.1 to 2.0 m/s in the third floor. The ventilation effect in the pedestrian zone is relatively uniform and both schemes can meet the requirements of indoor natural ventilation. However, scheme 2 has the risk of pollutants upward and downward flowing.

Thermal environment analysis: based on the regional characteristics of Chongqing area, Yuelai ecological sponge exhibition center conducts the design of ground source heat pump. Energy consumption simulation software Dest is adopted to conduct annual hourly air conditioning load analysis (Figure 18). Comprehensively considering the annual thermal balance of the soil and the annual efficiency of generator units, rational unit matching is conducted: the ground source heat pump screw unit with the heating capacity of 339KW and the cooling capacity of 387KW and the screw chiller with cooling capacity of 1135KW. The load in the winter is all provided by the ground source heat pump and the 35% of the load in summer is provided by the ground source. In the whole year, provided by the ground source is responsible for 39% of air conditioning load.



Project statistics	Unit	Statistic
Total air conditioning area	m²	6634.05
Project load statistics		
Annual maximum heating load	kW	370.9
Annual maximum cooling load	kW	1396
Annual maximum humidification	kg/h	97.86
Annual cumulative heating load	kW.h	141764.11
Annual cumulative cooling load	kW.h	993047.48
Annual cumulative humidification	kg	333.14
Project load area index		
Annual maximum heating load index	W/m²	56.7
Annual maximum cooling load index	W/m²	214.20

Figure 18 – Annual Hourly Air Conditioning Load Analysis of Yuelai Ecological Sponge Exhibition Center

6. Difficulty in the Collaborative Design of BIM Technology and Green Buildings

Through this research, we can discover that the combination of BIM technology and green buildings holds a distinct superiority, but there still exist some technical difficulties in solely utilizing green BIM to solve the design of full life cycle. Developmental researches need to be conducted on the cooperation between BIM model and performance-based analysis software.

7. Conclusions

China started to implement the new version of Evaluation Standard of Green Buildings since 2015 and the BIM technology was taken as innovation plus. Meanwhile, the Guidance of Promoting the Application of Building Information Model Technology issued by Shanghai also specifically proposed to enhance the research on integrative development of BIM technology, green buildings and construction industry, establish the BIM technical application system meeting the design and construction requirements

of prefabricated buildings and improve the simulation analysis software level based on BIM technology(Shanghai Urban and Rural Construction and Management Committee, 2014). Thus it can be seen that the collaboration between BIM technology and precise design of green buildings has gradually been brought into the official system. Therefore, it can be the key to solve the energy consumption constraint to actively explore rational green design strategies and realize the green management of the full life cycle from the beginning of the planning to the construction and maintenance utilizing the combination of the two. Global energy consumption and intensifying greenhouse effect severely hinders the optimal physical environment building of green buildings. Therefore, we should actively explore the computing method of carbon emission based on BIM (Guo Rongjun,Liu Jingdong, & Wang Xiwen,2014), improvement measures of green building indoor air quality based on BIM(Wu Dongdong,2015)and achieve the real-time monitoring of carbon dioxide concentration and pollutants in the air, which will effectively reduce energy consumption and create high quality spatial feeling. Meanwhile, the depth and breadth of precise deign of green buildings based on BIM technology will be upgraded continuously with the practice of BIM technology in new construction of green buildings and green revamping of existing buildings (Autodesk Company,2009).

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Comparative Study on Three-dimensional Reconstruction of Wheel Surface by FTP and WTP Methods

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Abstract: Among three-dimensional (3D) reconstruction methods based on phase distribution, Fourier Transform Profilometry (FTP) has the shortage of phase extraction on complicated surface because of spectrum aliasing. To improve 3D reconstruction accuracy in abrupt area, complex Morlet Wavelet Transform Profilometry (WTP) based on ridge detection is studied. To compare the comprehensive performance of 3D reconstruction of FTP and WTP on complex surface, peaks function is simulated and validated, experiments and analyses have been down on train wheel with two orthogonal artificial cracks. The results show that those two methods can well reconstruct the whole 3D surface of wheel and get detailed information of crack in width and in depth. For wheel tread area with flat surface, FTP method is better because of smooth surface reconstruction and processing efficiency, but for wheel flange area with abrupt surface and high reflectivity, WTP method is better because of its multi-resolution.

Keywords: Fourier Transform Profilometry; Wavelet Transform Profilometry; sinusoidal fringe projection; three-dimensional reconstruction; phase extraction.

1. Introduction

It is a common way to achieve 3D measurement by inspecting phase displacement of fringe projection. In this method, optical fringe is projected on the surface of object, the variation of surface leads to a deformed fringe, which causes a displacement of fringe phase. Capturing and processing the deformed fringe image, extracting the phase displacement, then the surface distribution can be calculated.

Among 3D measurement methods (Chen et al., 2000) based on phase displacement extraction, Fourier Transform Profilometry (FTP) (Chen et al., 2005) has the characteristics of high accuracy and fast processing speed, and only a single frame of image needed to achieve 3D reconstruction. But for complex surface object, because the frequency filter window in FTP is fixed (Li et al., 2009), it can't get an accurate phase displacement extraction because of frequency spectrum aliasing (Bu et al., 2003).

An improved method called Window Fourier Transform (WFT) (Lei et al., 2010) is put up by Gbaor. It can solve the problem of spectrum aliasing to some extent, but the frequency filter window only has single resolution (Qian et al., 2008).

Wavelet transform is a time-frequency analyses method, which has multiple resolutions, and can detailed analysis signals with high resolution in time domain or space domain.

In recent years, wavelet transform (Zhong et al., 2004) is introduced into 3D Profilometry and it highly promotes technical development in this filed (Colonna et al., 1997).

To improve phase extraction accuracy on area of abrupt surface, complex Morlet wavelet transform Profilometry based on ridge detection theory is studied in this paper (Carmona et al., 1997). To quantitative assess reconstruction accuracy of FTP [Paolo et al., 2001] and WTP methods, peaks function is simulated and a train wheel is tested and analyzed, where the train wheel has flat surface as well as abrupt surface (Heng et al., 2004). By comparative analyzing the 3D surface reconstruction accuracy in the whole wheel and the detailed part of wheel tread, a better solution is recommended.

2. Principle of 3D reconstruction of phase extraction

2.1. Principle of FTP Method

In Figure 1, axis x is perpendicular to fringe, and axis y is parallel to fringe. Optical fringe is respectively projected on the reference plane and the object in the frequency of f_0. Then light intensity distributions of fringe images captured by camera are shown in Eq. (1) and Eq. (2).

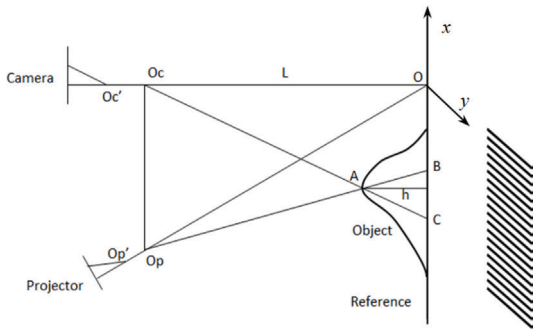


Figure 1 – Optical path of FTP methods

$$g_0(x,y) = \alpha(x,y) + r_0(x,y) \times \cos(2\pi f_0 x + \phi_0(x,y)) \tag{1}$$

$$g(x,y) = \alpha(x,y) + r(x,y) \times \cos(2\pi f_0 x + \phi(x,y)) \tag{2}$$

Where $\alpha(x,y)$ is light intensity of background, $r_0(x,y)$ and $r(x,y)$ are reflectivity of reference plane and the object, $\phi_0(x,y)$ and $\phi(x,y)$ are fringe phase of reference plane and the object.

Doing Fourier transform on each row of the fringe image to get spectrum distribution described in Eq. (3) and shown in Figure 2, where n is spectrum series.

$$G(f_x,y) = A(x,y) + \sum_{-\infty}^{\infty} Q_n(f_x - nf_0, y) \tag{3}$$

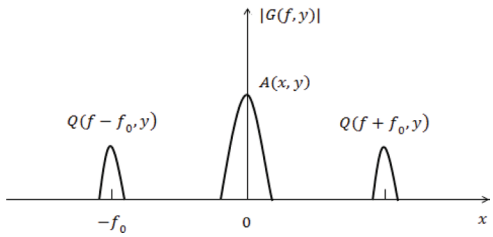


Figure 2 – Spectrum distribution of fringe image after Fourier transformation

Band filtering on spectrum of deformed fringe image to get fundamental frequency component, then doing inverse Fourier transform to get light intensity distribution corresponding to fundamental frequency, which is described in Eq. (4).

$$g'(x,y) = r(x,y) \times \cos(2\pi f_0 x + \phi(x,y)) \tag{4}$$

Light intensity distribution of reference fringe image corresponding to fundamental frequency can be got in the similar way, as described in Eq. (5).

$$g_0'(x,y) = r_0(x,y) \times \cos(2\pi f_0 x + \phi_0(x,y)) \tag{5}$$

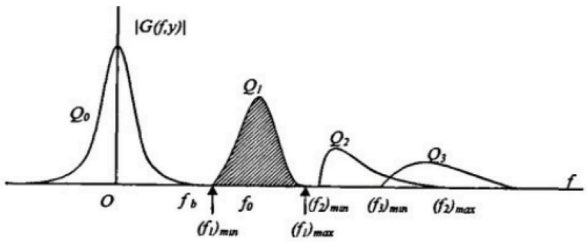


Figure 3 – Spectrum expanding and aliasing caused by abrupt surface or noise

From Eq. (4) and Eq. (5), $\phi(x,y)$ and $\phi_0(x,y)$ is extracted by doing inverse trigonometric transform, and phase displacement between reference plane and the object is obtained by Eq. (6).

$$\begin{aligned}\Delta\phi(x,y) &= \phi(x,y) - \phi_0(x,y) \\ &= \arccos[\frac{g'(x,y)}{r(x,y)}] - \arccos[\frac{g_0'(x,y)}{r_0(x,y)}]\end{aligned} \tag{6}$$

But abrupt surface or noise will lead to a spectrum expanding and aliasing, which will reduce phase extraction accuracy.

Since the phase displacement is truncated to $[-\pi, \pi)$, as shown in Figure 4. Phase unwrapping must be done to get the continual phase displacement.

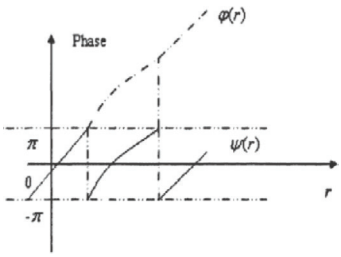


Figure 4 – The truncated phase and its unwrapping

It is known from Figure.1 that $\Delta\phi(x,y) = 2\pi f_0 \times \overline{BC}$, and $h(x,y) = (L \times \overline{BC}) / (d + \overline{BC})$ is deduced from similar triangles of ÄABC and ÄAO$_p$O$_c$, so the height distribution of object comparing to the reference plane is deduced as Eq. (7), then the 3D surface of the object can be reconstructed from $h(x,y)$ (Ricardo et al., 2004).

$$h(x,y) = \frac{L \times \Delta\phi(x,y)}{2\pi f_0 d + \Delta\phi(x,y)} \tag{7}$$

2.2. Principle of WTP Method

Wavelet is a new signal analysis method in time domain, which is constructed by scaling and shifting from mother wavelet in Eq. (8), where a is scaling factor, and b is shifting factor.

$$\psi_{a,b}(t) = \frac{1}{\sqrt{a}}\psi(\frac{t-b}{a}) \qquad a,b \in R;(a>0) \tag{8}$$

Apply one-dimensional Continuous Wavelet Transform (1D-CWT) on function $f(t)$ by Eq. (9), where $W_f(a,b)$ is called wavelet transformation coefficient, which shows the similarity between wavelet and $f(t)$ in the local part. When the frequency of wavelet is closed to the signal, the amplitude of $W_f(a,b)$ is larger.

$$W_f(a,b) = \frac{1}{\sqrt{a}} \int_R f(t) \psi^*_{a,b}(t) dt \tag{9}$$

Wavelet analysis has the advantages of multi-resolution. It can also be applied to complex spatial signals analysis. WTP is a 3D reconstruction method by applying wavelet analysis on fringe image to improve phase extraction accuracy.

Apply one-dimensional Continuous Wavelet Transform (1D-CWT) along x axis on one row of fringe image by Eq. (10). The width of wavelet transform window will change according to scaling factor a .

$$W_g(a,b) = \frac{1}{\sqrt{a}} \int_R g(x) \psi^*_{a,b}(x) dx \tag{10}$$

The amplitude and phase of wavelet transformation coefficient is calculated by Eq. (11) and Eq. (12).

$$A(a,b) = \sqrt{[\mathrm{Im}(W_f(a,b)]^2 + [\mathrm{Re}(W_f(a,b)]^2} \tag{11}$$

$$\phi(a,b) = \arctan[\mathrm{Im}(W_f(a,b) / \mathrm{Re}(W_f(a,b)] \tag{12}$$

When the frequency of wavelet is closed to the local frequency of the image analysised, the amplitude of $A(a,b)$ is larger. The location where $A(a,b)$ reaches to the maximum value along the scaling direction is defined as ridge of CWT, as shown in Eq. (13).

$$ridge(b) = \max[A(a_i, b)] \tag{13}$$

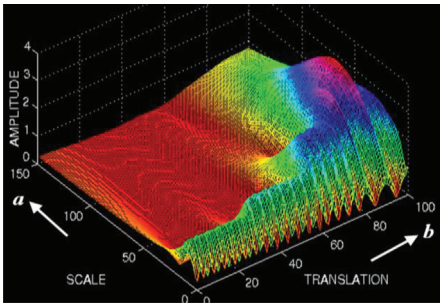


Figure 5 – Amplitude of wavelet transformation coefficient by 1D-CWT

The value of the scaling parameter a contributing to the ridge is the fittest window width, which is named as a_{ridge} . Put a_{ridge} and b into Eq. (13), then phase of ridge is obtained by Eq. (14).

$$\phi(a,b)_{ridge} = \arctan[\frac{\mathrm{Im}(W_f(a_{ridge}, b))}{\mathrm{Re}(W_f(a_{ridge}, b))}] \tag{14}$$

Repeat the above process on the whole fringe image, detecting the ridge and extracting the phase of ridge, then the height distribution of object is obtained.

2.3. Research Method

In this paper, FTP method and WTP method are comparative studied to evaluate their adaption on 3D reconstruction of complex surface object. FTP method and WTP method are applied on the same deformed fringe image, which is formed by a complex surface reflection of a sinusoidal fringe projection. The process flow is shown in Figure 6. In FTP process, the orthogonal ellipse filter is used to get fundamental frequency and phase is extracted by Eq. (6). In WTP process, selecting complex Morlet wavelet as a mother wavelet, by finding the maxim value to detect ridge of wavelet transform, and extracting phase by Eq. (14). Those two methods use the same regional relative reliability-guided phase unwrapping algorithm.

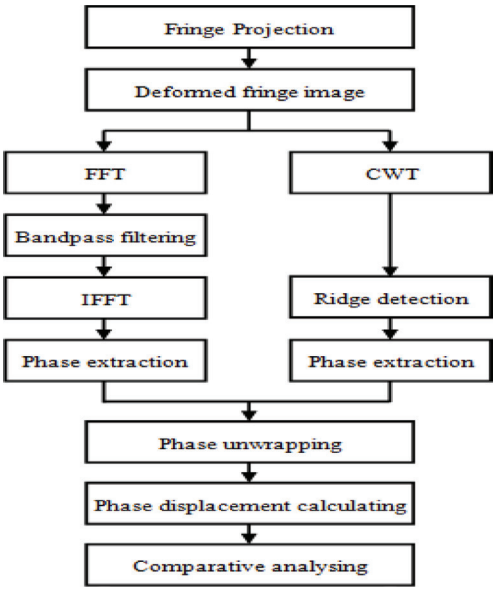


Figure 6 – Process flow of FTP and WTP methods

3. Experiments and analysis

3.1. Simulation and Validation

Based on peaks function by Matlab simulation, a virtual 3D object is constructed in 362 pixels plus 362 pixels, and the Gauss noise with 0.3 standard deviation is mixed on the surface. Sinusoidal fringe is projected on it and the deformed fringe is shown in Figure 7.

The extracted phase and unwrapped phase by FTP and by WTP method are shown in Figure 8 and Figure 9. Reconstruction error distributions of those two methods are shown in Figure 10 and Figure 11. The mean square error is 0.1982 for FTP method and 0.1830 for WTP method. So, either FTP method or WTP method can reconstruct the virtual 3D object in a high accuracy (Gasca-Hurtado et al., 2015).

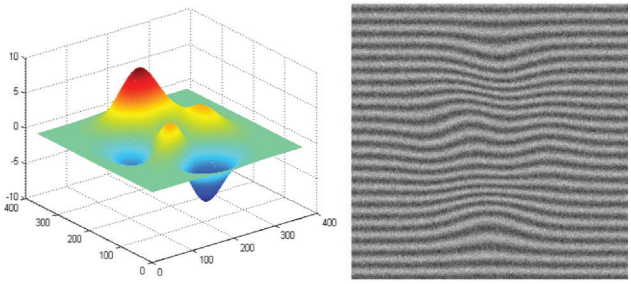
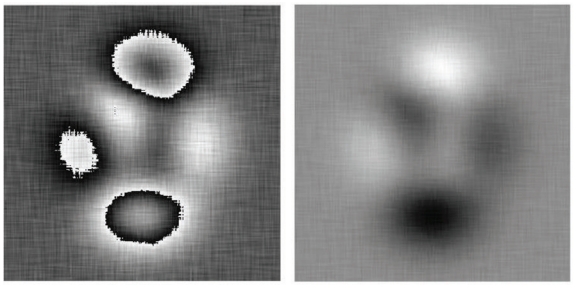
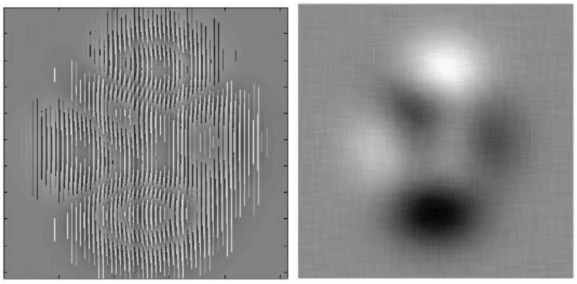


Figure 7 – 3D surface of peaks fuction and the deformed fringe



(a) The extracted phase (b) The unwrapped phase

Figure 8 – The extracted phase and unwrapped phase by FTP method



(a) The extracted phase (b) The unwrapped phase

Figure 9 – The extracted phase and unwrapped phase by WTP method

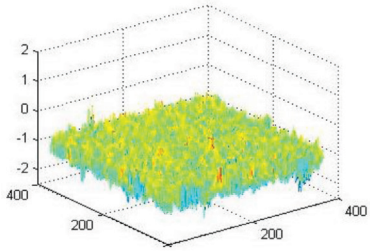


Figure 10 – Reconstruction error distribution of FTP method

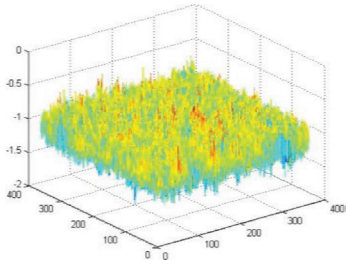


Figure 11 – Reconstruction error distribution of WTP method

3.2. Train Wheel 3D Reconstruction and Analysis

A new manufactured train wheel width in 135mm is used to compare the reconstruction accuracy of FTP and WTP method on real object. The experiment is done in Figure 12. The parameter L is 600 mm, D is 200 mm, and the stripe frequency f_o is 1/16 (stripe/pixel). The wheel surface is complex characteristic in a flat surface in wheel tread and an abrupt surface in wheel flange, as shown in Figure.12. Besides that, there are two orthogonal artificial cracks in length 10mm, width 2mm, and depth 2mm on tread, and the No.1 defect is along circumferential direction while No.2 defect is along axial direction. The wheel is made by metal which cause a strong reflection. Fringe is skewed projected onto wheel surface in 45 degrees. Defects on wheel tread and the deformed fringe image is shown in Figure.13. The extracted phase and unwrapped phase by FTP and by WTP method are shown in Figure 14 and Figure 15. The phase distribution of wheel surface and details in defects such as depth and width by two methods are shown in Figure 16 and Figure 17.

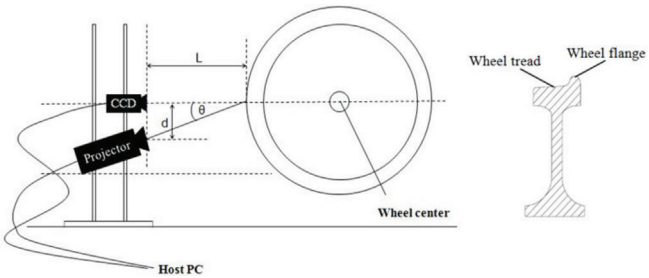


Figure 12 – Configuration of train wheel experiment and the wheel profile

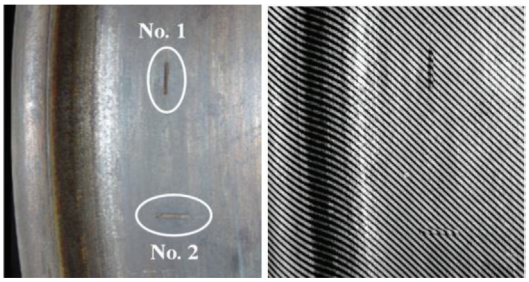


Figure 13 – Artificial defects on wheel tread and the deformed fringe image

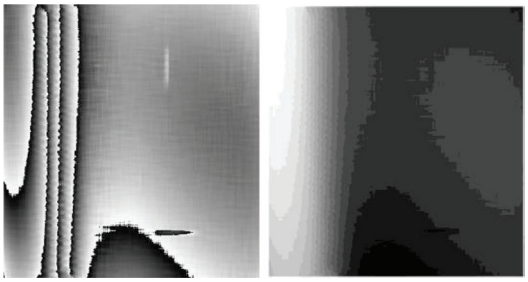


Figure 14 – Extracted phase and unwrapped phase by FTP method

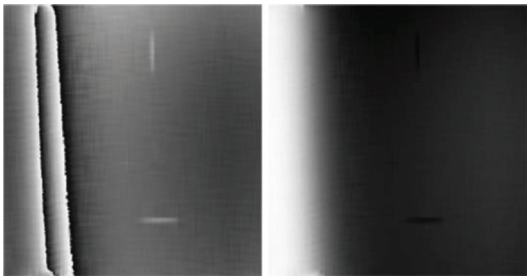


Figure 15 – Extracted phase and unwrapped phase by WTP method

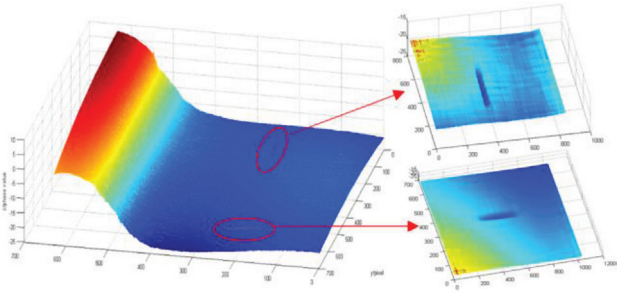


Figure 16 – Phase distribution on wheel surface by FTP method

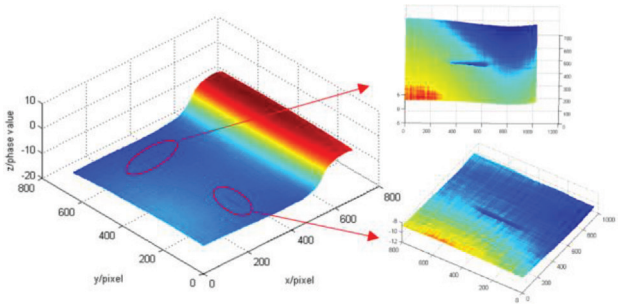


Figure 17 – Phase distribution on wheel surface by WTP method

Figure 18 and Figure 19 show phases of two selected rows of fringe image across the two defects by FTP and WTP method. Two curves have similar tendency in WTP method, but they are sensitive to noise, which results in curves fluctuation. For FTP method, two curves trend to different tendency, but curves are smooth comparing to WTP method. As for processing time, FTP is two times faster than WTP.

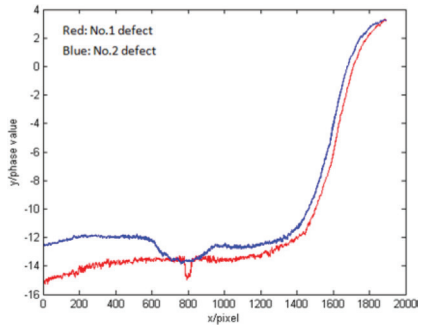


Figure 18 – Phase of sections across two defects by FTP

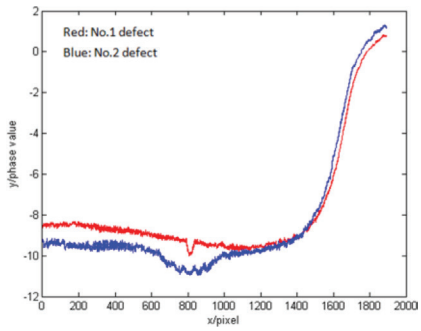


Figure 19 – Phase of sections across two defects by WTP

To qualitatively compare reconstruction accuracy of FTP and WTP, another method called S-transform Profilometry also based on ridge extraction is introduced.

Phase extracted by WTP and S-transform method have similar tendency, but differ from FTP method, as shown in Figure 20 and Figure 21. That means WTP method has a higher accuracy than FTP method for wheel surface reconstruction.

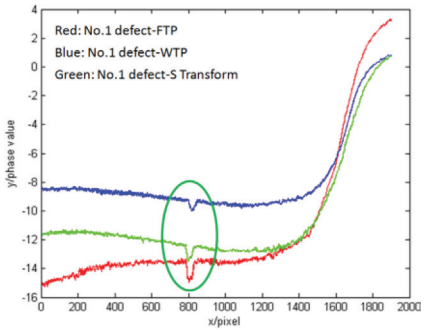


Figure 20 – Phase extracted in the same section of No.1 defect

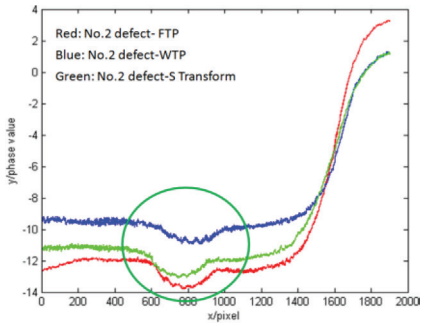


Figure 21 – Phase extracted in the same section of No.2 defect

The reasons caused a large phase deviation of FTP method is the abrupt surface and high reflectivity on wheel flange area. Figure 22 shows extracted phase by FTP and WTP method with wheel flange image cut off, and the phase deviation of two methods largely decreased.

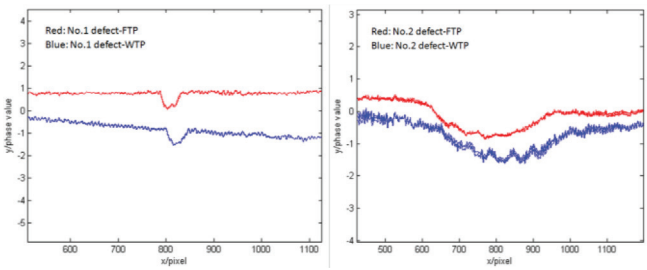


Figure 22 – Phase extracted with wheel flange image cut off

4. Conclusion

From experiment on train wheel, conclusions are drawn as following:

1. Either FTP or WTP method can well reconstruct the whole 3D surface of wheel, and can get wheel profile information include details of crack width and depth.
2. Compared to FTP method, WTP method has a higher accuracy for wheel surface reconstruction, but it is sensitive to noise, so the reconstructed surface is not smooth as FTP method, and it is a time-consuming method.
3. For wheel tread area with flat surface, FTP method is a good solution because of the performance of smooth reconstructed surface and the high efficiency of data processing. But for wheel flange area with abrupt surface, WTP method is better because of its multi-resolution to avoid a wrong reconstruction.

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Study on "People-oriented" College Students Management

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Abstract: In order to have a comprehensive and deepening study on the "people-oriented" college student management work, a neat, scientific and complete theoretical framework must be set up. In order to establish this kind of scientific and comprehensive theoretical framework, the core concept of relevant problems must be fully recognized. Defining the "people-oriented" college student management work, going into the nature of student management work and correctly grasping factors that influence people-oriented college student management work are necessary premises to study people-oriented college student management work. After determining the basic frame work of the scientific and comprehensive people-oriented college student management work, we will begin to see the system problem of college student management work and its manifestations. According to the progress of the society and the development of the times, fully understanding about the existing problems in the college student management work and its causes, discussion on the subject of people-oriented college student management work and fully demonstration of college student management work with people-oriented as the subject are according with era development and realistic requirements. Constructive suggestions are proposed on ways and methods of achieving people-oriented college student management work. Have a profound understanding about student management work and the meaning of student management work to social and individual development. Elaborate the objectives of student management work and provide a scientific and reasonable theoretical way for achieving people-oriented student management work.

Keywords: College Student Management System, People Orientation, Humanistic care.

1. Introduction

On the 4th Plenum of the 16th CPC Central Committee, the CPC central committee has made clear the great strategic goal of building a harmonious socialist society and continuously made it as the mission of strengthening its ruling level. The socialist harmonious society is based on the concept of scientific development, starting from the level of development and making efforts for the harmonious development of society in the future. The support source and the success base of establishing a harmonious socialist society is people-orientation that is advocated by Scientific Outlook on Development.

Recommendations for the 11th Five-Year Plan for Economic and Social Development was put forward on the 5th Plenum of the 16th CPC Central Committee and it further made clear that the current task of our country is to build a harmonious social environment. In accordance with the provisions of the people-orientation, we should first set about to deal with problems related to the interests of the masses and pay close attention to the social development, coordinate the sustainable economic society and promote all around development of moral, intellectual, physical, aesthetics; we should narrow the gap in social development, and let the masses share the benefits of reform as soon as possible; strengthen the construction of democratic legal system, to solve contradictions existing in the reform and development, assure the harmonious atmosphere, enhance citizens' sense of security and implement the comprehensive control measures of public security (Buch, 2002). Our ultimate goal is to bring about a dynamic and stable society that is democratic, law-based, fair, just, honest and friendly where man and nature live in harmony. "During the process of building a harmonious socialist society, high education has made an indelible contribution (Pan, 2010). It has given the intellectual support and assured that the country has stable resource of talents. At the same time of building the harmonious society, we should also pay attention to the building of harmonious campus." With the continuous progress of the ear, the country continues to deepen the reform and various contradictions will appear inevitably during the long process, which may bring adverse influences to the stability and harmony of the campus. To solve these problems is the goal of building a socialist harmonious campus (Yue and Jin, 2010).

Therefore, in order to build a harmonious campus, it is important to insist on people orientation during the daily work of college student management and the development of all school activities. Only taking people orientation as the value orientation can continuously perfect the internal and external management of the school and present an orderly, vibrant and friendly campus image in front of the broad masses (Abreu et al., 2015).

2. The Concept of "People Orientation" is the Intrinsic Requirement of Education Essence

In this material world, the cognition of human being is infinite, which makes people acquire new cognition in variable periods. Education is a shortcut for people to acquire more knowledge and make greater progress. In a certain degree, education can help people become a knowledgeable people, which is the nature performance of human being. Kant once said: "human being, only education can make them become human being," "human being is the result of education." (Brannan, 2000). The statements of forefathers are very reasonable. Education is a good ladder for people to develop fully and comprehensively. In this ladder, only continuous learning can make one climb higher and look further; only with widening knowledge scope can make one develop in an all-round way and contribute his/her share in the future construction, making the country and people proud of him/her. Education can make everyone take practical exercise and enrich their own life experience. Councils for International Education once declared one basic principle of education: "education should promote the comprehensive development of everyone, that is, the development in mind and body, intelligence, sensitivity, aesthetic consciousness, individual responsibility, spiritual value, etc.

3. Current Situation and Main Problems of the Implementation of People-oriented College Student Management Work

3.1. Current College Student Management System

Currently, most colleges and universities in China generally practiced the college student management system in a planned way and relevant institutes and organizations are established. Among these organizations and institutions, some management positions are established to divide the rights and work responsibilities. In this student management system, the boundary of different departments is clearer, so it can better implement the college student management system. Only by strengthening the management and education on college students, it can activate the college students and encourage them to devote themselves to the construction of the socialist modernization. Currently, in some colleges and universities in our country, a team that is led by school leaders and organized by students is established to strengthen the management; while in some other schools, it is led by the student union and different branches are established to strengthen the management and education.

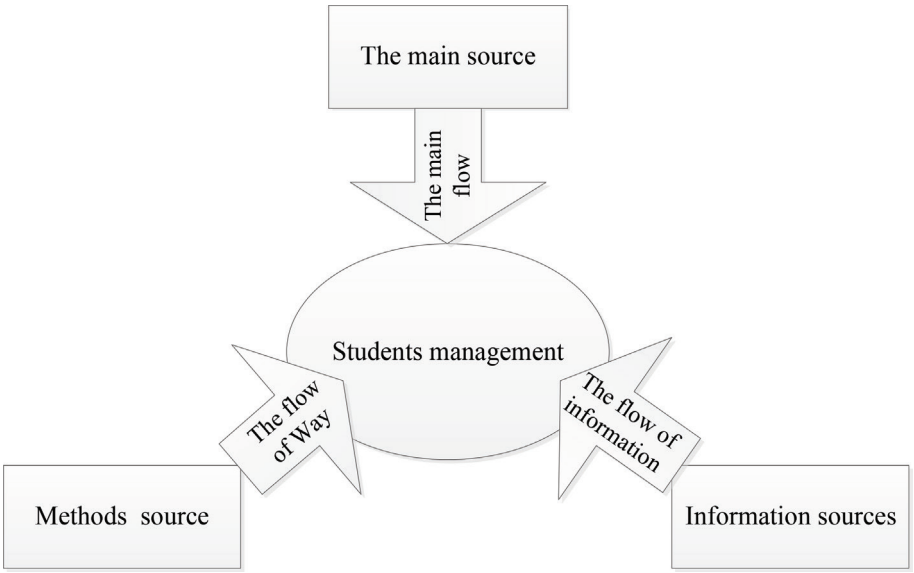

Figure 1 – Students Management in colleges and universities method

Time flies like an arrow. With time goes on, the college student management way should also follow the pace of the times. The old student management work pattern cannot be fully compatible with the current student management work pattern. But during the college management work, there are some problems and drawbacks in the operation, for example, decrease in management efficiency caused by buying time and quickening work pace while the decrease in management efficiency brings about the decrease in management quality; besides, there are also some loose management, like useless image project, etc.; because the division of labour is not clear and reasonable, so the

management efficiency is low and far away from the hard index of people orientation; ambiguous guidance in management personnel, etc (Zhang and Pan, 2012).

The emergence of various problems requires that the management work of the management personnel must be more scientific and reasonable and let more appropriate management system appear in various colleges and universities, to adapt to the development of college student management system, to help students enjoy the best management and education, to serve the people-orientated management work and to cultivate advance talents that accord with the socialist modernization.

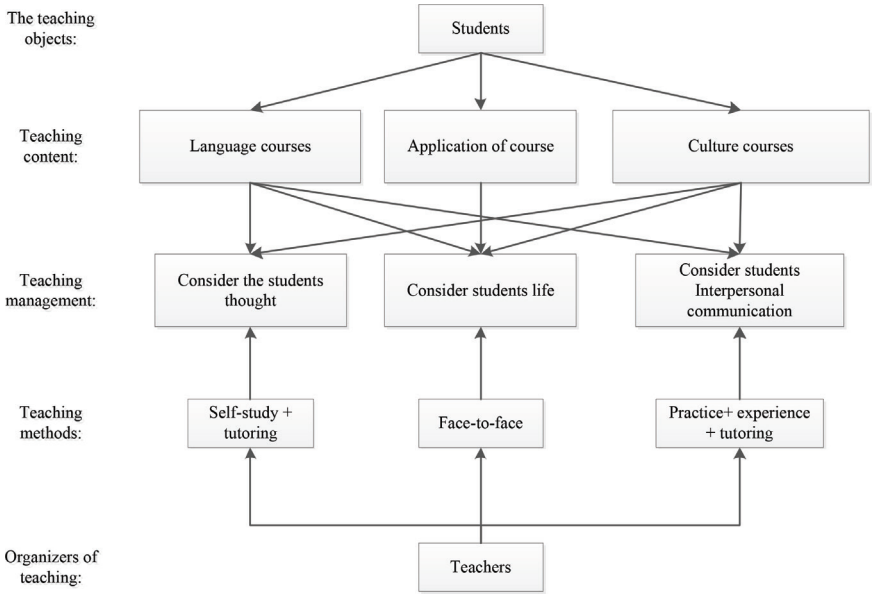

Figure 2 – People first management method

3.2. The main problems existing in the management of college students

Since the reform and opening up, in order to earnestly fulfil the talent construction and training plan set by the nation, cultivate talents who are excellent in various fields and aspects, strengthen the improvement and development of student management work, the colleges and universities have spent a lot of time and capital supporting the management of university and college students (Yu and Zheng, 2013). On such basis, a large number of tenants have emerged. However, in order to cultivate the innovative and advanced talents who can adapt to the international community, China has proceeded to draw lessons from the useful experience of foreign education management. What is more, after this the useful experience is combined with China's university management methods, a set of ways and methods which are suitable for the management of China's university students so as to make unremitting efforts to create the modern talents and cultivate the talents of tremendous promise in the future for our motherland. In this way, it will meet the needs of the socialist modernization construction. The highlight and

investment of various colleges and universities in China will improve the management work in universities and colleges. At the same time, as good results have been made finally, it makes the management personnel of colleges and universities pay more attention to the people-oriented management of students. As long as the recommendations and opinions are able to help to cultivate the talents who are conductive to the construction of the motherland, all colleges and universities will take into account the significance of them. Although China's university management has made considerable progress and development, what cannot be ignored is that some problems still exist.

1. Deviation for management guidance ideology

The management work in the school should not ignore the student's demand. They are required to highlight on the views of students based on the people-oriented principle so that students can better express their own views and they are more active to participate in teaching and management process. What is more, we should encourage and support the students in spirit and pay attention to their individual needs. Only when all the students are taking the initiative to participate in student management work can they strengthen the management work of students in a better way so that students are able to understand and support the management work carried out by the school. In this way, the greatest success will be made and a number of modern high-end talents who will adapt to the development of socialist modernization will be cultivated. In modern university management, managers must follow the pace of the times, speed up the transformation of student management work, pay attention to the students' individual needs, make better knowledge and spiritual counselling for students, eliminate the psychological barriers of students and promote them to healthy grow in fierce competition.

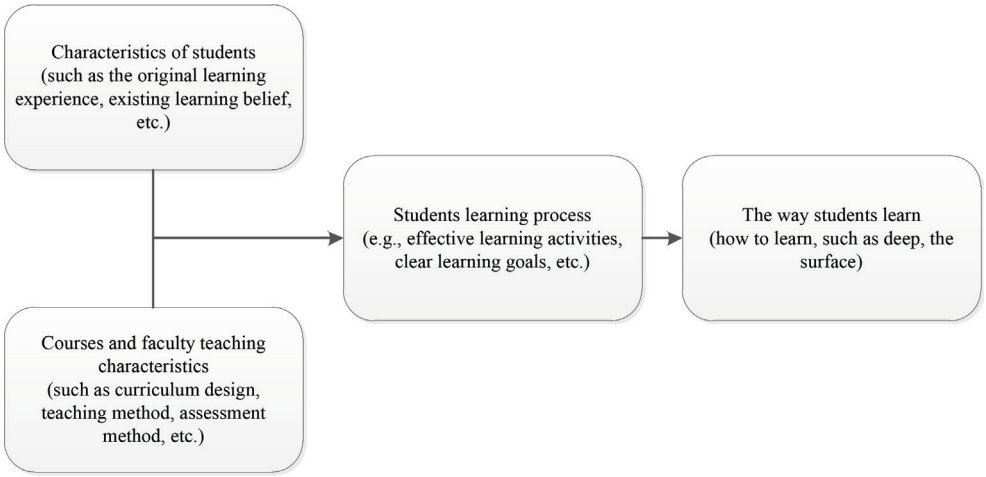

Figure 3 – Effective classroom teaching analysis theoretical model

2. The goal of training students is too unified

Due to the different characteristic of each college student, educators must have different management tools for the corresponding students so that students are able to maximize their potential. The management mode of various colleges and universities should

proceed by considering the reality and let the students have the courage to develop their daring and resolution and maximize their ability. For different students, we should "prescribe the right medicine" to help students find a most suitable direction of development so that they will obtain the best development opportunities within the limited time. In this way, the education process is carried out more effectively and the education in school will be a success finally.

3.3. Humanistic care is insufficient in terms of the management methods

In the management work of the University, the more convenient management way is usually adopted, but this management method also brings all sorts of problems: the management for students is too strict and the requirements are too delicate; the management of students in colleges and universities in our country is usually too strict, which does not allow students to make even a small mistake. In the people-oriented education management, this is not real; in the school management of students, the reward and encouragement are usually much less with the punishment being the dominant content. In most of the universities in our country, many schools regard the evening self-study as an order and the students absent will be punished. Although it can maintain the order in the campus and strengthen the management of students, but such education modes have serious drawbacks. This way of education will make the student management personnel slump into a very complex problem and it is difficult to allow them to make the right judgments and make a good conclusion. Additionally, it is difficult for these students to have sufficient time to learn the knowledge of books and some other knowledge beyond the books so as to comprehensively improve their ability.

4. The basic path for the realization of reform and innovation for the implicit and people-oriented management of college students

4.1. Students should be the interests body of the management work

In the practice of student management, it is an inevitable requirement to become a "service person". Only in this way can the students be actually benefited while at the same time they are in the dominant position. We must bear in mind that in the process of our work, both the ideological or practical problems are the ones to be solved by us. They are complement to each other and are to be resolved at the same time. Only in this way can it be in line with the excellent style of the Communist Party of China in terms of student management work. Regardless of how difficult the period is, we must regard the sufferings of the masses as the primary problem and integrating with the masses is the simplest expressions with the infinite implication. It has suggested finding out the trivial aspect in the way of seeing it in one spot so as to prevent something bad from happening at the beginning and solve the problems in the grassroots. What is more, we are required to adhere to the common solution with idea and practical problems being involved at the same time. This is actually consistent with student management work without previous consultation. All problems are solved from the perspective of the actual situation of students and their difficulties. Only thoroughly implement the solution of ideological problems and practical problems of students can the cohesion of the students be formed,

the talents of high quality and high level be cultivated so as to make colleges burst out of vitality and continue to make progress.

4.2. Students should be the main body of the development of management

This is undoubtedly a difficult problem for students management work that how to make students integrate into the community in a better way and form a social outlook in which they both comply with the provisions of society and have a foothold in society so as to obtain practical skills suitable for survival in it. Because we want students to have a dynamic understanding of the community and obtain the ability to make value judgments so as to take practical action for social development and progress. The formation and cultivation of the above abilities are required to be carried out by the ideological and political education in the students’ management work. So an important criterion for judging whether the students management work has been a success or not is whether the students are able to get involved in the society in the future and become a useful social person. Additionally, in terms of the student management work, we should also pay attention to the cultivation of students’ environmental awareness, the harmonious relationship between human and nature so that the civilized and rational way of life will actually become one part of them.

We should constantly strengthen the importance of “people”, which is the basis of the introduction of the people-oriented philosophy into student management. The introduction of the people-oriented education concept will improve the efficiency and effectiveness of the management of students. Therefore, the people oriented idea must be implemented in the whole process of the management of college students:

Firstly, we are required to develop a scientific and people-oriented students management target which can meet the needs of the development of students themselves in a better way and is in accordance with the requirements of the era. Under the guidance of Marx’s scientific idea, the combination of personal value and personal comprehensive quality will be regarded as the foundation of student management work.

Secondly, eliminate the concepts of the traditional student management work that do not meet the requirements of the times so as to strengthen the academic study of student management. There are actually some established ideological norms and more distinctive behaviours for student management work, but if you just let the students passively accept some established moral norms and exert the disciplinary education on them, tell them what is right and what is wrong. This is not actually feasible. In the process of the management of college students, we should not only study the correctness of the conclusions but also understand the differences between different conclusions, the premise and the process for the formation of conclusion. In the research process, it not only requires the participation of scholars and educators but also the students as the object of education so as to make them integrated with each other, which is more conducive to meeting students’ needs by student management work and more conducive to improving the students management in colleges and universities.

Thirdly, the research should go beyond the traditional cultural perspective of student management to increase its cultural inclusion. This is the right direction determined by cultural diversity and diversification. This means that educators should not just start

from some single aspect of culture or the traditional culture to deliver the conclusion to the students mechanically but they should compare the content of different cultural content in terms of ideological education so as to remove the dross and select the essence. Finally, it will be vividly manifested in front of the students.

5. Conclusion

We should constantly strengthen the importance of "people", which is the basis of the introduction of the people-oriented philosophy into student management. The introduction of the people-oriented education concept will improve the efficiency and effectiveness of the management of students. Therefore, the people oriented idea must be implemented in the whole process of the management of college students:

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The Quantitative Model of the Product Style Based on Eye Tracking Technique and Fourier Decomposition

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Abstract: The policy-maker makes decision based on perceptual experience and his own knowledge, which may result in some biases and defects in the process of designing, analysis and decision-making. Accordingly, the author proposes a theoretical model about the quantitative analysis of a product's style. The author acquires the vision hierarchy parameter on product modeling from users via eye movement experiments, then applies Fourier decomposition to make a quantitative deconstruction on modeling elements, finally obtains the similarity value of different product styles so as to provide decision makers with objective and reasonable references. Taking the style of CRH380 series products as an example, the author carries out experiments and analysis, and then verify the feasibility of the theoretical model.

Keywords: Design strategy, Style quantization, eye tracker, Fourier decomposition

1. Introduction

With the social development, the outlook and style of products tend to be assimilation. To enhance the brand recognition among consumers, many companies improve the identification of the product. The similarity of products' outlook plays an important role in human engineering, product function and expectation on brands (Mariëlle and Jan, 2005). However, although the designing approach is of great importance to meet the market demand, the decision makers always do this according to his own experience (Costa et al., 2012; Hsiao and Tsai, 2005; Zhang et al., 2013). Meanwhile, the recognition difference between users and designers on products design and the shortage of quantitative analysis of designing strategy (Shang et al., 2000) results in perceptual judgments from decision makers. Then it is hard to systematically assess the recognition of the designing scheme and product style, which makes a difference in position of designing strategies.

How can designers face the uncertainties during the process of decision making? How to make an objective and reasonable analysis and assessment on products' design? According to references (Chan, 2000; Li, 2011; Mccormack et al., 2004; Stiny and Mitchell, 1978), the style can be measured by the understanding of those unique designing elements. However, the measure method only aims at certain styles, not involves the difference of designs. Accordingly, the paper proposes the quantitative

model of the product style based on eye tracking technique and Fourier decomposition, utilizes quantitative method to make calculation about product style so as to provide new ways for the designing of the company's brand strategy.

2. The Quantification of Modeling Style

The quantification of product style involves the research on influential factors of product style characteristics and its parametric processing. Then the perceptual and obscure style will be transformed to the reasonable and quantitative measured parameter.

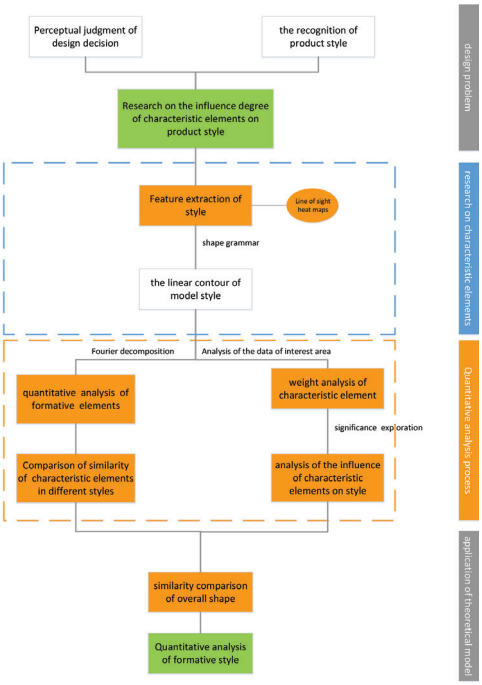


Figure 1 – The framework of theoretical mode

The paper, through the eye-movement experiment, obtains characteristics that influence product style, utilizes shape grammar to extract the contour of feature elements and transforms it to two-dimensional closed curve, then makes similarity analysis on different feature elements via Fourier decomposition. After an analysis of data acquired from observers' eye movement in the regions of interest (ROI), the author makes a weight analysis on the feature elements in product modeling, then carries out a significant research on each element, finally calculates the overall similarity of different products so as to provide guidance for product design and analysis. The theoretical model is depicted above (Puello, 2016).

3. The Extraction of Style Feature Elements

When it comes to the research on style features, (Xu et al., 2007) based on the analysis of it with multidimensional scaling and morphological analysis, proposed an optimized

model of high speed train	CRH380A	CRH380B
gaze view of product		
model of high speed train	CRH380C	CRH380D
gaze view of product		

Table 1 – Four kinds of experiment objects

design approach for imagery modeling on the strength of Genetic Algorithm (GA). After obtaining the data about observers' recognition on different product styles via the eye-movement experiment, the author makes a further extraction of the style features that influence the product's style.

3.1. The Design of Experiment

The paper makes a quantitative analysis on experiment objects including the headstock of CRH380A, CRH380B, CRH380C, CRH380D. The eye-movement experiment aims at identifying the characteristic elements that influence product modeling style.

In the experiment, the EysSo Ec60 remote-measuring eye tracker is the apparatus, and the experiment object is CRH380A train. To ensure that experimenters would stare at these trains at a real environment and avoid other irrelevant variables, the grey pictures presenting headstocks at a 45-degree angle with the same depth of field are chosen as experiment objects, which as the table 1 shows.

In the experiment, observers are 20 first-grade postgraduate students majoring in designing, as is shown in the table 2. They are required to judge the designing style of these trains within 20 seconds via observing the characteristic elements of the modeling.

serial number	experimental population	profession	number of people	average age	gender	corrected visual acuity	blind seruo
A	graduate student	design major	5	24	3 men and 2 women	good	no
B	graduate student	mechanical related major	5	23	3 men and 2 women	good	no
C	College Student	unlimited	5	22	4 men and 1 women	good	no
D	unlimited	unlimited	5	32	2 men and 3 women	good	no

Table 2 – Experimental population setting

3.2. Experimental Analysis

After the experiment is finished, the line of sight and heat maps of experiment objects are recorded as figure 2.

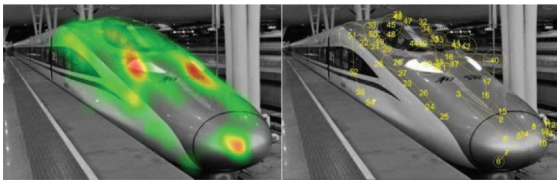


Figure 2 – Line of sight and heat maps of experiment objects

In the figure, the heat map displays the duration of experimenters' sight on specific objects, among which, red, yellow and green respectively stands for the longest, the second longest and the relatively short duration time, and the colorless area indicates that no one stared at this place. The line graph reveals the order of experimenters' interest in specific elements under the certain requirement, namely recognize the product style. The size of the spot represents relative length of duration of sight. To some extent, the research can be made on the characteristic elements that influence the high-speed train's modeling style according to the feature of experimenters and the graph of line of sight.

According to the result, for the experimenters, their line of sight mainly focused on the headlight, coupling gear, front windows, body contour and side windows. And the order of the line of the sight is the coupling gear, body contour, headlight, front windows and side windows. The significant research on characteristic elements for the whole product style will be made later. Therefore, the elements that influence high-speed train style were selected, including such five designing elements as coupling gear, body contour, headlight, front train window and side windows. And to simplify the experimental analysis, some small areas have been combined.

4. The Line Profile of Modeling Style

4.1. Shape Grammar

In the field of making quantitative analysis on product style, (Orsborn et al., 2006) used shape grammar to quantify the difference between cars with different kinds of rules, then designed the car within the range of parameters. It provided guidance for the design of new cars. To be more precise, it limited the design within specific range of parameters as well as combined rules and scopes via crossing the boundary of different types of cars so as to create the unique, interesting and mixed style.

The shape grammar, a way to analyze and create shape, refers to a language that can creating the two-dimensional geometric figure with a syntactic rule. Its advantage is that it can use the contour profile to show the graphic feature of the research object. The shape grammar illustrates the process of designing with the application of its rules, namely the grammar. Taking the corresponding original shape in the designing rule as an example,

such rule consists of the left and the right shape, if the left shape matches the original one, then the right one will replace the original one, which is shown in the figure 3.

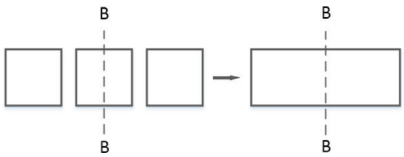
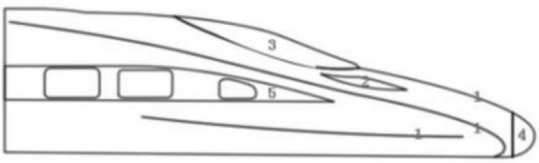


Figure 3 – Shape grammar rule

The limitation of the shape grammar is that the change of pictures must base on the parameters, that is to say, it requires similar shapes for any forms of change including zoom-out and rotation. To deal with that problem, the paper uses Fourier decomposition to parameterize designing elements. To meet the requirements of Fourier decomposition on closed property of the curve and avoid uncontrollable variables during the process of the quantification of designing elements, the paper, according to the shape grammar, changes the three-dimensional modeling of the high-speed train into the two-dimensional one to make analysis. Meanwhile, the paper, to some extent, simplifies the analysis of the quantification of the design.

4.2. The Contour Profile of Modeling Elements

When utilizing shape grammar to measure the product style, the designer must determine the influence of each designing element on the whole modeling. However, the designers often make judgments based on the appearance of shape elements and their own experience, recognition and emotions, which are obscure and uncertain. The paper makes an analysis on the order of line of sight and interest areas of observers via the eye-movement experiment, and then makes quantitative analysis and assessment on each factor that influence the modeling. According to the feature of high-speed train modeling, the paper chooses the front view and side view of shapes that, to a large extent, represent the product modeling as target objects, and then make quantitative analysis on modeling elements of each view. The extraction of characteristic elements from each view is shown in figure 4.



side view wireframe

Front view wireframe

Figure 4 – Characteristic elements of front profile and side profile of CRH380A type high speed train: 1, Side profile; 2, side headlight; 3, front window of side view; 4, coupler of side view; 5, side window of side view; 6, Front profile; 7, coupler of front view; 8, front headlight; 9, front window; 10, side window of front view;

The list of feature elements of the front and side view is as followed.

view	elements that affect the style				
front view	Front profile	front headlight	front window	coupler	side window
side view	Side profile	side headlight	front window	coupler	side window

Table 3 – List of feature elements of CRH380A type high speed train

4.3. The Quantitative Analysis on Modeling Elements

In the field of the quantification of designing elements, (McGarva and Mullineux, 1993) made a research on the closed planar curve that expressed by the Fourier coefficient and proposed the theoretical method that using harmonic wave to represent the closed curve to make quantitative analysis on the design. The Fourier decomposition represents the repeated periodic curves. Taking CRH380A, CRH380B, CRH380C, CRH380D as research objects, the paper extracts ten designing elements from each model to make a simple closed curve that expressed by the point set. (Orsborn et al., 2006) applies the Fourier decomposition and the genetic algorithm to design the car, the Fourier coefficient that he used can be expressed by the equation (1) below.

$$a_m = \sum_{k=0}^{N} \left(\frac{t_{k+1} - t_k}{2} z_{k+1} \exp(-2\pi i m t_{k+1}) + z_k \exp(-2\pi i m t_k)\right) \tag{1}$$

In the equation, a_m is a complex number. Z_k represents the point in the curve, its approximate value comes from N parts of the curve. t_k refers to the distance between point Z_k and $Z_{k+1.}$ According to (Orsborn et al., 2006), the calculation of the distance between point and point in the equation is as followed.

$$t_k = \frac{L_k}{L}, L = \sum_{i=0}^{N} \sqrt{(x_i - x_{i-1})^2 + (y_i - y_{i-1})^2}$$

$$L_k = \sum_{i=0}^{k-1} \sqrt{(x_i - x_{i-1})^2 + (y_i - y_{i-1})^2} \tag{2}$$

The two curve can be solved by (Orsborn et al., 2006)

$$SimInd(k,1) = \frac{100}{1 + D(k,l)} \% = \frac{100}{1 + \sum_{m=1}^{10} \alpha(m) \left\| g_{k,m} - g_{l,m} \right\|^2}$$

$$\left\| g_{k,m} - g_{l,m} \right\|^2 = \frac{(u_{k,m} - u_{l,m})^2}{(u_{\max,m} - u_{\min,m})^2} + \frac{(u_{k,-m} - u_{i,-m})^2}{(u_{\max,m} - u_{\min,m})^2} + \frac{(v_{k,m} - v_{l,m})^2}{(v_{\max,m} - v_{\min,m})^2} + \frac{(v_{k,-m} - v_{i,-m})^2}{(v_{\max,m} - v_{\min,m})^2} \tag{3}$$

The value of m is close to 10. Only the first ten harmonic waves are of significance, so the distance between two curves, (k, l), can be viewed as the distance weighted sum of the first ten harmonic curves. According to (Orsborn et al., 2006), $\alpha(m)$ is an important weight factor for the first harmonic curve instead of the last one, because the first one is easier to observe. $\alpha(m)$ is expressed by the form of exponent, its approximate weight is $1.08e^{-0.08m}$ (Yannou et al., 2008). Based on the equation (1) $a_m=u_m-iv_m$, the initial distance can be calculated from the difference between $g_{k,m}$ and $g_{l,m}$, $g_{k,m}$ is the harmonic number m comes from the curve k, and $g_{l,m}$ is the harmonic number m comes from the curve l. u_{max} and u_{min} are the maximum and minimum value of u_k, v_{max} and v_{min} are the maximum and minimum value of v_k. SimInd(k,1) is an approximate value that comes from the curve k and the curve l, and it ranges from 0% to 100%. The higher the similarity value, the more similar the curve is.

The Fourier decomposition can be viewed as a designing quantitative method to calculate the similarity value of different modeling style elements. The similarity of the body contour from the side view of 4 types high-speed train of CRH380 can be seen in the figure 5. The numerical difference of each iteration of the product style can be obtained through the comparison between the similarity value of the modeling elements of different generations, which can be the guidance for the product style iteration.

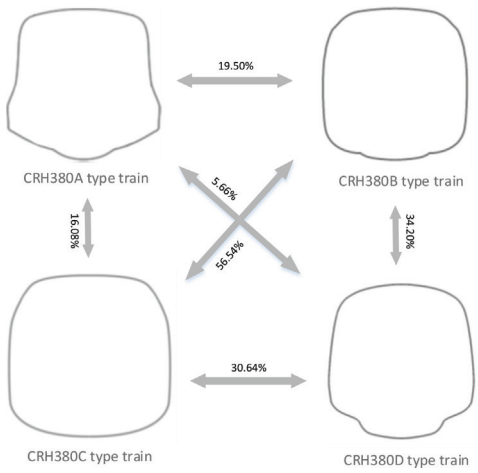


Figure 5 – The similarity value of side Contour view

5. The Weight Analysis of Feature Elements

The first experiment focuses on the influence of feature elements on modeling style. For the further quantitative analysis on its significant influence, the author, based on the part 1 and part2, chooses the front and side view that, to a large extent, represent the style of CRH380A to carry out eye-movement experiment. Before the experiment, the author delimits the corresponding are of interest (AOI) for the specific elements. The data in the AOI can reflect the significant influence of each feature element on the whole style. The set of AOI in the eye-movement experiment is for the author to make

analysis on the area that related to the experiment, the data out the region would not be counted. The result is as followed.

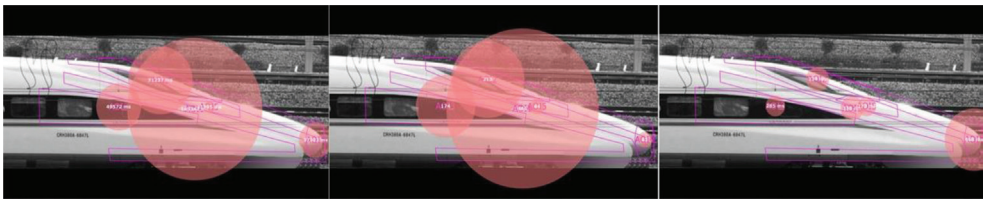


Figure 6 – The AOI data of CRH380A high speed train side view

The statistics are as followed.

	AOI1	AOI2	AOI3	AOI4	AOI5
fixation time	149347	71227	49572	37322	11955
number of fixation points	455	213	174	43	44
average fixation duration	336	334	285	868	273

AOI1, Side profile; AOI2, front window; AOI3, side window; AOI4, coupler; AOI5, side headlight;

Table 4 – The AOI data analysis of Side profile (unit: ms)

According to the above three groups of data, the order of significant feature elements is the body contour, front window, side window, coupling gear, then headlight, and their weights respectively are 46.77%, 22.30%, 15.51%, 11.68%, 3.74%.

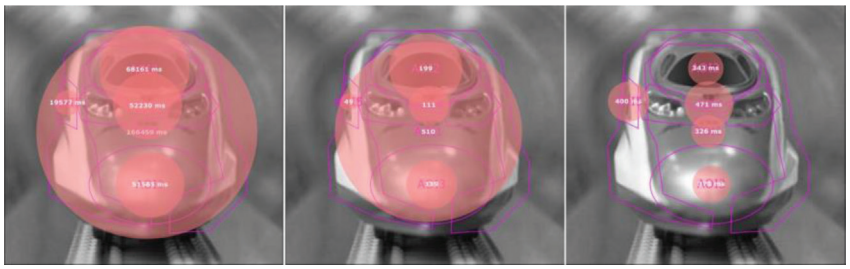


Figure 7 – The AOI data of CRH380A high speed train front view

	AOI1	AOI2	AOI3	AOI4	AOI5
fixation time	166459	68161	51565	52230	19577
number of fixation points	510	199	139	111	49
average fixation duration	326	343	371	471	400

AOI1, front profile; AOI2, front window; AOI3, coupler; AOI4, front headlight; AOI5, side window;

Table 5 – The AOI data analysis of front profile (unit: ms)

According to the above three groups of data, the order of significant feature elements is the body contour, front window, headlight, coupling gear, side window, and their weights respectively are 46.50%, 19.04%, 14.40%, 14.59%, 5.47%.

It can be observed from the experimental result that the body contour has the largest influence on the modeling style of CRH380A, which also verifies people's real-time observation and cognitive disposition will be influenced by their personal sense. Then the second largest influential factor is the front window. Therefore, when it comes to the recognition, the designer can give prominence to such distinctive feature factor as the front window so as to differentiate it from other product styles.

6. The Similarity Analysis of Product Modeling Style

The paper extracts the five feature elements of high-speed train via the eye-movement experiment, then uses shape grammar rules to make the line profile of the product modeling to get the planar elements from the front and side view, and make the quantitative analysis on 40 design elements of four kinds of high-speed train with the Fourier decomposition. After that, the author utilizes the element weight from the eye-movement to ultimately calculate the overall similarity value. The similarity between CRH380A and CRH380B is 21.62%, and that between CRH380B and CRH380C is 30.67%. Through this way, the similarity value of different product styles can be quantified to provide guidance for the recognition strategy of product designing. Meanwhile, such method can also be used in the iteration of products, making the changes on product style of different generations at a stable level so as to such avoid strategy mistake as designing the product that not accepted by the consumer. Besides, in the paper, the significant research on feature elements also provide guidance for highlighting the brand of the product in the process of designing, receiving recognition through attracting people's line of sight and ultimately making a unique brand.

7. Conclusion

The paper puts forward a theoretical model for quantitative analysis on the product modeling style due to the perceptual judgments appeared in the process of analysis and decision making. It combines the data acquired from the eye-movement experiment to make research on the level of significance in product feature elements. Meanwhile, the author uses shape grammar rules to make two-dimensional deconstruction of product modeling, utilizes the Fourier parameter to make quantitative analysis on feature elements so as to obtain the similarity value of different product modeling style. With such theoretical method, the designer can quantify the influence level of feature elements on the whole modeling and the difference of similarity between different product modeling style so as to provide guidance for the recognition of design and highlighting the brand style.

In terms of quantification of the design, the paper uses shape grammar to make the line profile for the feature elements of product modeling, and takes the Fourier decomposition as the quantification method of feature elements, making the judgments on product designing change from the qualitative one to the quantitative one, then effectively avoids the perceptual deviation in designing. In the experiment, due to the

uncontrollable factors and variables in the experimental environment, such as the light and the unbalanced move of people's eyes, there may be a little deviation in the result. Accordingly, it is necessary to pay attention to the experiment settings. And the research directions in the future are as followed. Firstly, making significant research on feature elements and the whole modeling style from different latitudes. Secondly, how can the quantitative analysis provide guidance for practice in a more effective way.

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On Teaching Reform of College English Based on Mobile Learning

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Abstract: Mobile learning is an effective form of college English teaching which can meet the personalized needs of language learners. With the development of mobile communication technology, mobile media terminal also shows a trend of diversification, but how to combine mobile learning with micro-video and micro-audio closely, in order to learn English scientifically and effectively for learners, is a major problem. Based on the theory of mobile learning, this paper tries to implement a new teaching model facilitated by smart mobile phone that can motivate students. We analyses the advantages of the micro-video and micro-audio, and then focuses on the strategies in making or selecting micro-video and micro-audio. Through the data analysis, we try to get information about the actual situation of college students' mobile learning.

Keywords: Mobile Learning, IELSMD questionnaire, Teaching Reform.

1. Introduction

Teacher-centered teaching approach has been dominant in China's college English instruction for a long time. Teachers are regarded as knowledge-spreaders and error correctors, while students tend to be satisfied with what is taught in class. Classes are directed by teacher-speech and dependent heavily on textbooks or lesson plans. The classroom instruction has been based on the misconception that it is of necessity for students to acquire a fixed world of knowledge. Consequently, many college English learners have been accustomed to relying on teachers' feeding, and at the same time, they are deprived of the competence of motivation and communication.

Computer assisted language learning method seems to be a possible solution to change the situation. With the development of mobile communication, mobile learning is becoming a new teaching and learning theory (Vázquez et al., 2016).

M-learning or mobile learning is defined as "learning across multiple contexts, through social and content interactions, using personal electronic devices. M-learning technologies include handheld computers, MP3 players, notebooks, mobile phones and tablets. M-learning focuses on the mobility of the learner, interacting with portable technologies. Using mobile tools for creating learning aids and materials becomes an important part of informal learning, under this mode, m-learners use mobile device educational technology at their time convenience.

M-learning is convenient in that it is accessible from virtually anywhere. Sharing is almost instantaneous among everyone using the same content, which leads to the reception of instant feedback and tips. M-learning also brings strong portability by replacing books and notes with small devices, filled with tailored learning contents.

Student-centered learning, also known as learner-centered education, broadly encompasses methods of teaching that shift the focus of instruction from the teacher to the student. In original usage, student-centered learning aims to develop learner autonomy and independence by putting responsibility for the learning path in the hands of students (Pedersen et al., 2003). Student-centered instruction focuses on skills and practices that enable lifelong learning and independent problem-solving. Student-centered learning theory and practice are based on the constructivist learning theory that emphasizes the learner's critical role in constructing meaning from new information and prior experience (Hannafin et al., 2009).

Student-centered learning puts students' interests first, acknowledging student voice as central to the learning experience. In a student-centered learning space, students choose what they will learn, how they will learn, and how they will assess their own learning This is in contrast to traditional education, also dubbed "teacher-centered learning", which situates the teacher as the primarily "active" role while students take a more "passive", receptive role. In a teacher-centered classroom, teachers choose what the students will learn, how the students will learn, and how the students will be assessed on their learning. In contrast, student-centered learning requires students to be active, responsible participants in their own learning and with their own pace of learning.

Usage of the term "student-centered learning" may also simply refer to educational mindsets or instructional methods that recognize individual differences in learners. In this sense, student-centered learning emphasizes each student's interests, abilities, and learning styles, placing the teacher as a facilitator of learning for individuals rather than for the class as a whole.

The main goals and contributions of this paper are the use of a new learning theory based on mobile learning (Carvalho et al., 2015), combined with the practice of college English listening and speaking teaching and put the theory into practice. We analyze the problems in listening and speaking teaching and provide some appropriate teaching strategies. With making or selecting interesting micro-audio and micro-video materials which were played in mobile media terminal, we hope English learners can practice more effectively.

This work is organized as follows. Section 2 describes related work. In Section 3 we introduce the overview of mobile learning. In Section 4 study design based on mobile learning theory is proposed. In Section 5 data analysis is given. In Section 6 we conclude this paper.

2. Related work

Over the past two decades, technology devices have become mobile to the point that they have become pervasive in everyday life. The use of mobile devices has become common among a wide range of age groups due to affordability and availability (Rebecca et al., 2009). Significant investments have been made to provide infrastructure, content, and

resources related to the integration of mobile devices into learning environments, and researchers have long had an interest in this evolving landscape.

Nilgün (Nilgün et al., 2009) defined mobile learning as "learning with the assistance of mobile devices, or the intersection of mobile computing, the application of portable, and wireless computing and communication devices and e-learning as learning facilitated through the use of information and communications technology"

A lot of research papers reported the use of short messages (SMS) for language acquisition on mobile phones. For example, researchers adopted text messages as a means of offering vocabulary practice for quizzes and surveys. Thoronton (Thoronton et al., 2005) carried on three researches in mobile phone learning. They tested university students in Japan regarding the email sending through the mobile phones, attending vocabulary lessons by SMS at fixed intervals and using mobile phones to instruct English idioms. The results indicate that students taking mobile phones facilitated instruction had a better performance than students participating in conventional lessons. Students considered the use of mobile phone in learning as "a valuable teaching method" and they rated its "educational effectiveness" highly in the classroom.

A study by Kiernan (Kiernan et al., 2004) evaluated the use of mobile phones as tools for classroom instruction. University freshmen were grouped into three: group one made use of text messages through mobile phones, group two used e-mail through computer, and group three just received traditional teaching without any electric devices. The study concludes that mobile device is an effective English learning device that is worth further research. There is another study supporting the usage of mobile phones in English learning. The researchers adopted an SMS system to provide feedback on assignments for undergraduate students. The above studies show that students hold a positive attitude towards SMS communication if only no extra cost was incurred.

Audio clips have been applied to improve pronunciation for EFL study by Klein. The results of this study reveal that short units should be adopted as the content (Klein et al., 2002). Lara has also employed video clips to facilitate language learning on mobile devices. Nevertheless, the large video file size and small size screen discourage their use on cell phones (Lara et al., 2013).

Drawn from the above literature, the results provide the converging evidence that students' English language competence is promoted by using smart phones.

3. Mobile learning overview

Mobile learning is the delivery of learning, education or learning support on mobile phones, PDAs or tablets. E-learning has provided the ability for traditional learning to break out of the classroom setting and for students to learn at home. Mobile learning has enhanced upon e-learning by taking it a step further and allowing students to learn virtually anywhere a mobile signal is available.

Mobile learning is the delivery of learning, education or learning support on mobile phones, PDAs or tablets. E-learning has provided the ability for traditional learning to break out of the classroom setting and for students to learn at home. Mobile learning has

enhanced upon e-learning by taking it a new mobile technology, such as hand-held based devices, is playing a large role in redefining how people receive information. The recent advances in mobile technology are changing the primary purpose of mobile devices from making or receiving calls to retrieving the latest information on any subject. "Numerous agencies including the Department of Defense (DoD), Department of Homeland Security (DHS), Intelligence community, and law enforcement are utilizing mobile technology for information management."

Applications in classrooms and other learning spaces combine the use of handheld computers, PDAs, smartphones or handheld voting systems with traditional resources. Mobile devices in the classroom can be used to enhance student-centered learning, group collaboration among students through communication applications, interactive displays, and video features (Murray et al., 2011). Existing mobile technology can replace cumbersome resources such as textbooks, visual aids, and presentation technology. Access to classroom activities and information on mobile devices provides a continuum for learning inside and outside the classroom.

Mobile devices can be used in brick-and-mortar or online settings to enhance learning experiences. The mobile phone (through text SMS notices) can be used especially for distance education or with students whose courses require them to be highly mobile and in particular to communicate information regarding availability of assignment results, venue changes and cancellations, etc. It can also be of value to business people, e.g. sales representatives who do not wish to waste time away from their busy schedules to attend formal training events. Mobile devices facilitate online interaction between instructor and student, and student to student.

M-learning in the context of work can embrace a variety of different forms of learning. It has been defined as the "processes of coming to know, and of being able to operate successfully in, and across, new and ever changing contexts, including learning for, at and through work, by means of mobile devices".

Learning for work, which could be also described as 'just-in-case' learning, involves classic and formal education activities, such as training courses, that prepare learners for future work-related tasks. A typical, corporate application is the delivery of mobile compliance training, which can be seen as a viable means to reach geographically mobile employees, such as consultants or staff in logistic and transport systems. Another application is mobile simulations that prepare learners for future situations, for example real-time SMS-based simulations for disaster response training.

Learning at and through work, which could be labelled as "just-in-time" mobile learning, occurs in informal education settings at the workplace. Employees can use the mobile phone to solve problems via handheld devices in situ, for example by accessing informational resources (such as checklists and reference guides) prior to customer visits or mobile decision support systems. The latter are popular in clinical settings where they support highly mobile medical staff through rule-based algorithms in the decision regarding more complex patient cases. Their application was associated with learning and in particular with practice improvement of medical staff. Learning through work also occurs by interacting with distant peers via phone. "People tagging" is an approach whereby people assign topics they associate with co-workers. The aggregation

of interests and experiences serves not only as a means to raise awareness but also to help find competent experts on demand, for example with context-sensitive expert location systems.

Cross-contextual learning that bridges the gap between work settings and formal education formats has perhaps the biggest potential for work-based mobile learning, especially with respect to tertiary education systems. This involves approaches in which learning in the workplace is facilitated and substantiated (for example through formative assessments, reflective questions or the documentation of personal achievements in multimedia learning diaries or portfolios The so-created materials are later used in more formal educational formats, for example in the classroom or in the discussion with tutors. The value of these mobile phone-mediated learning practices lies in the integration and reconciliation of work-based learning and formal education experiences which otherwise tend to remain separated.

4. Study design

This study is guided by mobile learning theory, and focuses on the practical application in college English listening and speaking. Mobile devices which are available for the students are used as the platform. Some micro-video and micro-audio which are suitable for students' psychological characteristics were designed and can stimulate students to learn at any time and any place. During this process, we summarize the problem, searching or making more learning materials. And revising some teaching strategies and applied the strategies in class.

There are 1500 college students involved in this study, including 643 English majors and 857 non-English majors. The participants who answered the IELSMD (investigation on English listening and speaking with mobile devices) questionnaire are sophomores aged from 18 to 22 years old from Foreign Languages Department, Economics Department, Software Department and Art Institute. They were randomly made the Control Class (CC) and the other the Experimental Class (EC).

In order to know the electronic devices college students have, learning status with their electronic devices and the obstacles they encounter while practicing college English listening and speaking, IELSMD questionnaire was made. Table 1 lists all the variables in our study.

Before performing the experiment, the participants received a pre-test for assessing their initial English competence. The next phase lasted for one semester when the two sorts of classes received two modes of instruction.

In the control class, the teacher still adopted a traditional multimedia-assisted presentation, practice, production model. The content of the experiment class is as follows.

Classroom activities: The classroom activities are conducted with the objective of conducting mobile devices assisted learning activities as well as motivating and preparing students to engage in subsequent out-of-school activities. Ask a host of

Variables	Description
	A. Yes B. No
Q1. Do you have cell phones or other electronic devices? Q2. What are your mobile devices on hand?	A. Cell phone B. MP3/MP4/MP5 players C. Electronic dictionary D. Laptop E. Ipad
Q3. What do you often do on the Internet?	A. Chat B. Playing games C. Studying
Q4. Do you often study English online?	A. Often B. Sometimes C. Occasionally D. Never
Q5. Do you love watching micro-video on line to practice English listening and speaking?	A. Love it Very much B. Love a little C. don't love at all
Q6. Do you love listening to micro-audio on line to practice English listening and speaking?	A. Love it very much B. Love a little C. Don't love at all
Q7. How long do you prefer the video or audio clip to last?	A. 3 - 5 minutes B. 5 - 10 minutes C. Longer than 10 minutes
Q8. What do you often do to practice English listening and speaking?	
Q9. What kind of materials are you interested in while studying on line? Q10. What are the obstacles you encounter in English listening and speaking?	

Table 1 – Description of the IELSMD questionnaire

questions relevant to the subject and ask the students to make use of their phones to find the answer as quickly as they can. This will enable students to be familiar with the background information of the questions, along with recognition of some crucial keywords of lecture. Students are allowed to take a few minutes to study the background information systematically on the website by using 4G webs or WiFi through their mobiles. Before one puts forward the questions, teachers can require students to put away their phones and quizzing them. Students explain the new words and expressions with the photos or videos they either take themselves or find from the internet. There are a few ways to realize this goal. Stu-dents can just describe the pictures or video to the class and explain how they are associated with the words or expression relevant or they can ask other students to find the appropriate expressions to match the picture or videos.

Out of class activities: WeChat is a new and powerful mobile communication tool, which supports sending voice, video, photo and text messages. WeChat works on Android and IOS devices. We created a group for the whole class and students were required to

register and join the group. Students can message any question, and then the teacher can answer through Wechat instantly or find the chance to answer the questions with salient features in the next class. What's more, two or more questions on the same point will give valuable feedback or direction on what part of the class were more difficult to follow.

5. Data analysis

There are three topics in the questionnaire about the types of electronic devices held by students. According to the survey, cell phone is the most commonly used among students, with one cell phone for each, about 75 percent of students use MP3/MP4/MP5 players, 67 percent of students use electronic dictionaries, 45 percent of the students use laptop, 38 percent of the students use iPad, the comparison is shown in Figure 1.

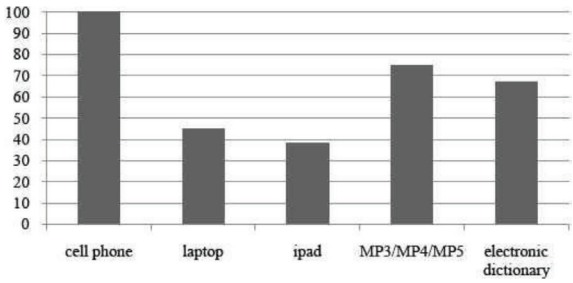

Figure 1 – Various electronic devices of students

In the statistical results of 1470 valid questionnaires, 100 percent of the students get the access to the Internet with their devices; 98 percent of students conduct online learning; in a variety of learning styles, and 53.21 percent of the students think micro-video can have better effects; 34.79 percent of the students believe that micro-audio can improve their English pronunciation and have good effect on improving listening ability; 9.87 percent of the students think the form of learning is not important, and they can take advantage of network resources to learn off their own bat: 2.13 percent of the students never study online. The analysis results are shown in Figure 2.

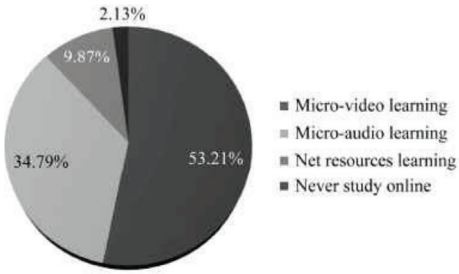

Figure 2 – Ratio of students' learning with the electronic devices

Ten obstacles students often encounter in English listening and speaking were selected. They are listed by descending order of proportion as following: 1) do not understand the

meaning of words; 2) can not recognize the learnt words; 3) recognize the words, but don't know the meaning in the material; 4) miss the later sentence while thinking about the former sentence; 5) former obstacles lead to misunderstanding later information; 6) forget the information just heard quickly; 7) do not understand the key information; 8) understand the meaning of every word, but do not understand the overall meaning of discourse; 9) can not keep up with the speaker or are not used to the speaker's accent and intonation; 10) do not understand the cultural context involved in the contents. Table 2 shows the proportion of the ten barriers before and after mobile learning training (Hu, 2015).

	1	2	3	4	5	6	7	8	9	10
Pre-training	100	100	97.13	97.13	92.98	92.83	85.87	84.63	82.57	82.39
Post-training	40.1	34.25	21.20	22.54	17.25	11.34	7.67	23.12	12.57	68.29
Decline	59.9	65.75	75.93	74.59	75.73	81.49	78.20	61.51	70.00	14.10

Table 2 – Decline in the proportion of the obstacles

Data analysis shows that after studying through micro-video and micro-audio method, there is a substantial decline in the proportion of the obstacles except the tenth one.

6. Conclusions

Advanced technology and increased availability of mobile technologies have altered and expanded the scope of education. A variety of mobile learning tools have been used in the field of education, which benefit learners, teachers, schools and society. The findings of our study demonstrate that the approach that combines class-room instruction and out of class activities has been proved effective in enhancing college English competence, especially English listening and speaking can be greatly enlarged. The result of the questionnaire also confirms the effectiveness of the new mobile assisted learning mode. Besides, it stimulated the enthusiasm of students.

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An Algorithm of Pressure Drop Prediction in Vertical Pipes based on Test Data

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Abstract: Hasan model is the common calculation model of pressure drop in the oil and gas field development. Based on Hasan model, the results of multiphase flow test show that the relative average error of Hasan model is 40.46% and the maximal relative error reaches 95%. Through the comparison between the predicting error and the test condition number of the Hasan model, when the liquid volume flow rate is constant, the predicting error of Hasan model has close relationship with the gas liquid ratio and has no obvious correlation with the water content. In this paper, the piecewise linear interpolation model is established to represent the relational expression between the predicting error of the Hasan model and the gas liquid ratio. Combing the piecewise linear interpolation model and the Hasan model, a new pressure drop predicting model denoted as HM model is proposed. By dealing with the test data, the calculation results show that the predicting average relative error of HM model decreases to about 9.48%. HM model improved the pressure drop predicting accuracy of multiphase flow. It contributes to improve the reliability of oil-gas well design and analysis.

Keywords: Multiphase flow – Pressure drop – Predicting error – Hassan model – Linear interpolation

1. Introduction

The pressure drop prediction of multiphase flow is the important theoretical basis of oil-gas well design and analysis. The researchers have done a lot of work on the pressure drop prediction (Li et al., 2009; Bounaouara et al., 2005; Peng and Wang, 2016; Fu et al., 2016; Wei et al., 2014; Poettman and Carpenter, 1952; Hagedorn and Brown, 1965; Prkiszewski, 1967; Aziz and Govier, 1972; Beggs and Brill, 1973). People have striven to research a better correlation of the pressure drop prediction of multiphase flow for oil-gas wells.

As early as 1914, Davis-Weider, the researcher of Wisconsin university, published a large amount of experimental data obtained from the experiment which lift water by air in the vertical well with diameter 31.75 mm (Poettman and Carpenter, 1952). The researchers associated the friction factor in wells with the slippage and tried to get the curve which is consistent with the friction factor of single phase flow. But it failed. The reason is

that the total flow density of mixture is not considered and only the density of water is used. In 1952, the researcher Poettmann-Carpenter of Phillips Petroleum published an article which discussed the application of the multiphase vertical pipe flow in the gas lift operation design (Poettman and Carpenter, 1952). This paper is considered as the most classical achievement about the multiphase vertical pipe flow in oil wells before 1960s. It is widely accepted in the Petroleum engineering. The hypothesis of the method is: (1) the oil-water mixture flow is considered single phase flow; (2) the density of the mixture is not changed; (3) the flow is turbulent; (4) the fluid viscosity is ignored; (5) the temperature gradient is linear. It reasonably introduced the computational methods of mixture mass and volume. The flowing pressure in wells reaches a certain accuracy. But because the flow is considered as homogeneous flow model, this model doesn't reflect the changing characteristics of gas liquid ratio, density and viscosity with respect to the well depth. This method is fit for the cases of high flow rate and low gas liquid ratio and it has large error in the case of low flow rate and low density. Although this method is improved the researchers Baxendell-Thomax, Tex, Fancher-Brown and Hagedorn-Brown, this method is not applied in engineering. In 1961 and 1963, Duns-Ros pressure drop model is another method which has significant influence in the oil industry. Duns-Ros proposed dimensionless groups. It played an important role for the development of multiphase vertical pipe flow in oil wells. The flow regime map is developed in depth so far. Duns-Ros model has perfect accuracy in engineering and it is more applicable to shorter pipe segment. But for the wells which has large depth and pressure difference, it must calculate piecewise. In 1965, Hagedorn-Brown built an entirely empirical correlation based on gas-liquid two phase slippage to be suitable for the flow model of long pipes (Hagedorn and Brown, 1965). This model gives the fully empirical correlation based on the slip model of the gas-liquid two phases. The analysis indicates that the friction factor can be obtained by Moody chart. In the case of high flow rate, the energy loss is caused by friction and it can relate to Reynolds number. The result of the friction factor of two phases flow are close to that of single phase flow. In the case of low flow rate, static pressure gradient plays a main role in the total pressure loss. Because the static pressure gradient is increased by the slip action of gas and oil, the calculation results are not consistent with the Moody chart. Hence, it requires to calculate the liquid holdup to modified the friction factor and then solve the static pressure gradient. In this case, the Reynolds number needs to be redefined by the mixture rate, viscosity and density which are used in the Moody chart. Although it is an empirical correlation, it has high accuracy in application and the slip model is widely used in the horizontal multiphase flow. In 1967, Orkiszewski (1967) used the original data of Hagedorn and defined a coefficient which is changed as the change of the liquid type, viscosity, flow rate and pipe diameter. The coefficient is called the liquid distribution coefficient Γ. Orkiszewski method generalized the calculation of slug flow proposed by Griffith-Wallis to the scope of high flow rate. Orkiszewski firstly applied the concept of bubble lift speed which reflects the two-phase flow mechanism to the pressure drop calculation of two-phase flow in vertical oil and gas wells. The method completely gave the discriminated method of flow pattern and firstly calculated each flow pattern separately. As the pressure drop calculation method for gas and oil two-phase flow, the model method of flow pattern is applied in the oil industry. Orkiszewski method is proved to be one of the most reliable methods for all flow patterns. In 1972, Aziz-Govier-Fogarasi (1972) proposed the flow pattern distribution map which is more reliable and simple than Duns-Ros. In this distribution

map, the transition boundary of flow pattern is clear and convenient to deal with by using computer with the given expression. In the terms of density and friction loss, Aziz-Govier-Fogarasi introduced the local gas volume factor through the effect of gas liquid separation. It showed the difference between the Aziz correlations and the homogeneous flow model. This method is reasonable theoretically and was widely accepted by oil industry. In 1973, Beggs-Brill (1973) proposed the equations of pressure gradient based on homogeneous flow energy equations. Beggs-Brill found that there exists dependency relation between the liquid holdup and the angle of inclination. Because most studies focused on the vertical flow or horizontal flow, it is not successful when the relevant laws are applied to the inclined tube flow. Only the Beggs-Brill pressure drop model can be applied to the pipe which has arbitrary angle of inclination. But this method is not good for calculating the liquid holdup and the friction coefficient is not continuous. In 1980, considering the transition mechanism from one flow pattern to another flow pattern, Taitel-Bornea-Dukler (1980) proposed the physical model described the transition and developed the transition equation of theoretical basis to construct the flow pattern map. In 1986, Hasan-Kabir (1986) gave the predicting model of pressure gradient in oil wells with respect to various flow pattern based on the research results of transition mechanism of gas liquid two-phase flow proposed by Taitel. Hasan-Kabir model is based on the flow mechanism and it is widely used in the oil industry. In 1994, Ansari et al. (1994) modified some coefficients of correlations, and combined the previous research results of the flow pattern mechanism to build a predicting model of pressure gradient with detailed comprehensive mechanism properties. It has two characteristics: (1) it uses modelling method of flow pattern transition mechanism; (2) for each flow pattern modelling, it solves the liquid holdup of the flow pattern based on the hydrodynamic characteristics of bubble motion and then gets the pressure drop correlation logically. Ansari method still cannot deal with the churn flow. The churn flow is considered as part of slug flow. This method is more strict and complete than the previous methods in the description of the physical phenomenon and the modeling of pressure drop prediction. The practicability of Ansari method needs the test of the oil industry application.

Among the existing prediction model, Hasan model widely used for the vertical wells and it is a representative calculation model for pressure drop prediction. According to the results obtained by dealing with the test data given by this paper, the average relative error between the pressure drop calculated by Hasan model and the test pressure drop exceeds 40%. Hence, it is necessary to further study the Hasan model and establishes a new pressure drop model. Because there is no obvious regularity shown in Figure 1 between the pressure drop calculated by Hasan model and the test pressure drop, the modeling approach proposed in the reference (Li et al, 2016) is not suitable for the Hasan model. The modeling approach proposed in reference (Dong, et al, 2016) doesn't require strong regularity for data and has strong generalizability. But the realization process is complex. This paper will simplify the modeling approach proposed in reference and establish a new pressure drop prediction model based on Hasan model.

Firstly, the predicting error of Hasan model is defined in Eq(1) which is denoted as PE_H.

$$PE_H = CPd_H - EPd \tag{1}$$

In Eq(1), *PE_H* denotes the predicting error of Hasan model. *cpd_H* denotes the calculating pressure drop of Hasan model. *EPD* denotes the test pressure drop. Then the relation between *PE_H* and parameters which are gas liquid ratio and liquid flow rate is analyzed. Taking the liquid volume flow rate and *PE_H* as the abscissa and the ordinate respectively, the piecewise linear interpolation model is established and denoted as PH model. Finally, combining the PH model and Hasan model, a new pressure drop prediction model denoted as HM model is built. The calculating results show that HM model has higher accuracy.

2. Prediction of Hasan Model

The test conditions are described in this section. The pipe is vertical. Five liquid volumetric flow rates and five gas liquid ratios are given. The test temperature is between 14 and 27 with unit degree centigrade. The test media are air, white oil and water. Test pressure drop value is from 0.57 to 3.12 kPa/m. The pipe diameter is 63 mm. Three water contents are given. The roughness is taken as 0.0003 mm. The comparison results between the calculating pressure drop of the Hasan model and the test pressure drop are shown in Figure 1. Most calculating pressure drop of the Hasan model is less than the test pressure drop. The average error of the Hasan model is 1.254 kPa/m and the average relative error reaches 4.46%.

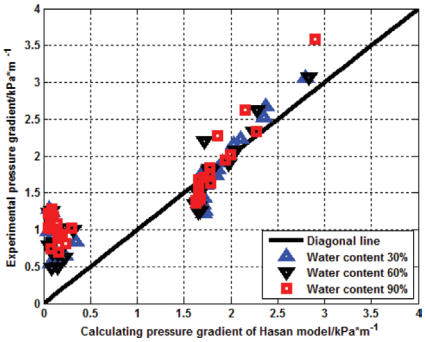

Figure 1 – Comparison between the calculating pressure drop of Hasan model and the test pressure drop

For different liquid flow rates, the curve is drawn shown in Figure 2. The abscissa and the ordinate are gas liquid ratio and the predicting error, respectively. From Figure 2, four results can be obtained below.

1. Among the error curves with water contents 30%, 60% and 90%, no one error curve lies between other two error curves. It shows that the effect of water content on the error has no obvious regularity.
2. Under different liquid flow rates, there exists some differences for the value ranges of the predicting errors.
3. Under the same liquid volume flow rate and gas liquid ratio, the effect of the water content on the predicting error is generally small.

For the constant liquid flow rate, the predicting error curves with respect to the gas liquid ratio have some similarity on the geometry.

Hence, regard to the constant liquid flow rate, the correlative relation expression between the predicting error and gas liquid ratio is considered to be established.

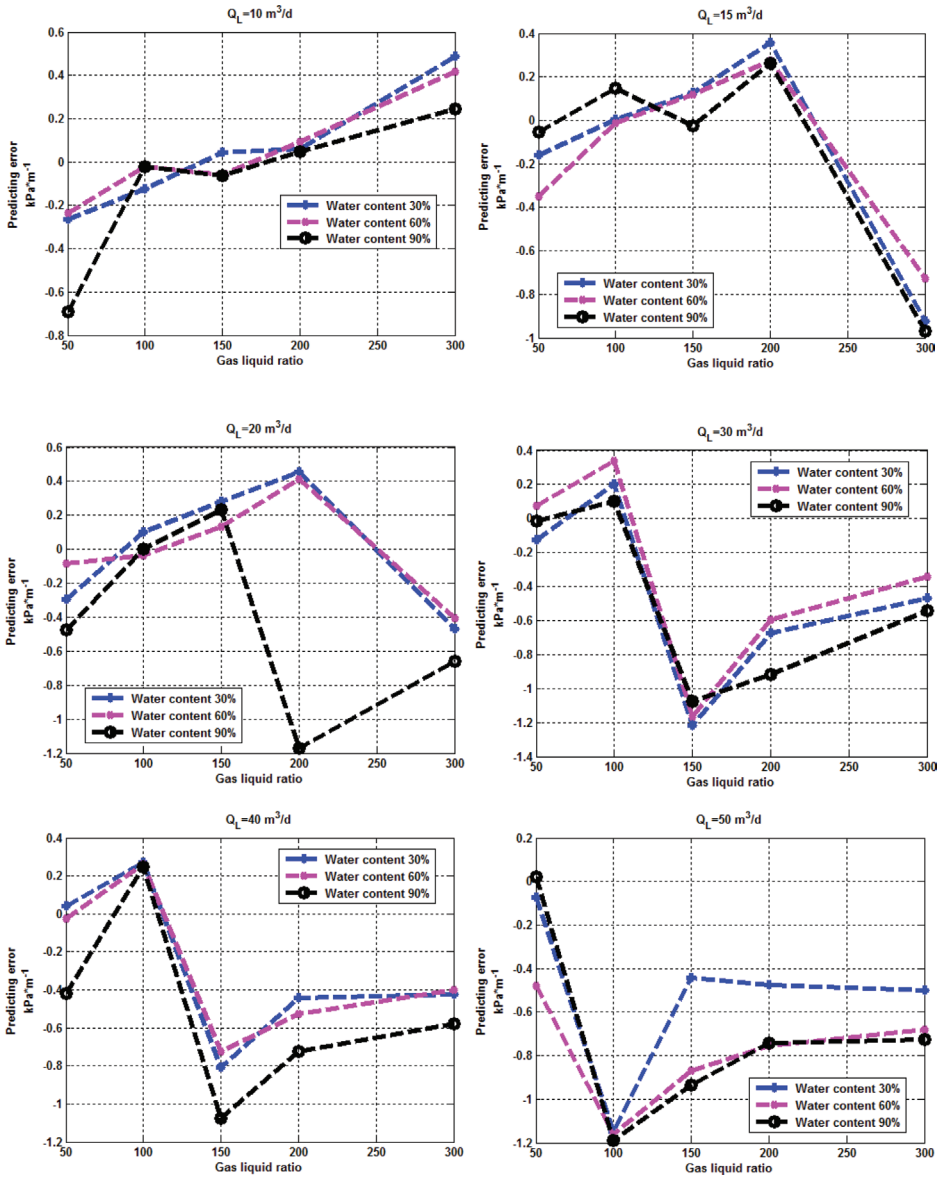

Figure 2 – Correlation between the pressure drop predicting error of Hasan model and gas liquid ratio under different liquid volume flow rate

3. Piecewise linear interpolation model of the predicting error of Hasan Model

In accordance with the foregoing analysis, for six different liquid volumetric flow rates, the piecewise linear interpolation model of the predicting error is established with respect to the gas liquid ratio.

The piecewise linear interpolation model is established under two cases.

Case 1 If the liquid volume flow rate is one of the values 10, 15, 20, 30, 40 and 50 m^3/d given by the test. The predicting model is established as follow.

Step 1 Under the same liquid volume liquid flow rate and the same gas liquid ratio, the average value of the predicting errors corresponding to different water contents is evaluated by Eq(2).

$$x_i = \frac{x_{i,1} + x_{i,2} + x_{i,3}}{3} \tag{2}$$

In Eq(2), x_i denotes the average predicting error under the i-th gas liquid ratio for i=1,2,3,4,5 corresponding to five gas liquid ratios 50, 100, 150, 200 and 300 respectively. $X_{i,1}$ denotes the predicting error corresponding water content 30%. $X_{i,2}$ denotes the predicting error corresponding water content 60%. $X_{i,3}$ denotes the predicting error corresponding water content 90%.

Step 2 The data points (t_i, x_i) for i=1,2,3,4,5 are constructed. t_i is the quotient obtained by dividing the i-th gas liquid ratio by 300.

Step 3 The piecewise linear interpolation model is shown in Eq(3) under the unknown gas liquid ratio t×300.

$$x(t) = \begin{cases} x_1, & t < 1/6 \\ \dfrac{t_i - t}{t_i - t_{i-1}} x_{i-1} + \dfrac{t - t_{i-1}}{t_i - t_{i-1}} x_i, & t_{i-1} \le t \le t_i, i = 2,3,4,5 \\ x_5, & t > 1 \end{cases} \tag{3}$$

If the liquid volume flow rate equals one of the values in the test, then the error prediction model of the Hasan model can be determined by Eq(3).

Case 2 If the liquid volume flow rate Q_L is not equal to the given values in the test, then the predicting model is established below.

Step 1 If $Q_L < 10$, then the error prediction model corresponding liquid volume flow rate 10 m^3/d is used. It is shown in Eq(3).

Step 2 If $Q_L > 50$, then the error prediction model corresponding liquid volume flow rate 50m^3/d is used. It is shown in Eq(3).

Step 3 If $Q_1 < Q_L < Q_2$, where $(Q_1, Q_2) = (10,15),(15,20),(20,30),(30,40),(40,50)$, then the error prediction models denoted as $x^{(1)}(t)$ and $x^{(2)}(t)$ are built with respect to the liquid volume flow rates according to the case 1. And the error prediction model corresponding to the liquid flow rate Q_L is built in Eq(4).

$$x(t)=\frac{Q_2-Q_L}{Q_2-Q_1}x^{(1)}(t)+\frac{Q_L-Q_1}{Q_2-Q_1}x^{(2)}(t) \tag{4}$$

Hence, the error prediction model under the conditions of arbitrary liquid flow rate and gas liquid ratio can be established.

Figure 3 shows the predicting error of the Hasan model and the predicting values of error under the given liquid volume flow rates in the test.

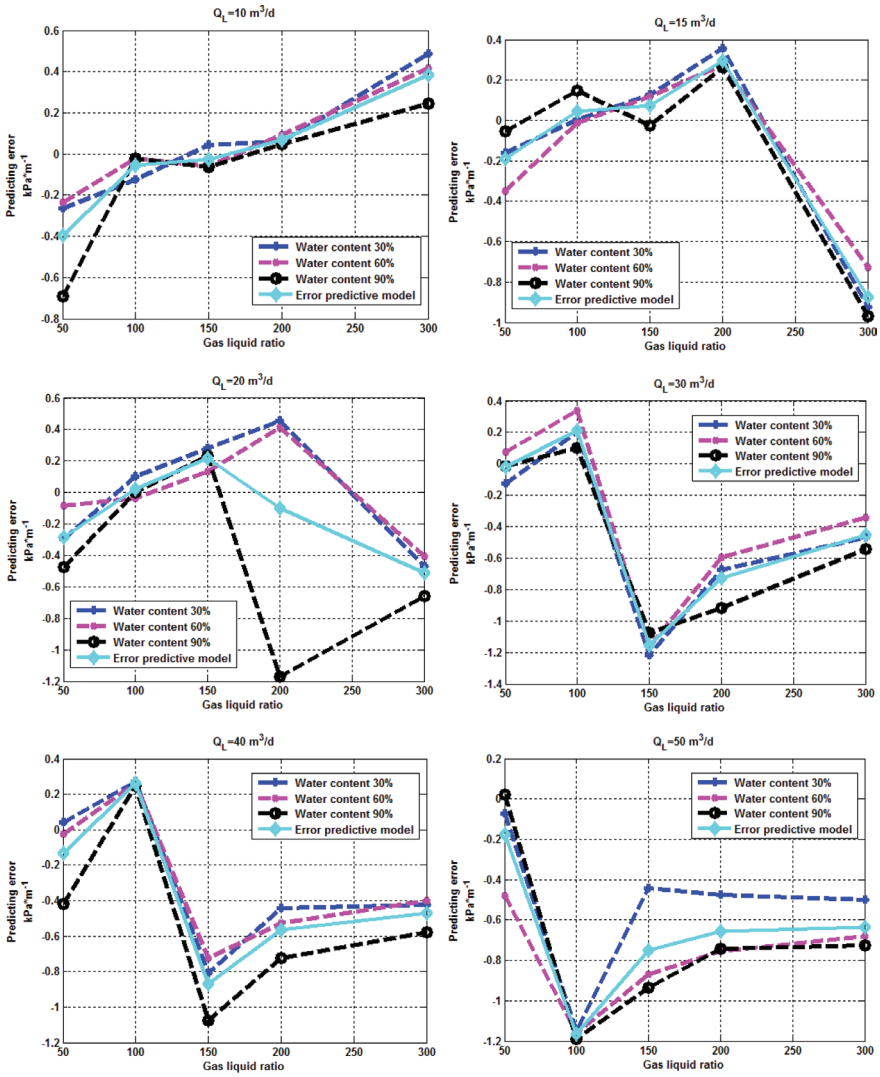

Figure 3 – Predicting error of the Hasan model and the predicting values of error under the given liquid volume flow rates

4. Modified Hasan Model

As indicated in the introduction, the Hasan error is the value obtained by subtracting the test pressure drop from the calculating pressure drop of the Hasan model. Combining the Hasan model and error prediction model, the new pressure drop prediction model is established in Eq(3). The modified model is denoted as HM model.

$$HM\ model = Hasan\ model - EP\ model \tag{3}$$

The predicting pressure drop of the HM model is shown in Eq(4).

$$HM\ Value = Hasan\ Value - EP\ Value \tag{4}$$

In Eq(4), *HM Value* denotes the calculating pressure drop value of the HM model with unit kPa/m. *Hesan Value* denotes calculating pressure drop value of the Hasan model with unit kPa/m. *EP Value* is the error prediction value obtained from the error prediction model with unit kPa/m.

5. Test of HM model

In order to test the HM model, the calculating pressure drop value of the HM model is compared with the test pressure drop firstly. The comparison results are shown in Figure 4. In Figure 4, the abscissa of the data points is the calculating pressure drop value of the HM model and the ordinate is the test pressure drop. Obviously, comparing with Figure 1, the distribution of data points in Figure 4 is more close to the diagonal line and more uniform. It shows that the predicting pressure drop of HM model is more consistent with the test pressure drop.

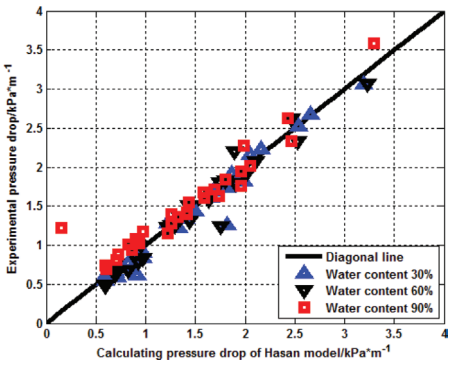

Figure 4 – Comparison between the predicting pressure drop of HM model and test pressure drop

The relative error of the predicting pressure drop of HM model is

$$err = \frac{|HM\ Value\text{-}E\ Value|}{E\ Value}, \tag{5}$$

where, *E Value* denotes the pressure recorded in the test.

In Table 1, the relative errors for part of the data points between the H model and HM model are compared. On average, the relative error of the HM model is far less than the one of H model.

Data serial number	The relative error of H model/%	The relative error of HM model /%
1	2.36	3.89
2	26.44	4.31
3	-85.5	7.6
4	2.24	9.63
5	-92.86	1.59
6	-3.28	-1.8
7	19.96	-1.66
8	-82.22	21.98
9	-1.4	6.07
10	-92.73	0.36
11	-3.44	-1.96
12	19.25	-2.58
13	-88.96	-20.14
14	-18.39	-12.49
15	-92.89	-1.89

Table 1 – Comparison the relative errors between the H model and the HM model

6. Conclusions

1. Firstly, the predicting error of the Hasan model is established with respect to the gas liquid ratio. And then, a modified pressure drop prediction model is established, that is HM model.
2. With regard to the test pressure drop, the average relative error of the HM model is 9.48%.
3. By comparing the calculating pressure drop between the HM model proposed in this paper and the Hasan model, it shows that the new model is superior to the Hasan model.
4. The modified model proposed in this paper is heavily dependent on the the test data. The more the data points are given, the more accuracy the results are. Hence, if the data points are increasing, the model proposed in this paper has more superiority. Based on the characteristics of the model proposed in this paper, some new techniques such as a measurement method for three-

dimensional turbulent velocities based on vector decomposition and synthesis [16] can be used to improve the accuracy of the test data. But being limited by the cost factor, the size of the test data points cannot be increased indefinitely, the numerical simulation techniques proposed in the references [17] and [18] can be considered. It needs some simulation data. And then the simulation data is compared with the test data. The simulation data which can be consistent with the test data is to be used as the teat data.

Acknowledgement

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Empirical Study for Factors of Customer Satisfaction Based on B2C Online Shopping

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Abstract: In order to have a comprehensive and deepening study on the "people-oriented" college student management work, a neat, scientific and complete theoretical framework must be set up. In order to establish this kind of scientific and comprehensive theoretical framework, the core concept of relevant problems must be fully recognized. Defining the "people-oriented" college student management work, going into the nature of student management work and correctly grasping factors that influence people-oriented college student management work are necessary premises to study people-oriented college student management work. After determining the basic frame work of the scientific and comprehensive people-oriented college student management work, we will begin to see the system problem of college student management work and its manifestations. According to the progress of the society and the development of the times, fully understanding about the existing problems in the college student management work and its causes, discussion on the subject of people-oriented college student management work and fully demonstration of college student management work with people-oriented as the subject are according with era development and realistic requirements. Constructive suggestions are proposed on ways and methods of achieving people-oriented college student management work. Have a profound understanding about student management work and the meaning of student management work to social and individual development. Elaborate the objectives of student management work and provide a scientific and reasonable theoretical way for achieving people-oriented student management work.

Keywords: B2C, Online shopping, Customer satisfaction.

1. Introduction

Electronic commerce specifically B2C (Business to Consumer) has been a popular medium for users to obtain information about products and services, conduct buying and selling transactions (Korner et al., 2000; Nolasco, 2016). Thus, customer satisfaction for B2C website is crucial in attracting online shoppers to visit a cyber store and learn about its products and services and in ensuring repeat purchases. Practically all Internet users are their potential customers (Sá et al., 2016). Whether or not they can convert their potential customers into real ones and retain them depends on the service they offer and the customer satisfaction consumers perceive. Customer satisfaction is a critical issue in the success of any business system, traditi onal or cyber store.

Lots of researchers have presented their ways of the modelling of customer satisfaction. Among them, some studies proposed factors (expectations and disconfirmation) and consequences (intention to purchase) of customer satisfaction. However, these studies were based on traditional channels. Whether or not these results are appropriate for the cyber store of electronic commerce still remains to be seen.

Data mining techniques to customer satisfaction have been become more and more important. Data on customer satisfaction have been discussed in many studies, such as find the path travel mode, the website flow, the product is the most visited, the hot areas of a web page, the customer profile based on these browsing data.

The main purpose of understanding customer satisfaction is to predict the future value of an individual. It is achieved by building a model based on user's demographic characteristics, life-style, and previous behaviour. The model produces information that will focus customer retention and recruitment programs on building and keeping the most profitable customer base. It is called customer profiling. A customer profile is a tool that helps target marketers better understand the characteristics of their customer base.

The main goals and contributions of this paper are intended to explore the factors of customer satisfaction and to examine the relationships between customer satisfaction and the factors of the cyber store. Firstly, we begin by attempting to apply the factors we have adopted from the existing literature on customer satisfaction to the cyber store during our interviews with them. Their ideas as to what really matter to their customers give us valuable data from which our factors of customer satisfaction, through our analysis, are derived. Then a model is established with a series of hypotheses. All of these factors, the model and hypotheses are further examined and analyzed through data mining techniques.

This work is organized as follows. Section 2 describes related work. In Section 3 we explain our research model with hypotheses and data mining techniques. In Section 4 data analysis is given. In Section 5 we conclude this paper.

2. Related work

Despite the increased use of the online shopping as a new shopping channel, many researchers, however, have reported that the number of online shoppers and total sales through the online shopping are still marginal as compared with those in traditional retailing. For example, there are many online bookstores available on the Internet; however, not many users are using the online facilities to purchase books. This might be due to reasons such as poor website design, slow loadings of web pages, unattractive interfaces, or other related matters hindering users to adopt the electronic technology for purchasing purposes (Lohse et al., 1998).

According to Hoffman (Hoffman et al., 1995), website facilities do significantly influence attitudes towards online purchasing intention as users choose to visit a website if the websites fulfils their criteria. Some good criteria that are used in evaluating websites are clarity, accessibility, coverage and reliability.

The concept of customer satisfaction occupies a central position in marketing thought and practice. Bearden think that satisfaction is important to the individual consumer because it reflects a positive outcome from the outlay of scarce resources and the fulfilment of unmet needs (Bearden et al., 1983).

Churchill (Churchill et al., 1983) urged disconfirmation as an intervening variable affecting satisfaction and that the effect of disconfirmation is adequately captured by expectation and perceived performance. They used experimental procedures and processed two types of products: a durable and a nondurable good. The results suggested the effects are different for the two products. Rather, that satisfaction was determined solely by the performance of the durable good.

Tse (Tse et al., 1988) followed the results proposed by Churchill, and investigated customer satisfaction formation. Results of a laboratory experiment suggested that perceived performance exerted direct significant influence on satisfaction in addition to those influences from expected performance and subjective disconfirmation. However, expectation and subjective disconfirmation seem to be the best conceptualization in capturing customer satisfaction formation.

Besides, there is a two measure instrument of customer satisfaction. They include the ratio and difference between perceptions and expectations. Cooper (Cooper et al., 1989) has adapted the SERVQUAL instrument designed by Parasuraman (Parasuraman et al., 1989) and compared these two instruments. The investigation found that the 'ratio of perceptions' and expectations resulted in a scale with lower reliability, lower relative validity, and had dimensions that were more difficult to interpret than the scale developed using the 'differences of perceptions'. SERVQUAL include five dimensions: tangibles, reliability, responsiveness, assurance, and empathy. Further empirical research was also undertaken on other targets: telephone companies, insurance companies, and banks in order to confirm the reliability and validity of the model.

From the perspective of factors and consequences of satisfaction,

Oliver proposed a model that expresses consumer satisfaction as a function of expectation and expectancy disconfirmation. Results have confirmed this concept (Oliver, 1980). Moreover, satisfaction significantly affected customer's attitude and their intention to purchase.

Bearden (Bearden et al., 1983) also studied the same issue. His data obtained from 375 members of a consumer panel in a two-phase study of consumer experiences with automobile repairs and services were used to examine the factors and consequences of consumer satisfaction. The results support previous findings that expectations and disconfirmation are appropriate determinants of satisfaction, and suggest that complaint activity may be included in satisfaction or dissatisfaction research.

In order to investigate the moderating effects of customer satisfaction, Carsky (Carsky, 1989) examined information, prior beliefs, experience and styling preferences for automobiles on consumer satisfaction and intention to repurchase. Data were obtained from experiment and the results indicated that information would moderate satisfaction, but not intention to repurchase.

3. Methodology

From the discussions of related literatures above, we find that few researches have described and verified the relationships between customer satisfaction and its factors for cyber store. In this paper, the methodology on research consists of two major parts: research model and data mining method.

3.1. Research model with hypotheses

Case method based on the literatures begins with a pilot case and is followed by multiple cases. From this method a research model may be derived and some hypotheses proposed. The researchers, using the theories of electronic commerce and marketing, have listed a pool of items on factors of customer satisfaction under online shopping environment.

For example, we have chosen a well-known cyber store in China. This company has operated its business for more than ten years and now has a standard demo store. The store sold includes books, computer hardware, software, CDs, etc. We interviewed thirty staff members of this cyber store. They include the general manager, marketing staffs and technicians. After discussions with these staffs, some additional items that affected customer satisfaction were identified. At the end of interviews, a 12-item instrument was developed using a seven point Likert-type scale ranging from “strongly disagree” to “strongly agree.” These items were to be confirmed again by the staff.

Based on the results of the case, the factors of customer satisfaction for cyber store induced five factors: logistical support, technological characteristics, information characteristics, homepage presentation, and product characteristics. Logistical support contained quick response to customers’ needs, providing communication channels, quickly delivering goods for customers, and providing after service. Technological factors contained modern computer and network facilities and well-structured

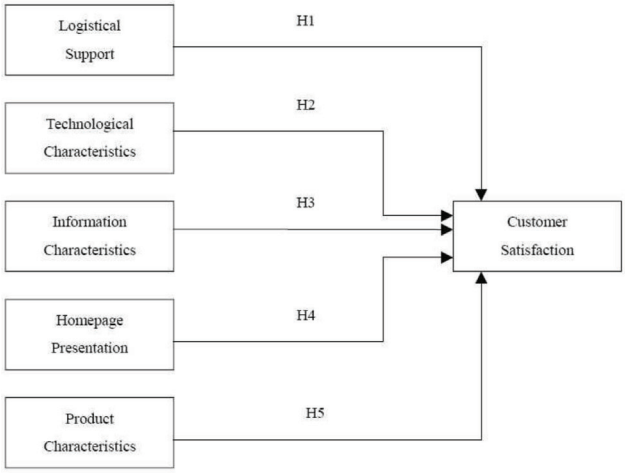

Figure 1 – Research model for the factors of customer satisfaction of cyber store

information systems. Information factors included reliable output information and secure transaction. Homepage presentation contained providing ease to use interface and detail information of goods. Product characteristics included variety of goods and lower prices for goods. Moreover, to measure customer satisfaction, the researchers applied the overall scale attributed to the marketing research.

From the descriptions above, this paper proposes a research model for customer satisfaction of cyber store shown in Figure 1.

Logistical support, technological characteristics, information characteristics, homepage presentation, and product characteristics, are each held to influence customer satisfaction in Figure 1. Thus, the research model encompasses 5 hypotheses regarding factors of customer satisfaction.

3.2. Data mining techniques

Considering the amount of information available for each customer, it is clearly non-trivial to detect the factors of customer satisfaction manually. Data mining and programming tools help to extract automatically prototypical customer profile from data. They are also useful to visualize non-linear interaction of variables. There are several data mining methods, and determination of which to apply can be decided by the quality of the data, the situation, and the objective.

The most known data mining methods are: Clustering, Classification and regression, Association rule discovery and sequential pattern discovery.

Clustering is a technique that puts similar entities into the same groups based on similar data characteristics and those with dissimilar entities are put in different groups. Similarity is measured according to a distance measure function. The meaning of the clusters is therefore dependent on the distance function used. Thus, clustering always requires significant involvement from a business or domain expert who needs to both propose an appropriate distance measure to judge whether the clusters are useful. Clustering example is shown in Figure 2.

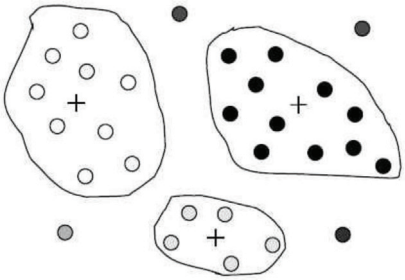

Figure 2 – Data are organized into groups of “similar” values with clustering

Clustering supports the development of population segmentation models, such as demographic-based customer segmentation. Clustering techniques include k-means

or k-nearest neighbours, a special type of neural network called Kohonen net or self-organising maps (SOM).

Classification and regression represent the largest part of problems to which data mining is applied today, creating models to predict class membership (classification) or a value (regression). Classification is used to predict what group a case belongs to.

Regression is used to predict a value of a given continuous valued variable based on the values of other variables, assuming a linear or non-linear model of dependency. Logistic regression is used for predicting a binary variable. It is a generalization of linear regression, because the binary dependent variable cannot be modelled directly by linear regression. Logistic regression is a classification tool when used to predict categorical variables such as whether an individual is likely to purchase or not, and a regression tool when used to predict continuous variables such as the probability that an individual will make a purchase. There are several classification and regression techniques including decision trees, neural networks, Naïve-Bayes and nearest neighbour. Decision trees example is shown in Figure 3.

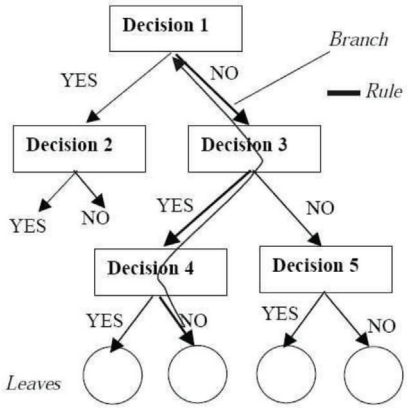

Figure 3 – Traversing the tree from the leaf to the root provides the rule that classifies the target variable

Association and sequencing tools analyze data to discover rules that identify patterns of behavior, e.g. what products or services customers tend to purchase at the same time, or later on as follow-up purchases. While these approaches had their origins in the retail industry, they can be applied equally well to services that develop targeted marketing campaigns or determine common (or uncommon) practices. In the financial sector, association approaches can be used to analyze customers' account portfolios and identify sets of financial services that people often purchase together. They may be used, for example, to create a service "bundle" as part of a promotional sales campaign.

4. Data analysis

A comprehensive survey was distributed through mail to each person who had purchased goods from cyber store and had agreed to participate in the study. Respondents were

voluntary, and people were assured that their individual responses would be treated as confidential.

Eighteen items of questionnaires (twelve items for factors, two items for evaluation of customer satisfaction, and four items for individual data) were sent to respondents. A total of 8900 completed questionnaires (7100 were men and 1800 were women) from 12000 respondents were returned to the researchers. The response rate was 74%. The average age is about twenty-five.

From the research model of Figure 1, we induce five factors as follows:

1. Logistical support: There were four indicators in this study. These indicators included: quick response to customers' needs, providing communication channel for customers, quick delivery of goods for customers, providing after service.
2. Technological characteristics: Two indicators of technological characteristics were included in this study: the importance of providing modern computer and network facilities, well-structured information systems.
3. Information characteristics: It was measured by two item scale. This scale included: reliable output information, and the importance of secure transaction.
4. Homepage presentation: Two indicators of homepage presentation were included in this study: ease to use the interface, and detailed information of goods for homepage presentation.
5. Product characteristics: This measure included: variety of goods, and lower prices for goods.

For the evaluation of customer satisfaction, there were two overall indicators: confirmation of customers' needs, and high degree of satisfaction. All items used a seven point Likert-type scale ranging from "strongly disagree" to "strongly agree." Single item questions were used to ascertain respondents' gender, age, education, and which goods the customers purchased.

Using the sample of 8900 responses, the data were examined by data mining methods. Three different data mining methods were used during the process. Decision tree was used to classify the customers into two groups. The training set consisted of both thousands of customers who satisfy the cyber store and thousands of customers who didn't. With the decision tree model the customers were flagged according to their membership in the group of likely satisfied customers.

Sequential pattern finding was used to find out the frequent sequence of events that preceded the customer satisfaction.

Clustering was finally used to cluster the customers into groups with similar characteristics. The clustering found 12 clusters of customers.

We ended up using classification and regression tree (CART) for prediction. After the training the tree had 29 leaf nodes, which were considered as separate customer segments. Each segment was described by the rules produced by CART. The maximum predicted rate in the leaves was 84 % and the cumulative lift chart can be seen in Figure 4.

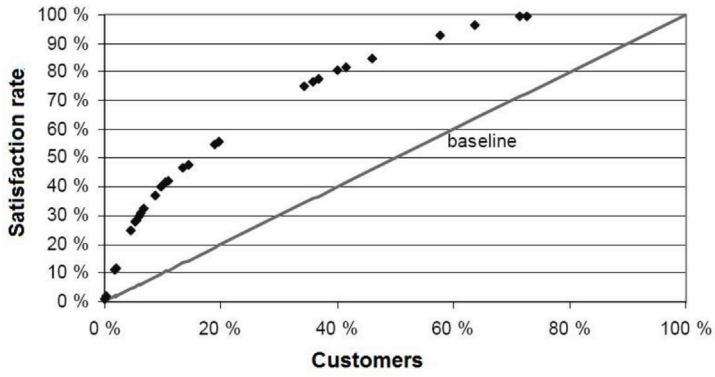

Figure 4 – Predicted amount of customers likely to satisfy

Prediction of factors of customer satisfaction is the next phase in profiling of the online customers. Neural networks are good tools for this kind of tasks and they were trained with online activity of the customers to discover patterns in their behaviour. In addition to give a better knowledge of the existing customers, neural networks can be used to target more efficiently new visitors of the website. Finally, a sensitivity analysis of the neural network gives information about the factors affecting the customer satisfaction. In this particular case the most important factors were quick response to customers' needs, ease to use the interface and products price. Thus, the findings of the sensitivity analysis agree with the previous analyses.

5. Conclusions

The discussion of customer satisfaction in the paper is based toward traditional channels, and there has been little research to explore and examine customer satisfaction and its factors for cyber store on the Internet. We contribute to this area by building a model of customer satisfaction for cyber store and proposing five validated hypotheses. Moreover, a survey was used to examine these hypotheses and found that the factors and customer satisfaction are significantly correlated. At last, we use data mining methods to verify our model.

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The Application of the Improved NMF and LDA Combining Algorithm in Face Recognition

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Abstract: With the rapid development of our society, science and technology as well as the global integration have developed rapidly. Besides, the biometric identification technology has also obtained a rapid development and application. As its most active part, face recognition technology has aroused more and more people's attention. As we all know, the effective feature extraction is an important guarantee of the successful face recognition algorithm. Hence, the Non-negative Matrix Factorization (NMF) feature extraction algorithm is analyzed in this paper. Then, according to the defects in the process of feature extraction, the original NMF algorithm is improved, and the fusion algorithm combined with Linear Discriminant Analysis (LDA) is proposed. First of all, we improve NMF algorithm, and then strengthen the sparsity of base matrix by combining classical objective function and sparse constraints. Secondly, the improved NMF is used to deal with face image to obtain basic image and the coefficient matrix, and then LDA is adopted to classify sample characteristics effectively in solving the subspace. Finally, a common classifier face sample is used to identify. Through testing many databases, we can find that the algorithm proposed in this paper shows a higher recognition rate.

Keywords: Face Recognition, NMF Algorithm, LDA Algorithm.

1. Introduction

The face recognition technology had an early origin. In 1888, Calton (Bledsoe, 1964) published a paper in Nature, an internationally renowned journal, which studied and analyzed human face recognition ability. With the continuous development of technology, face recognition technology had become mature gradually, and a variety of new feature extraction and recognition algorithms had been put forward by scholars. In 1972, Goldstion and Harmon etc. (1973) adopted the geometric characteristics to represent the front face image. In 1991, Turk etc. (1991) proposed a face recognition algorithm based on Principal Component Analysis (PCA). Based on Linear Discriminant Analysis (LDA), the Fisher faces method put forward by Belhumeur et al., was also a very successful one during this period (Yang et al., 2000). According to the effectiveness of this algorithm, some scholars proposed Direct Linear Discriminant Analysis (DLDA) (Yu et al., 2004), and subspace discriminant model (Zhao et al., 1998). In 1988, Kohonen et al., (1988) applied

Self Organizing Map (SOM) neural networks in face recognition. Lawrence et al., (1997) used neural network convolution method in face recognition. In 2004, He et al., (2004) first proposed the Locality Preserving Projections (LPP) algorithm. In 1994 Paatero and Tappe (1994) made a factor analysis on the environment actual data and ensured the non-negativity of factors in the operation process. In 1999, Lee and Seung (1999) presented Non-negative Matrix Factorization (NMF) algorithm in the journal Nature. Professor Oyer (2004) proposed an improved model that is a NMF model with sparse restrictions. Wang (2004), etc. introduced the Fisher authentication information (within-class scatter and divergence class difference) in the target function and constructed the Fisher non-negative matrix Factorization (FNMF) method. Based on the above, this paper combines the improved integration of NMF algorithm and LDA algorithm, and then proposes a fast and effective face recognition algorithm, so as to meet the needs of the rapid development of face recognition technology (Martins and Azevedo, 2013).

2. NMF Algorithm

2.1. NMF Algorithm Basic Principle

NMF is a new method of matrix decomposition. It can solve many problems that can't be solved by the traditional matrix decomposition like PCA (Ge et al., 2009), and ICA (Hyvärinen et al., 2000), etc. First, n times observations are made to a m dimensional random vector. The observation vector sets are written as $\{a_j, j=1,2,...,n\}$, and $A=[A_1, A_{2,...}A_n]$, in which $A_j=a_j$, $j=1,2,.....n$. All the elements of A are set as the non-negative elements, and can be approximated as the product of two non-negative matrices.

$$A_{m\times n} \approx W_{m\times r} H_{r\times n} \tag{1}$$

Classical NMF algorithm is used to solve the non-negative basic matrix M with the size of $m´r$ and the non-negative coefficient matrix H with the size of $r´n$, in which r is the dimension of non-negative matrix decomposition. In general, the selection of r must satisfy $(n+m)r<nm$, which means and are smaller than the matrix A.

2.2. The Target Function and Iteration Rules of NMF Algorithm

Firstly, we must define the target function in order to obtain a decomposition process similar to $A \approx WH$, which can ensure us to achieve the corresponding approximate results. At present, common target functions contain the following two ones: Euclidean distance and generalized KL divergence.

Euclidean distance is commonly used to evaluate the closeness of two matrixes. For example, the distance between matrix A and matrix WH can be expressed as follows:

$$\begin{aligned} F_2(A||WH) &= \sum_{ij}(A_{ij}\log\frac{A_{ij}}{(WH)_{ij}} - A_{ij} + (WH)_{ij}) \\ J &= \arg\max(\frac{J^T S_b J}{J^T S_w J}) \end{aligned} \tag{2}$$

When $A=WH$, the Euclidean distance between matrix A and matrix WH is zero. Hence, NMF can be converted into a constrained optimization problem

$$\begin{cases} F_1(A||WH) = \min\|A - WH\|^2 \\ s.t. W, H \geq 0 \end{cases} \tag{3}$$

The target function $\|A - WH\|^2$ is not a convex function for the two non-negative matrixes W and H, so the globally optimal solution cannot be obtained. While gradient descent method is the easiest way, we can use it to get the locally optimal solution. First, we need to find out the fastest descent direction.

$$\frac{\partial D(A||WH)}{\partial W_{ia}} = \sum_j 2(A_{ij} - (WH)_{ij})(-H_{aj}) = (WHH^T)_{ia} - (AH^T)_{ia} \tag{4}$$

$$\frac{\partial D(A||WH)}{\partial H_{aj}} = \sum_i 2(A_{ij} - (WH)_{ij})(-W_{ia}) = (W^T WH)_{ia} - (W^T A)_{aj} \tag{5}$$

Steps are separately taken as:

$$\eta_1 = \frac{W_{ia}}{(WHH^T)_{ia}} \qquad ,\eta_2 = \frac{H_{aj}}{(W^T WH)_{aj}} \tag{6}$$

Thus, the iteration rule of and can be transformed into:

$$W_{ia} \leftarrow W_{ia} + \eta_1[-((WHH^T)_{ia} - (AH^T)_{ia})] = W_{ia}\frac{(AH^T)_{ia}}{(WHH^T)_{ia}} \tag{7}$$

$$H_{aj} \leftarrow H_{aj} + \eta_2[-((W^T WH)_{aj} - (W^T A)_{aj})] = H_{aj}\frac{(W^T A)_{aj}}{(W^T WH)_{aj}} \tag{8}$$

3. LDA Algorithm

The purpose of LDA technique is to make good classifications on the samples. This algorithm fully uses the known category information of training samples and seeks the projection directional subspaces which must be the most useful to classification. In these subspaces, samples which are projected to the subspace can be maximally classified, that is, different types of training samples after projected can have a minimum inner-class distance and a maximum inter-class distance.

Suppose there are a group of d dimensional samples $x_1, x_2..., x_n \hat{I} R^d$ belonging to two classes, among which the former n_1 samples belong to the class w_1, and the latter n_2 samples belong to the classw_2 . All of them are subject to the Gaussian distribution of the same covariance matrix. The mean vectors of various types of samples are as follow:

$$m_i = \frac{1}{n_i} \sum_{x \in X_i} x \qquad i = 1,2 \tag{9}$$

Sample inner-class scatter matrix:

$$S_i = \sum_{x \in X_i} (x - m_i)(x - m_i)^T \qquad i = 1,2 \tag{10}$$

Total inner-class scatter matrix:

$$S_w = S_1 + S_2 \tag{11}$$

Sample inter-class scatter matrix:

$$S_b = (m_1 - m_2)(m_1 - m_2)^T \tag{12}$$

w is the projecting direction of the best classification. Then the ultimate representation of Fisher criterion function is as follows:

$$J_F(w) = \frac{w^T S_b w}{w^T S_w w} \tag{13}$$

4. Improvement and Implementation of the Algorithm

LDA algorithm has added the face class information, which is more useful for the classified recognition of human face later. However, because of the small samples problem lying in LDA algorithm, LDA algorithm cannot be executed when the extracted characteristic dimensions are much larger than the number of samples. Based on this, this paper presents that first, the improved NMF algorithm is used to conduct the feature extraction on face information, and then the LDA algorithm is used to deal with the feature information extracted by NMF algorithm. To reduce the feature dimensions, this paper makes sparse improvements on NMF algorithm at first.

First of all, the non-negative coefficient matrix H in NMF algorithm is made sparse Improvement. On the target function of Euclidean distance, we add a constraint which can reach the sparsity of coefficient matrix H.

$$\min D(W,H) = \sum_{ij} (A_{ij} - (WH)_{ij})^2 - \lambda \sum_{ij} \frac{1}{(H_{ij} + \varepsilon)^\theta} \qquad s.t. W, H \geq 0 \tag{14}$$

$, \theta, \varepsilon$ are parameters, $\lambda = \frac{1}{\theta}$.

In this paper, the gradient descent method is continually used to figure out the fastest descent direction of the target function.

$$\frac{\partial D(A||WH)}{\partial H_{aj}} = \sum_i 2(A_{ij} - (WH)_{ij})(-W_{ia}) = (W^T WH)_{aj} - (W^T A)_{aj} - \frac{1}{(H_{aj} + \varepsilon)^{\theta+1}} \quad (15)$$

Steps are separately taken as:

$$\eta_1 = \frac{W_{ia}}{(WHH^T)_{ia}} \qquad ,\eta_2 = \frac{H_{aj}}{(W^T WH)_{aj} + \frac{1}{(H_{aj} + \varepsilon)^{\theta+1}}} \quad (16)$$

Then we can obtain the following iterative formula.

$$H_{aj} \leftarrow H_{aj} \frac{(W^T A)_{aj}}{(W^T WH)_{aj} + \frac{1}{(H_{aj} + \varepsilon)^{\theta+1}}} \quad (17)$$

Each image matrix is stored as a column according to the line, and the column vectors of all the training samples will be stored as Matrix *A*. Then the NMF based on the improvement of Matrix *A* is decomposed to form the basic matrix *W* and the coefficient matrix *H*.

The NMF-based feature extraction algorithm has sparsely decomposed high-dimensional images, which meets the LDA requirements for dimensions. We continue to use the LDA algorithm for the optimal discriminant subspace, so that the samples can be maximally distinguished.

Suppose the vector $\{H_1, H_2, \ldots\ldots, H_m\}$, which is made up of coefficient matrixes, belongs to a decomposed coefficient matrix containing m images with C different faces as objects. The total mean vector of the sample is:

$$X_i = \frac{1}{n_i} \sum_{k=1}^{n_i} H_k \quad (18)$$

Put the parameters into the formula, and we can obtain the inner-class scatter matrix S_w and inter-class scatter matrix S_b, and then gain the optimal projection matrix.

$$J = \arg\max\left(\frac{J^T S_b J}{J^T S_w J}\right) \quad (19)$$

We can make the former basic matrix as a projection matrix, and get the final classification features of human faces through projecting and extracting in the optimal identification subspace.

5. Experiment and Analysis

5.1. Database and Algorithm Setting

In order to assess the effect of the method proposed above, this paper adopts ORL face database and Yale face database to test. Under the same conditions, we use PCA, LDA, and NMF as comparison algorithms to verify the validity of our algorithm. Besides, we use the nearest neighbor classifier for classification, and set e=0.5, q=17, g=100 in the improved NMF algorithm. Our experimental environment contains: Hardware environment Intel (R) Core (TM) i5-4300M @ 2.60GHz, 4G memory, and the Windows 7 software environment, with MATLAB as the design language.

Yale face database totally contains 165 frontal face grayscale images of 15 individuals and 11pictures per person. In this paper, the face images in Yale database are all pretreated into pictures with 80 * 80 pixels. ORL database is made up of 400 images, including 40 individuals and 10 face images per person. Besides, the face images in ORL database are all pretreated into pictures with 62 * 47 pixels in this paper.

Figure 1 – Images in Yale face database

Figure 2 – Images in ORL face database

5.2. Experimental Results and Analysis

The performances of different algorithms in Yale database can be seen from Table 1. It shows the recognition accuracy of each method when the number of samples is taken as 3 and 4. As can be seen from the table, the algorithm proposed in this paper has

higher recognition rate than the other traditional algorithms, which obviously has better performance in Yale database.

Yale	Improved algorithm	PCA	LDA	NMF
3	93.2	85.4	86.2	88.4
4	98.7	93.3	94.8	95.0

Table 1 – The best recognition rates (%) of different algorithms on Yale

Table 2 shows the performances of different algorithms in ORL database. It indicates the recognition accuracy of each method when the number of samples is taken as 10 and 15. It can be seen from the table that the algorithm proposed in this paper has higher recognition rate than the other traditional algorithms, which performances better in ORL database.

ORL	Improved algorithm	PCA	LDA	NMF
10	95.7	92.2	92.3	94.3
15	99.2	96.5	95.1	97.2

Table 2 – The best recognition rates (%) of different algorithms on ORL

6. Conclusion

In this paper, the combination between the improved NMF algorithm and the LDA algorithm are put forward to solve face recognition problems. Firstly, a constraint is added to NMF algorithm so that its coefficient matrix can achieve sparsity. Then the improved NMF algorithm and LDA algorithm are combined, which can effectively avoid the small sample problem of LDA algorithm. Finally, the classification of facial images is completed through the classifier design of the nearest neighbour. In this paper, two public face databases are adopted as the experimental data. Experiments show that the algorithm proposed in this paper improves the convergence speed of NMF, and at the same time, enhances the feature extraction speed of LDA. Compared with the results of other algorithms, it is obvious that this algorithm has a higher recognition rate.

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Data Mining of Cultural and Creative Talents on the Association Relationship between Creative Behavior and Motivation Factors

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Abstract: How to use big data and other technology to improve us in decision has been widely discussed. Selecting the appropriate incentives is according to different characteristics of employees, with which can improve staff's innovative behavior, and then to enhance the competitiveness of the whole organization. This is each enterprise manages needs to consider. With crowdsourcing method, this paper from the aspects of incentive factors to study the innovative behavior of technology employees, determine the relationship between technological innovation behavior and incentive factors. After analyzing the data from the questionnaire survey, the author can obtain relevant data on cultural and creative enterprises in Jiangsu Province. Using data mining method, the study finds that the incentive factors and the technological innovation behavior has significant correlation, and puts forward some suggestions.

Keywords: data mining, culture and creative talents, innovation behavior, incentive factors, crowdsourcing.

1. Introduction

Nowadays, big data has brought us a lot of results which we did not expect as before (Ferreira et al, 2015). With this, the frequency of cultural and creative talents' initiative and innovation activity directly determines the economic benefit of enterprises, which has important influence on the sustainable development of enterprises. Grasp the law of cultural and creative talents' innovation behavior, design reasonable incentive mechanism, improve employee's innovation enthusiasm, and then enhance competitive power of the whole organization, is each enterprise managers need to consider.

This paper intends to use data mining method, and analyze the relationship data between creative behavior and incentive factors of cultural and creative talents, and then puts forward suggestions on the construction of cultural and creative enterprises' incentive mechanism.

2. Theoretical Review

Richard in the book "The rise of the creative class", think that the creative class is made up of two types of members. A group is a "super creative core" groups, including scientists

and engineers, university professors, poets and novelists, artists, actors, designers and architects; another group is ideological pioneer of modern society, such as nonfiction writer, editor, cultural figures, think-tank members, analysts and other "opinion makes" (Richard, 2010). Li, Zeng, et al. from the perspective of the nature of labor begin to define the creative talent, and that the essence of creative talents is mental workers, by exerting own ability to provide products and services with high added value (Li, 2011). Kanter believes that innovation is a multi-stage process, the proposer of creative ideas is an initial stage (Kanter, 1988).

Based on Kanter's point, Scott and Bruce divided individual innovation behavior into three stages: the first stage is the establishment of problem, that is, the generation of solutions or innovative ideas; the second stage is the support seeking that want to try to set up the union of supporting the idea of personal and find person who support their ideas; the third stage is to convert innovation idea into "product", namely the final output innovative ideas, the transformation stage (Scott, 1994). Zhou and George think that individual innovation behavior not only reflected in its innovative idea creation, promotion, development and formation of executable plan, but also in the innovation of the idea itself, to ensure that finally able to effective implementation of innovative ideas; they have also made clear that the start and foundation of the organizational innovation is individual innovation (Zhou, 2001). Based on the investigation and empirical study, Mahan puts forward especially for knowledge workers of four important motivating factors, respectively for individual development, wealth, work autonomy, business results (Paul, 2003).

Top five of the motivation of the knowledge employee incentive factors are promising company, guaranteed and stable work, personal development and growth, wage incentive compensation, challenging work, was by Wang Jun Zhang, Professor Jian Feng Peng derived from empirical research on Chinese knowledge employee incentive factors (Zhang, 2001). In the research on the incentive mechanism of employee's innovation behavior, Willson discusses in detail the motivation of the research and development staff from the material demand as the starting point (Willson, 1994). John puts forward from the incentive material, methods and fairness to encourage research and development staff to do research (John, 1993). Chester put forward incentive standards for the R & D personnel, including the implementation of the team incentive, nonmonetary incentives, organizational incentives, personal incentives (Chester, 1995). Watson found that the job satisfaction of individuals depends on the rich working salary, a variety of workplace training programs and a good supervisor, after exploring the leadership behavior of job satisfaction research (Watson, 2009).

Bundy, Einfeld and Jooste proposed that strengthen the staff's work skills is the decisive factor of incentive factors, and incentive factors are divided into two aspects, one is the system, other hand is the employee's personal belief (Bundy, 2009). Zhu and Xu, who constructed a model of combination incentive based on the target interest and points out that enterprise and scientific research personnel are not exactly consistency in the interests of the target, from the point of view of product innovation to hold incentive measures, analyze the substitution relationship of the spiritual and material incentives

(Zhu, 2004). Zhang and long through the analysis of 316 of leader - member matched data, investigated the relationship between performance salary and team members' exploratory innovation behavior and the use of innovative behavior, and test the appraisal cycle regulation effect (Zhang, 2013).

3. Research Routine and Questionnaire Design

This paper intends to use data mining method analyzing the relationship between creative behavior and incentive factors of cultural and creative talents, and then puts forward suggestions on the construction of cultural and creative enterprises' incentive mechanism. This article according to this research ideas, proposing the question, analyzing the problem, solving the problem and empirical analysis, constructing theoretical framework - recognizing characteristics of creative talent group - obtaining research data-the data correlation analysis - applying data analysis to creative people-putting forward some countermeasures and suggestions.

Survey study on the relationship between corporate culture and creative innovation behavior and incentive factors of creative talents. A total of 25 survey questions. In addition to the basic situation of the first part of the survey, the questionnaire designed by 5 Likert scale, with the level of 1-5 asked the respondents to a question of the description of the situation to judge. The first part is the basic situation of the creative talents, including the gender, age, education, and time. The second part is the Self cognition survey of creative talents. Including the creation of new ideas, to seek the support of others and the innovation of the product. The third part is the survey of cultural and creative talents incentive factors, including ten questions: personal curiosity, spiritual encouragement, Self-challenge, personal growth, working condition, material incentives, budget guarantee, organization value, innovation atmosphere, the trust of the leadership. Based on a lot of literature to extract the 10 incentive factors, as the main incentive factors of Jiangsu Province' cultural and creative talents innovation behavior. Specific content see Table 1.

4. Data Analysis

In the process of using data mining method, the questionnaire was mainly distributed to cultural and creative enterprises in the Jiangsu Province, a total of 20 research related businesses, 110 questionnaires were issued and 110 were taken back among which 103 are valid.

4.1. Factor Analysis, Reliability Analysis

1. Incentive factor analysis and reliability analysis

Take the principal component analysis method for incentive program to carry on the factor analysis, the main component analysis method and the maximum variance rotation method are used to analyze the multidimensional structure of the incentive factors for the 10 items. In accordance with the characteristic value of more than 1, the

Dimension	Incentive factors	Index interpretation
personal development and growth	personal curiosity	curiosity is the driving force for your creative work
	spiritual encouragement	you want to be commended for innovative behavior
	self-challenge	you like challenging your limits.
	personal growth	you want to get opportunities from work to enhance knowledge and skills.
working condition and compensation	working condition	your unit encourages creative talent to solve the problem in a creative way
	material incentives	your unit's material incentives to make you excited
	budget guarantee	your unit can fully supply the required capital or budget for the project.
	organization value	your unit attaches great importance to cultivate and retain the relevant creative talents
innovation atmosphere and interpersonal relationship	innovation atmosphere	your unit express support and affirmation for the innovation of creative talents
	leader trust	your supervisor will be fair to measure the performance of each creative talent.

Table 1 – Incentive factors of culture and creative talents

factor load is not less than 0.4 of the standard extracted 3 factors. Factor load in 0.548 - 0.791, cumulative variance ratio of 59.653%. Analysis for the reliability of the incentives factors scale, incentive factors of the overall scale of alpha=0.859, with good reliability. Among this, personal development and growth factor (alpha)=0.794 more credible, work condition and compensation (alpha)=0.815 very credible, innovation atmosphere and interpersonal relationships (alpha=0.679) belongs to the reliability of relatively small, is still acceptable. Therefore, the internal consistency of the questionnaire data is very good, and it has good stability (MARTINS and AZEVEDO, 2013). Table 2 has shown the incentive factors scale reliability analysis results.

2. Innovative behavior factor analysis and reliability analysis

In this paper, we used the principal component analysis method to analyze the factors of the 9 item of the innovative behavior scale, and determine the 3 factors according to the broken stone figure. This paper names three factor as seeking innovative solutions (3 items), seek support (3 items), innovative productized (3 items). The cumulative variance of the three factors explained 83.371% of the variance, which seeks support explain the 29.32% variation, seeking innovative solutions to explain 28.904%, and 25.147% of innovative product interpretation. Analyze the reliability of the innovative behavior scale, he overall scale reliability of the innovative behavior a=0.918, which has a very good reliability. The component table in the search for innovative solutions

(a=0.903) is very credible, seek support factor (a=0.855) is very reliable, innovative products (a=0.791) is more reliable. Therefore, the questionnaire has good reliability and good internal consistency. Table 3 has shown the innovative behavior factors scale reliability analysis results.

Factors	Factor Cronbach's alpha	Whole scale Cronbach's alpha
personal development and growth	0.794	0.859
working conditions and compensation	0.815	
innovation atmosphere and interpersonal relationship	0.679	

Table 2 – Incentive factors scale reliability analysis results

Factors	Factor Cronbach's alpha	Whole scare Cronbach's alpha
innovation solutions	0.903	0.918
seek support	0.855	
innovation productized	0.791	

Table 3 – Innovative behavior factors scale reliability analysis results

4.2. Correlation Analysis and Regression Analysis

1. Correlation analysis

A higher positive correlation between the dimensions of motivation factors and the dimensions of innovative behavior of creative talents. Seeking innovative solution stage in creative talent innovation behavior and incentive factors of each dimension of the relationship, relationship from strong to weak respectively for personal development and growth, innovation atmosphere and interpersonal relationships, work conditions and compensation. The relations are very significant between cultural and creative enterprises' creative talents to seek innovative solutions and the incentive factors. The relationship between creative talents seek support and incentive factors, from strong to weak for personal development and growth, innovation atmosphere and interpersonal relationship, working conditions and compensation. Relationship between Cultural and creative enterprises' creative talents seeking support stage and incentive factors are very significant. The relationship between product innovation stage and the motivating factors of creative talents from strong to weak respectively for personal development and growth, work conditions and compensation, innovation atmosphere and interpersonal relationship. So the relationship between the creative talent of the cultural creative enterprise and the incentive factors is very significant.

2. Regression analysis

1. To seek innovation solutions as the dependent variable, and the three dimensions of incentive factors as the independent variable to carry on the regression analysis.

After regression analysis, we can find there is a correlation between variables. In order to further analysis the relationship between variables, this article uses the multiple regression analysis. On the basis of the standardized data. SPSS is used to establish regression relationship between independent variable and dependent variable (in Table 4).

model	***R***	***R²***	**Adjusted *R²***	**changed *R²***	**Durbin-Watson**
1	.499	.249	.227	.249	1.652

Table 4 – Regression analysis of incentive factors dimension and active degree of individuals seeking innovative solutions

From the numerical value of the regression coefficient table, there are three factors that do not have the problem of co linearity. Therefore, for the first phase of innovative behavior to seek innovative solutions, the search for innovative solutions (*sis*) can be describe as:

$$sis = 0.388 * pdg + 0.074 * iair + 0.241 * wcr \quad (1)$$

Where: *sis* is the search for innovative solutions;

pdg is personal development and growth;

iair is innovative atmosphere and interpersonal relationships;

wcr is working conditions and remuneration.

It shows that there is a significant positive correlation between the various dimensions of incentive factors and innovative solutions.

2. To seek other people to support the initiative as the dependent variable, and the three dimensions of incentive factors as the independent variable to carry on the regression analysis.

model	***R***	***R²***	**Adjusted *R²***	**changed *R²***	**Durbin-Watson**
1	.370	.137	.227	.137	1.207

Table 5 – The regression analysis of the dimensions of motivation factors and seeking support from others

From the numerical value of the regression coefficient table, there are three factors that do not have the problem of co linearity. Therefore, for the first phase of innovative behavior to seek support for others, to seek others to support the development and growth can be describe as:

$$sso=-0.211*pdg+0.287*iair+0.203*wcr \quad (2)$$

Where: *sso* is the seeking support from others;
pdg is personal development and growth;
iair is innovative atmosphere and interpersonal relationships;
wcc is working conditions and remuneration.

Illustrates the incentive factors of two dimensions and for others to support the existence of significant positive correlation, and in the personal development and growth, and the coefficient is negative, indicating that the creative talent in the dimension tends in self-interest rather than altruism, is cautious in seeking cooperation.

4.3.Taking the initiative of the creativity productized as the dependent variable, and taking the three dimensions of incentive factors as the independent variable to carry on the regression analysis.

model	*R*	R^2	Adjusted R^2	changed R^2	Durbin-Watson
1	.363	.132	.106	.132	1.557

Table 6 – The regression analysis between incentive factors and creativity productized

From the numerical value of the regression coefficient table, there are three factors that do not have the problem of CO linearity. Therefore, for the first phase of innovative behavior to seek support for others, to seek others to support the development and growth can be describe as:

$$cc=0.181 * pdg+0.35 *iair+0.112*wcr \quad (3)$$

Where: *cc* is the commercialization of the creative;
pdg is personal development and growth;
iair is innovative atmosphere and interpersonal relationships;
wcr is working conditions and remuneration.

Over all, it shows that there is a significant positive correlation between the three dimensions of motivation factors and the support of others.

Model	Non standardized coefficient		Standardized coefficient	T	Sig
	B	Standard error	Beta		
(constant)	.00978	.576		0.697	.093
personal development and growth	.548	.149	.388	3.667	.000
working conditions and compensation	-.097	.159	.074	-.606	.546
innovation atmosphere and interpersonal	.273	.133	.241	2.052	.043

Table 7 – Regression coefficient of incentive factors dimension and active degree of individuals seeking innovative solutions

Model	Non standardized coefficient		Standardized coefficient	T	Sig
	B	Standard error	Beta		
(constant)	.00698	.558		0.835	.000
personal development and growth	-.269	.145	-.211	-1.857	.066
working conditions and compensation	.338	.154	.287	2.191	.031
innovation atmosphere and interpersonal	.207	.129	.203	1.611	.110

Table 8 – The regression coefficient of the dimensions of motivation factors and seeking support from others

Model	Non standardized coefficient		Standardized coefficient	T	Sig
	B	Standard error	Beta		
(constant)	.00876	.743		0.524	.000
personal development and growth	.306	.193	.181	1.588	.066
working conditions and compensation	.549	.205	.351	2.673	.031
innovation atmosphere and interpersonal	.153	.172	.112	0.891	.110

Table 9 – The regression analysis coefficient of incentive factors and creativity productized

5. Conclusion

With crowdsourcing method, and after analyzed with data mining, we can find some conclusions to the relationship such as:

1. Individual development and growth has a significant positive effect on the creative behavior of creative talents in the cultural and creative enterprises

From regression equation, personal development and growth factors have entered into the regression equation, and there is a correlation with innovative behavior, this shows that the incentive factors of innovative behavior of creative talents are personal development and growth factors.

The company provide related technical training for the creative talents while improving the technology innovation ability of employees, meeting the staff self-development and growth needs, complete the technical knowledge system, finally to improve the technological innovation level of employees.

At the same time, the creative talents in the individual development dimensions tend to be selfish rather than altruistic, when search for cooperation, they are cautious, this means that we need to guide for innovative cooperation of the kind of talent actively.

2. Innovation atmosphere and interpersonal relationship motivation both have significant positive effect.

By the coefficient of the regression equation, we can know that the innovation atmosphere and the interpersonal relationship factors are the most important factors in the whole innovation behavior, which indicates that the innovation atmosphere and interpersonal relationship are the most important factors.

Innovation atmosphere and interpersonal motivation can promote employee innovation behavior in seeking support phase, which is due to strengthen communication between the technology innovation individual, under the good atmosphere of innovation and organizational innovation environment, the accumulation and recreation of technology is a good foundation.

When people are in an atmosphere of mutual trust, a working environment conducive to openness, communication and communication, always be more creative.

On the other hand, good innovation atmosphere and interpersonal relationship in the entire firm to promote the staff to share the technical knowledge they have mastered, so that the technical staff in the daily work can get more technical resources.

3. The working conditions and compensation has a significant positive impact on the innovative behavior of the technical staff.

The fundamental guarantee for employees to carry out technical innovation is to enrich the technical knowledge, perfect working environment, as well as the matching of salary and benefits and other material incentives. And generous pay and perfect welfare conditions will give employees a good living conditions, the staff's life is stable, no worries, and also conducive to the innovative behavior of staff.

Good working environment and perfect technical innovation infrastructure make the staff's technology innovation environment more comfortable and convenient. Flexible workplace and working hours to provide a more convenient platform for staff's technological innovation.

Although the incentive factor for innovative behavior is a relatively low correlation factor, but not the incentive factors, for the innovation of technical staff is unfavorable. And the development of innovative behavior need protection of pay and work environment.

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Statistical Analysis in Transmission Lines Based on the Quasi-Monte Carlo Method

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Abstract: The uncertainty of geometric parameter decided by the transmission lines distribution will result in changes of the crosstalk of transmission lines, thus this paper proposes a statistical method on the crosstalk of transmission lines in frequency domain based on QMC (Quasi-Monte Carlo) method. This method can not only accurately predict the change value of the crosstalk of transmission lines, but also obtain probability density function of the crosstalk of transmission lines. Compared with the predictive results of numerical experiment by the traditional MC (Monte Carlo) method, the method in this paper is more efficient on statistical analysis of the crosstalk of transmission lines, and the computed result is also more accurate and stable, which offers reliable basis for the wiring harness layout of equipments and pre-design of integrated circuit in the perspective of EMC (Electromagnetic Compatibility).

Keywords: EMC; crosstalk of transmission lines; statistical analysis; QMC method

1. Introduction

For the reason that the circuit integration degree and the digital signal frequency is becoming higher with the rapid development of electronic technology, there needs to pay enough attention to the signal integrity problems. In those problems, the the crosstalk of transmission lines from the wiring harness in electrical and electronics equipments and the interconnects in PCB (Printed Circuit Board) becomes more and more outstanding, which can lead to equipment performance degradation, even failure in some serious situations (Hara and Colebrooke, 2003). The wiring harness positions will change now and then for different installation methods and working conditions of equipments, the process fluctuations of PCB interconnects will also appear in manufacturing process, all which can affect the crosstalk of transmission lines. Through experiments it can be found that the maximum crosstalk due to the position change of wiring harness can be 20dB (Capraro et al., 1981), therefore it is extremely necessary to estimate the uncertainty of the crosstalk of transmission lines.

In recent years, many methods have been applied to the statistical analysis of the crosstalk of transmission lines. Capraro et al. made repetitive simulation experiments for the crosstalk of transmission lines under different conductor configuration by MC

method and statistics for the objective the crosstalk of transmission lines (Capraro et al., 1981; Bellan et al., 2001; Shiran et al., 1993). Beetner et al., put forward the worst-case method by looking for the the crosstalk of transmission lines in limiting position (Beetner et al., 2007; Ranganathan et al., 2002). The RMD method proposed by Salio and Canavero generated the random positions of the transmission lines piecewise by fractal theory, and also made statistical techniques (Aalio et al., 1999); Sun et al., proposed the RDSI algorithm on the basis of RMD method, ensuring the smoothness of every segmentation (Gao et al., 2014; Sun et al., 2007); Wu et al., made the worst-case analysis for the crosstalk of transmission lines by the convolution method (Wu et al., 2008; Wu et al., 2009); Based on polynomial chaos principle, Stievano et al., made statistical analysis for the crosstalk of transmission lines through expressed distribution parameters of the transmission line by orthogonal polynomial and combined with the telegraph equation of transmission line (Stievano et al., 2001); Among these methods, the MC method is widely used because of its simpleness, substantivity and easy implement (Zhang et al., 2001). However, the application effect of MC method in analog simulation is restricted by its slow convergence speed, low calculation efficiency and unstable calculation result et al. Main text of the document, as well as the format applied to subtitles in tables and figures, and the norms used in the references.

The main reason that leads to the MC method's shortcomings shown above lies in its use of pseudo-random number with strong randomness, but insufficient uniformity. In order to improve this problem, replace the pseudo-random number sequence by low deviation sequence with better uniformity to simulate, which is called QMC method (Niederreiter, 1992).Various low deviation sequences, such as Halton sequence, Faure sequence and sobol sequence, have already been used to take place of pseudo-random sequence, which can accelerate the convergence speed, improve the computational efficiency, guarantee the stability and reliability of calculation results, making up for the deficiency of MC method (Singhee et al., 2010; Zou, 2014).

In this paper, the QMC method is applied to the statistical analysis of the crosstalk of transmission lines, achieving the prediction of crosstalk variation range and its probability density distribution function. Compared with the traditional MC method, the results verify the accuracy, efficiency and stability of QMC method in statistical analysis of the crosstalk of transmission lines.

Articles can be written in Portuguese or Spanish.

The article must not exceed 16 pages in its whole, while observing the format here described.

Headlines and footnotes will be added by the editors.

2. The Theory of QMC Method

The page format should be A4, with a top margin of 6,5 cm, a bottom margin of 5,5 cm and 4cm both to in left and the right m Compared with the traditional MC method, the QMC method makes simulation based on the deterministic low-deviation sequence, rather than the pseudo-random sequence adopted by the MC method. The convergence speed and stability of QMC method mainly depend on the deviation. The deviation is

used to evaluate the uniform distribution degree of sequence on the function field, and the more uniform the sequence, the smaller the deviation, the faster the convergence speed, the better the stability and the higher the calculation precision. The traditional MC method is based on the law of large numbers and the central limit theorem, and the error convergence order of pseudo-random number sequence with N numbers is $O\left(N^{-1/2}\right)$. The QMC method is based on number theory, and the deviation convergence order of low-deviation sequence with N numbers is $O\left(N^{-1}\log\left(N\right)^{d-1}\right)$, which related to the dimension d, and its error convergence order is $O\left(N^{-1}\right)$ (Niederreiter et al., 1999). Therefore, the convergence speed of low-deviation sequence is higher than pseudo random sequence. Meanwhile, to reach the same calculation precision, the sample size of the QMC needs will be reduced greatly.

2.1. The Generation of Low-Deviation Sequence

Compared with pseudo-random sequence, the low-deviation sequence can fill the sampling space more uniformly, the arbitrary subsequence created can fill the function space evenly, and each dimension of low deviation sequence is also independent. The low-deviation sequences proposed currently are Halton sequence, Faure sequence, sobol sequence, etc. The sobol sequence has the fastest convergence speed, better distribution uniformity, and doesn't appear gathered phenomenon until 260-dimension.Therefore this paper takes sobol sequence to simulate QMC method (DIMOV et al., 2013). This sequence obeys U(0, 1) distribution, and its production process is as follows:

1. Take d primitive polynomials whose coefficients are 0 or 1, and each polynomial has different order. The primitive polynomial can be expressed as

$$f\left(y\right)=y^{p}+a_{1}y^{p-1}+\cdots+a_{p-1}y^{1}+a_{p} \tag{1}$$

   where p represents order, a_i represents coefficient whose value is 0 or 1.

2. For each primitive polynomial, take p positive odd as initial value $m_1, m_2,..., m_p$, where $m_i<2^i$, the top p values of υ_j can also obtain by type (2) at the same time.

$$\upsilon_j = m_j \big/ 2^j \quad \text{j=1,2,...,p} \tag{2}$$

3. When $i>p$, m_i and υ_j can be produced by the recursive formula(3)

$$\begin{cases} m_i = 2a_1m_{i-1} \oplus 2^2a_2m_{i-2} \oplus \cdots \oplus 2^p a_p m_{i-p} \\ \upsilon_i = a_1\upsilon_{i-1} \oplus a_2\upsilon_{i-2} \oplus \cdots \oplus a_p\upsilon_{i-p} \oplus \upsilon_{i-p} \big/ 2^p \end{cases} \tag{3}$$

   where $\oplus$ represents the bitwise x or of binary.

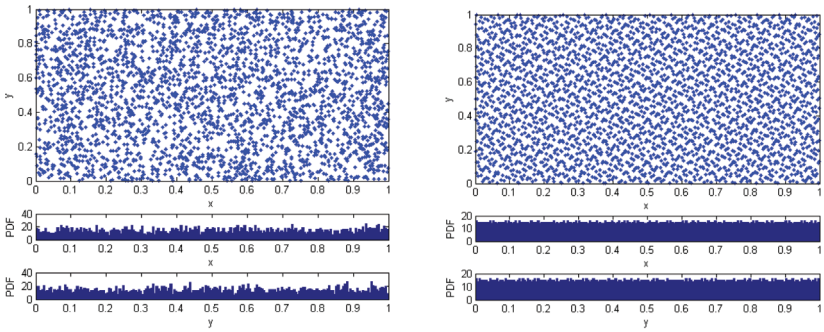
4. The n-th s_n of Sobol sequence can be expressed as:

$$s_n = b_1 \upsilon_1 \oplus b_2 \upsilon_2 \oplus b_3 \upsilon_3 \oplus \cdots \tag{4}$$

where $\cdots b_3 b_2 b_1$ is the binary representation of i.

To facilitate the contrast distribution effect of sobol sequence and pseudo random number visually, the two-dimensional sobol sequence with 3000 elements is generated by above method. Each one-dimensional sobol sequence obeys U(0, 1) distribution, and the comparison diagram with two-dimensional sobol sequence that obeys the U(0, 1) distribution is shown in figure 1.

From figure 1 it can be obviously found sobol sequence has better uniformity and smaller deviation within the interval of (0, 1), which can explain the QMCmethod with sobol sequence has faster convergence speed, better stability, and higher computational efficiency compared to the traditional MC method.



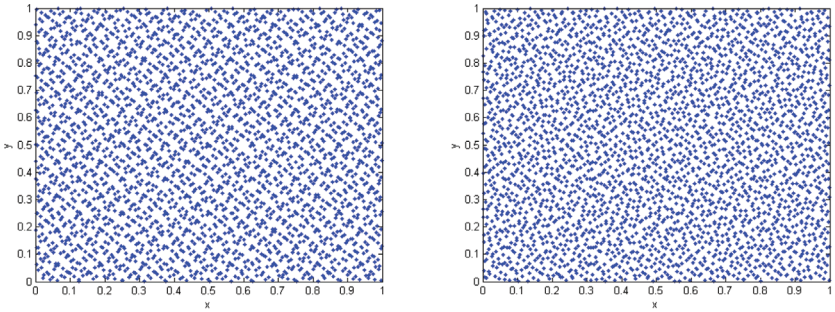
(a) The sampling distribution and histogram of two-dimensiona

(b) The sampling distribution and lhistogram of two-dimensional sobol

Figure 1 – Distribution comparison of two random sampling sequence comparisons (3000 samples)

2.2. The Generation of Low-Deviation Sequence

Sobol sequence is deterministic point series with low deviation, which is bad for simulating some random process. Thus it needs to scramble the Sobol sequence, strengthening the randomness. Using random extraction- replacement method, this paper makes scrambling for the elements generated by sobol sequence. Its basic idea is as follows: suppose the generated sobol sequence is s_1, s_2,..., s_m, then extract one element in these m elements, and exchange it with the last element s_m. To avoid the element is extracted repeatedly, extract one element s_r in the second time and exchange it with the element s_{m-1}. By such analogy, the randomness of sobol sequence with better uniformity can be achieved by extracting m times. As shown in figure 2, the sobol sequence scrambled by random extraction-replacement method shows better randomness.



(a) The sampling distribution of two dimensional sobol sequence without randomizingrandomizing

(b) The sampling distributionoftwo dimensional sobol sequence with randomizingrandomizing

Figure 2 – The sampling distribution comparison diagram of sobol sequence randomness (3000 samples)

The sampling sequence generated by sobol sequence obeys U (0, 1) distribution. However, the model input variables follow uniform distribution in the actual problem, which are assumed to random variables following normal distribution in most situations. Therefore, there needs to make some sort of transformation for quasi random sequence that obeys uniform distribution, obtaining the random variables of required non-uniform distribution types, such as normal distribution.

Take the following as an example: convert the random variables generated by sobol sequence, which obeys U(0, 1) distribution, into the random variables, which obeys the normal distribution. It can be achieved by two steps: the first step is to generate the standard normal distribution series by exchanging the random variables of sobol sequence which obeys the U (0, 1) distribution; the second step is to exchange the standard normal distribution into the corresponding normal distribution based on the mean and variance of necessary standard normal distribution series. The transformation methods in the first step mainly include Box-Muller algorithm and the Moro algorithm. However, compared with Moro algorithm, Box-Muller algorithm is not ideal for tail process effect of normal distribution, at the same time Moro algorithm has relatively fast generating speed. Therefore, this paper chooses Moro algorithm as transform algorithm.

Here make illustration for the Moro algorithm implementation, as shown in equation (5), where the cumulative standard normal distribution function is the integral of standard normal distribution density function. The Y axis of cumulative standard normal distribution follows the unit uniform distribution U (0, 1). Therefore, the corresponding sample value (i.e., X (Y)) on the X axis can be found from the Y axis of cumulative standard normal distribution.

$$Y(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-\frac{s^2}{2}} ds \tag{5}$$

The Y axis of cumulative standard normal distribution is divided into two parts by Moro algorithm, and then takes two corresponding algorithms for processing. One part is the central part, namely $0.08 \le u \le 0.92$, where u is the sample value of quasi random sequence; the other part is the tail part, namely $u < 0.08 \,\&\, u > 0.92$. Moro algorithm takes different algorithm for different part.

When $|y| \le 0.42$ (the corresponding peak part), use the Beasley algorithm, whose estimate value of inverse function $F^{-1}(u)$ is as follows.

$$F^{-1}(u) = \frac{\sum_{n=0}^{3} a_n y^{2n+1}}{1 + \sum_{n=0}^{3} b_n y^{2n}} \tag{6}$$

Where $y=u-0.5$ .The values of constant a_n and b_n are shown in table 1

When |y|>0.42 (the corresponding tail part), use the chebyshev approximation, whose estimate value of inverse function $F^{-1}(u)$ is as follows.

$$F^{-1}(u) = \left| \sum_{0}^{8} c_n T_n(z) - \frac{c_0}{2} \right| \tag{7}$$

where $z = k_1 \left\{ 2\ln\left[-\ln\left(0.5 - |y|\right)\right] - k_2 \right\}$. The values of constant k_1, k_2 and c_n are shown in table 1. So the Y(u) transform from the uniform distribution to the cumulative standard normal distribution function, Moro algorithm has a high degree of accuracy.

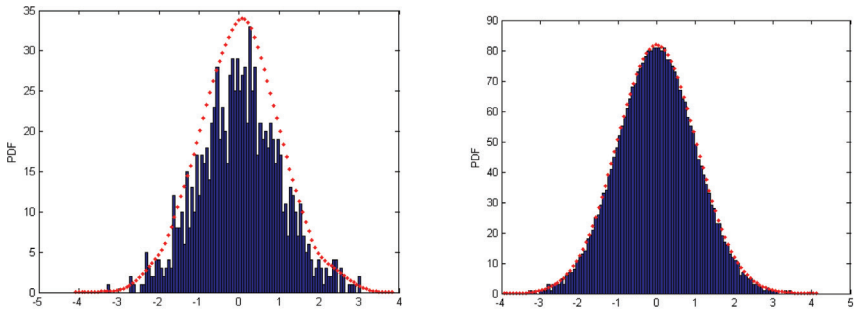
n	a_n	b_n	c_n
0	2.50662823884	1.00	7.7108870705487895
1	- 18.61500062529	- 8.47351093090	2.7772013533685169
2	41.39119773534	23.08336743743	0.3614964129261002
3	- 25.44106049637	- 21.06224101826	0.0373418233434554
4		3.13082909833	0.0028297143036967
5			0.0001625716917922
6			0.0000080173304740
7	k_1	k_2	0.0000003840919865
8	0.4179886424926431	4.2454686881376569	0.0000000129707170

Table 1 – The constant table of Moro algorithm

Figure 3 shows the random sequence contrast chart of quasi-random sequence conformed to the standard normal distribution, which is generated by sobol combined with the Moro algorithm, andpseudo-random number conformed to the standard normal distribution, where samples m = 1000. Through observation it can be confirmed that the former is more conform to the standard normal distribution, which is suitable for practical application.

Combined with the proposed method for generating random number sequence, the simulation process of QMC method can be divided into the following four steps:

1. Determine the function expression $y=f(x_1, x_2,...x_d)$ of statistical model;
2. Determine the distribution type of input variable and sample size m.
3. Generate the sampling samples for every variable by the transformation of the scrambling quasi random sequence to meet the requirements of (2).



(a) Generated by pseudo random number combined with Moro algorithm

(b) Generated by sobol sequence

Figure 3 – The contrast chart of pseudo-random sequence and standard normal distribution sequence by sobol combined with the Moro algorithm

4. Solve the equation by substituting the variable sampling samples generated in (3) into the function expression in (1), and the mean μ_y and variance σ_y of model output can be obtained. Then further statistical analysis can be done according to the actual situation.

3. The Frequency Domain Model of Transmission Line of CrossTalk

Take the traditional three-conductor transmission line as an example in this paper, making statistical analysis for the crosstalk of transmission lines caused by the change of the height h_1, h_2 over the ground and mutual distance S between wires, shown in figure 4.

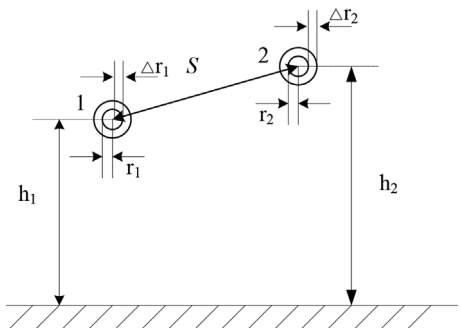


Figure 4 – The actual geometry diagram of wires

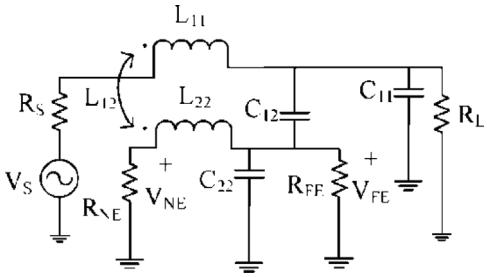


Figure 5 – The equivalent circuit of three-conductor the crosstalk of transmission lines

Figure 5 shows the equivalent circuit diagram of three-conductor transmission line. When make analysis for the crosstalk of transmission lines on the frequency domain, it is mainly focused on the terminal voltage V_{NE} and V_{FE} of disturbance wire, thus this paper takes the crosstalk V_{NE} at near end as an example to carry out statistical analysis. The essence of crosstalk change is the change of distribution parameters between wires. From principle of electromagnetism, it can be confirmed that the mutual inductance of per unit length between wires is as follows (Paul2006):

$$L_m = \frac{\mu_0}{4\pi}\ln(1+4\frac{h_1 h_2}{S^2}) \tag{8}$$

Because of insulation layer, the media surrounding the conductor is uneven, and it can't get the mutual capacitance Cm of per unit length by the important relation $LC = CL = \mu_0\varepsilon_0$. However, the mutual capacitance of per unit length can be obtained by mirror principle, shown in equation (9) (Gao et al, 2011).

$$C_m = \frac{\pi\varepsilon_0 \ln(1+\frac{4h_1h_2}{S^2})}{(\frac{1}{\varepsilon_r}\ln\frac{1}{r_1}+\varepsilon_e\ln\frac{1}{r_1+\Delta r_1}-\ln\frac{1}{2h_1})*(\frac{1}{\varepsilon_r}\ln\frac{1}{r_2}+\varepsilon_e\ln\frac{1}{r_2+\Delta r_2}-\ln\frac{1}{2h_2})-\frac{1}{4}\ln^2(1+\frac{4h_1h_2}{S^2})} \tag{9}$$

Where h_1, h_2 represent the heights over the ground of emission line and disturbance line, respectively; r_1, r_2 are the conductor radius of emission line and disturbance line, respectively; Δr_1, Δr_2 are the insulation layer thickness of emission line and disturbance line, respectively;

μ_0, ε_0 are the vacuum magnetic permeability and vacuum dielectric constant, respectively. $\varepsilon_e = (\varepsilon_r - 1)/\varepsilon_r$ is the effective dielectric constant.

The crosstalk of transmission lines at near end can be expressed as (Bellan et al, 2005)

$$\begin{aligned} V_{NE} &= V_{NE}^{IND} + V_{NE}^{CAP} \\ &= j\omega\frac{R_{NE}}{R_{NE}+R_{NE}}\frac{1}{R_S+R_L}lL_mV_S + j\omega\frac{R_{NE}R_{FE}}{R_{NE}+R_{NE}}\frac{R_L}{R_S+R_L}lL_mC_mV_S \end{aligned} \tag{10}$$

Taking dB as unit, equation (7) can be represented as:

$$NEXT = 20 * \log\left(\left|V_{NE} / V_S\right|\right) \tag{11}$$

where V_s is excitation voltage of emission line; V_{NE}^{IND} ,V_{NE}^{CAP} are the inductive coupling voltage and capacitive coupling voltage of transmission line at near end, respectively; ω is the angular frequency of transmission line.

4. Numerical Experiments

For the three-conductor transmission line shown in figure 4, the wire length is 1 m, the material is copper, the insulation layer is PVC (polyvinyl chloride), the relative dielectric constant is 3.0, the radius of conductor is r=0.4mm, the thickness of insulating layer is Δr =0.6mm. Assume the heights over the ground for the two wires are h_1=h_2=30mm, wire 1 is emission line, wire 2 is disturbance line, where the excitation voltage of emission line is V_S= 1V, the impedances of source end and load end for emission line and disturbance line are h_1, R_S=R_L=R_{NE}=R_{FE}=50Ω. The mutual distance between conductors is S=20mm. Now consider the influence on crosstalk caused by the random changes of height over the ground h_1, h_2 and mutual distance S. Treat h_1, h_2 and S as random variables, which accord with normal distribution, and take standard deviation to 10% of the average, thus the three random variables can be represented as h1~N(30, 9), h1~N(30, 9) and S~N (10, 4).

In the following the statistical analysis of the crosstalk of transmission lines by QMC method will be carried out. Firstly, quasi random sequence of 3-dimensional normal distribution accord with the requirements of above random variables will be generated by the conversion of sobol sequence. Secondly, the samples of unit distribution parameters L_m and C_m can be obtained by substituting the samples of these three variables into equation (8) and (9); The crosstalk can be got by substituting the samples of unit mutual inductance and unit mutual capacitance into equation (10). Lastly, the crosstalk of transmission lines within a certain range of frequency can be got by calculation. Compared with the traditional MC method, it can be found that the QMC method has higher efficiency and better stability in the statistical analysis of the crosstalk of transmission lines.

According to the distribution state and related calculation formula of the above three random variables, the experimental result comparisons of random variables under different sample size m and same sample size by MC method and QMC method can be seen in table 2 and table 3.

Known from table 2, when the sample sizes are 50,100, 500, the mean and standard deviation of the crosstalk of transmission lines calculated by MC method has lager fluctuation than QMC method, which indicates that the MC method become gradual convergence after a larger fluctuation. When make simulation for small sample size, the calculation results are not reliable, whereas the QMC method can achieve ideal result through relatively small sample, improving the computational efficiency. At the same time, by comparing the standard deviation σ of simulation results in the last column

m	50	100	500	1000	5000	10000	σ
μ_p	75.31	71.68	71.88	71.76	71.69	71.92	1.62
μ_q	72.36	72.47	71.85	71.82	71.86	71.85	0.3
σ_p	10.12	8.83	8.07	8.48	8.714	8.74	0.69
σ_q	9.22	8.55	8.81	8.78	8.76	8.78	0.22

In the above table, μ_p is the mean of crosstalk calculated by MC method; μ_q is the mean of crosstalk calculated by QMC method; σ_p is the standard deviation of crosstalk calculated by MC method; σ_q is the standard deviation of crosstalk calculated by QMC method; σ is the standard deviation simulated by different sample size.

Table 2 – The experimental result comparisons under different sample size (f=6MHz, mV)

$\mu_{p,100}$	$\mu_{q,100}$	$\sigma_{mp,100}$	$\sigma_{mq,100}$
71.88	71.86	0.291	0.023
$\mu_{\sigma p,100}$	$\mu_{\sigma q,100}$	$\sigma_{\sigma p,100}$	$\sigma_{\sigma q,100}$
8.82	8.77	0.272	0.082

In the above table, $\mu_{p,100}$ and $\sigma_{mp.100}$ represent the mean and standard deviation of numerical experiment result μ_p by 100 times MC method, respectively; $\mu_{q,100}$ and $\sigma_{mq.100}$ represent the mean and standard deviation of numerical experiment result μ_q by 100 times QMC method, respectively; $\mu_{\sigma p,100}$ and $\sigma_{p,100}$ represent the mean and standard deviation of numerical experiment result σ_p by 100 times MC method, respectively; $\mu_{\sigma q,100}$ and $\sigma_{\sigma q.100}$ represent the mean and standard deviation of numerical experiment result σ_q by 100 times QMC method, respectively;

Table 3 – The numerical experiment result contrasts of 100 times statistics under fixed sample size (m = 1000)

of table 1, it can be found that the standard deviation of simulation results in different sample size is smaller, which also predicts that the simulation results of the crosstalk of transmission lines based on QMC method has better stability.

Through the data in table 3 it can be confirmed that when the sample size is fixed, the mean and standard deviation simulated by 100 times QMC method has smaller fluctuation, which shows that the QMC method has better stability and reliability once again.

The simulation result comparison of QMC method and MC method indicates the efficiency and stability of the QMC method in statistical analysis of the crosstalk of transmission lines. Now predict the range of the the crosstalk of transmission lines in

frequency domain by QMC method, and obtain the probability density distribution of the crosstalk of transmission lines under specific frequency at the same time.

In frequency domain, the rational range of the uncertain the crosstalk of transmission lines caused by the height over the ground and mutual distance of transmission line is $\left[\mu_q + 3\sigma_q, \mu_q - 3\sigma_q\right]$ (Papoulis, 1991). The range of the crosstalk of transmission lines at near end predicted by QMC method is shown in figure 6. From figure 6 it can be found that when the height over the ground and mutual distance are changed, which obey the certain distribution, the range of crosstalk under 9 MHz can reach more than 10 dB, thus it is extremely necessary to make statistical analysis for the the crosstalk of transmission lines.

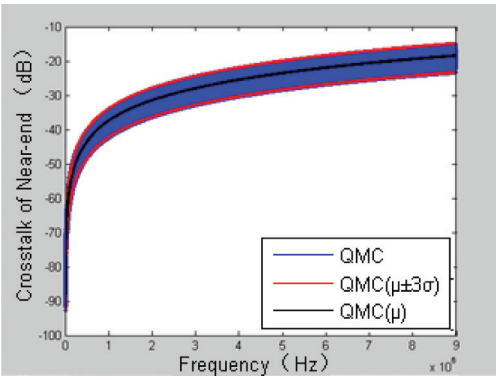


Figure 6 – The range of the crosstalk of transmission lines calculated by the QMC method

At the same time, the QMC method can get probability density distribution function of the crosstalk of transmission lines for random variables which obey specific distribution under one certain frequency quickly. Figure 7 shows the comparison of probability density distribution function for the crosstalk of transmission lines by the QMC method and MC method (sample size m=1000) when the frequency are 30kHz, 128kHz, 6MHz, respectively. From figure 7 it can be seen that the probability density distribution of crosstalk by these two methods is consistent, indicating that the QMC method can be applied to the prediction of probability density distribution function for the crosstalk of transmission lines. Figure 8 shows the comparison of probability density distribution function for the crosstalk of transmission lines by the QMC method and MC method under certain frequency (f=6MHZ) when the random variable sample size is not same. And Figure 9 shows the comparison of probability density distribution function for the crosstalk of transmission lines by 10 times repetition of the QMC method and MC method under certain frequency (f=6MHZ) when the random variable sample size is same. All the two situations consider two cases of small sample size and large sample size. From figure (8) and (9) can be found that the probability density distribution function of the crosstalk of transmission lines obtained by QMC method under different samples is relatively more consistent, showing its better stability in prediction. At the same time, under the same sample size, the QMC method in repeatedly experimental

results is more consistent and stable than the MC method, especially more apparent under the condition of small sample, which indicates that QMC method can guarantee the accuracy and stability in predicting probability density distribution of the crosstalk of transmission lines under small sample size for random variable. Above all, theQMC method is a more efficient and stable algorithm in statistical analysis of the crosstalk of transmission lines than traditional MC method.

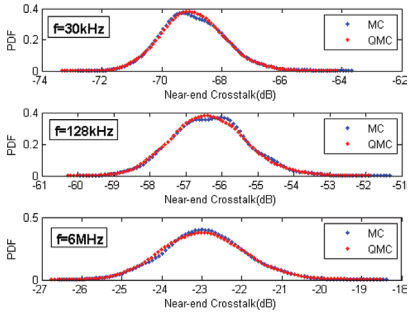
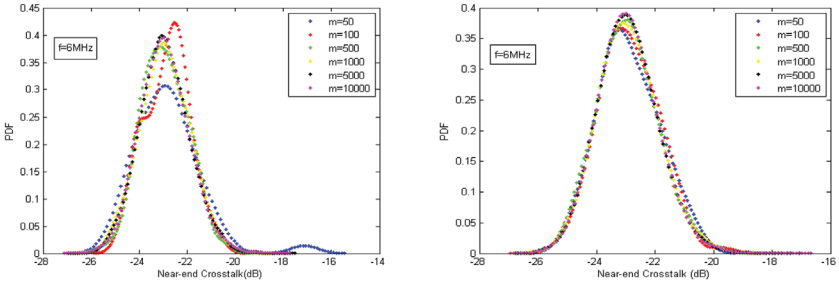


Figure 7 – The probability distribution comparison gained by MC and QMC under different frequencies



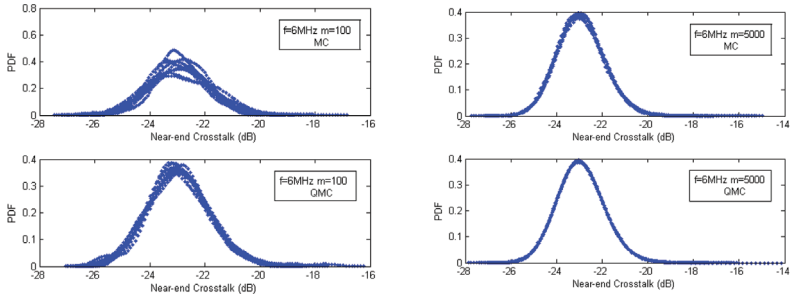
(a) The probability density distribution of MC method under different sample size

(b) The probability density distribution of QMC method under different sample size

Figure 8 – The contrast figures of the probability density distribution for these two methods under different sample size (f = 6 MHZ)

5. Conclusion

Compared with the traditional MC method, the QMC method proposed in this paper is better in the crosstalk of transmission lines prediction by the numerical experiment. This proves that the QMC method, which uses the scrambling of low deviation sequence, can not only accelerate the convergence speed of calculation, improving the calculation efficiency, but also ensure the stability and reliability of prediction results. Therefore, the crosstalk of transmission lines analysis based on QMC method can be widely used in the wiring harness crosstalk prediction in automobile, aircraft and other equipments, and



(a) The contrast figure of the 10 times probability density distribution under small sample size

(b) The contrast figure of the 10 times probability density distribution under large sample size

Figure 9 – The contrast of the 10 times probability density distribution for these two methods under the same sample size (f = 6 MHz)

the evaluation of influence on performance due to parameter perturbation for integrated circuit in manufacturing process. This method has practical significance in discovering the EMC issues for equipment and integrated circuit designs as earlier as possible.

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How to curtail controlling shareholders' capital expropriation: evidence from IT firms in economy

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Abstract: This paper aims to explore how to curtail controlling shareholder's capital expropriation from psychological ownership perspective. We propose that ratio of personal shareholder and Pre-IPO ages have positive effects on controlling shareholder's capital expropriation. Furthermore, these effects are reduced by ownership disparity and ratio of independent directors. The database from 169 listed firms in both software and also internet industries from China supports our arguments. This paper contributes to literature on controlling shareholders' capital expropriation from psychological ownership perspective by finding the role of psychological rather than legal ownership.

Keywords: IT firms; Capital expropriation; Psychological ownership; Transition economy.

1. Introduction

Given the bursting growth of IT industry in emerging economies such as China, governance scholars attached increasing research attention to them. The principal-principal conflict is increasingly central consideration of corporate governance design. Due to the goal incongruence and information asymmetry, controlling shareholders often exploit minority shareholders (e.g., expropriating capital from the firm, excess salary for the controlling shareholder, controlling director board). Especially in transition economy where legal system protecting the minority shareholders is not well developed (Young et al., 2008). Previous literature mainly investigates how to curtail controlling shareholders' capital expropriation from Principal-Principal theory, which views expropriation as the results of formal institution void, ownership concentration, and informal institutions (Young et al., 2008; Dharwadkar et al., 2000; Sá and Rocha, 2012).

Although principal-principal theory dominates the extant literature, it is still difficult to explain the shareholders' capital expropriation in developed countries with well established institutions. Extending this line of literature, this research argues that the expropriation is viewed as the result of entrepreneurial shareholders' psychological ownership. Based on psychological ownership theory, we propose that formal ownership of entrepreneur, Pre-IPO age promote psychological ownership and then lead to capital expropriation. However, we find that these effects decrease when ratio of independent directors and ownership disparity increase.

This research contributes to extant literature by offering alternative theoretical explanation and solution for Principal-Principal conflict. Although previous literature suggests that the essence of PP conflict is goal incongruence, psychological ownership theory further explain why and when the controlling shareholders has incongruent goals with minority shareholders. To our knowledge, this article is the first try to explore how to curtail controlling shareholders' expropriation from psychological ownership perspective. Our findings suggest that even if formal institution protecting minority shareholders is well established, it is not enough to remove controlling shareholders' motivation to expropriate minority shareholders.

2. Theoretical framework

Principal-Principal (PP) theory suggests that controlling shareholders have different goal from minority shareholders, which motivate controlling shareholders to expropriate minority shareholders when formal institution is absent (Su et al., 2007; Chen and Young, 2010). However, this theory does not offer explain why goal congruence exists and offer partial explanation for the motivation to expropriate minority shareholders (Jiang and Peng, 2010; Li and Qian, 2013).

Psychological ownership theory complement with PP theory to explain these issues. Psychological ownership refers to the feeling of possession toward some target. The individual controlling the target, investing in the target, and being familiar with the target often develop intense psychological ownership toward target. For IT firms established usually by an entrepreneurial team, controlling entrepreneurial shareholder sets up their firms and often invests in huge energy during the entrepreneurial process (Pierce et al., 2001). Furthermore, during the entrepreneurial process, controlling shareholders often are more familiar with their firms than the other minority shareholders. Therefore, the controlling shareholders often develop higher level of psychological ownership toward their firm. This feeling of possession often makes controlling shareholders refuse to share their firm with other shareholders (Sieger et al., 2013). Therefore, previous developed psychological ownership creates psychological inertia, which promotes the controlling shareholder continue to put tight control on the listed firm and less attention on the minority shareholder interest. When the firm is publicly listed, controlling shareholders often maintain this feeling of possession and thus leads to capital expropriation of minority shareholders from the listed firm.

This psychological ownership grows with the controlling shareholders' previous linkage with the firm. When ratio of entrepreneurial share is high, the controlling shareholder invested more financial, effective, and other resources to the previous firm. Therefore, when firms are listed, the controlling owner with high ratio of previous ownership may hold higher level of psychological ownership. In this case, controlling shareholders may attach less attention to the interest of minority shareholders, which promotes the capital expropriation.

Following this logic, we also argue that if the Pre-IPO age is high, controlling shareholders often develop higher level of psychological ownership toward the listed firm. In this case, controlling shareholder also attach less attention to the interest of minority shareholders, which thus increases capital expropriation. Therefore, we propose that:

H1a: Ratio of entrepreneurial share has positive effect on controlling shareholders' capital expropriation

H1b: Pre-IPO age has positive effect on controlling shareholders' capital expropriation

However, we argue that when ownership of the listed firm is disperse, the controlling shareholders may experience more challenges from other shareholders. In this case, the controlling shareholders attach more attention to other shareholders' benefits and therefore ownership disparity reduces the controlling shareholders' feeling of psychological ownership (Sieger et al., 2013). Furthermore, when ownership disparity is high, controlling shareholders has less power to expropriate other shareholders. According to principal-principal theory, independent directors also can constrain the power of controlling shareholders' power to expropriate minority shareholders (North, 1990). Therefore, we propose that:

H2a: Ownership Disparity weakens the positive effects of Ratio of entrepreneurial share on controlling shareholders' capital expropriation

H2b: Ownership Disparity weakens the positive effects of Pre-IPO age on controlling shareholders' capital expropriation

Based on above analysis, we build a model to explain the controlling shareholders' capital exploitation by integrating both principal-principal theory and also psychological ownership theory.

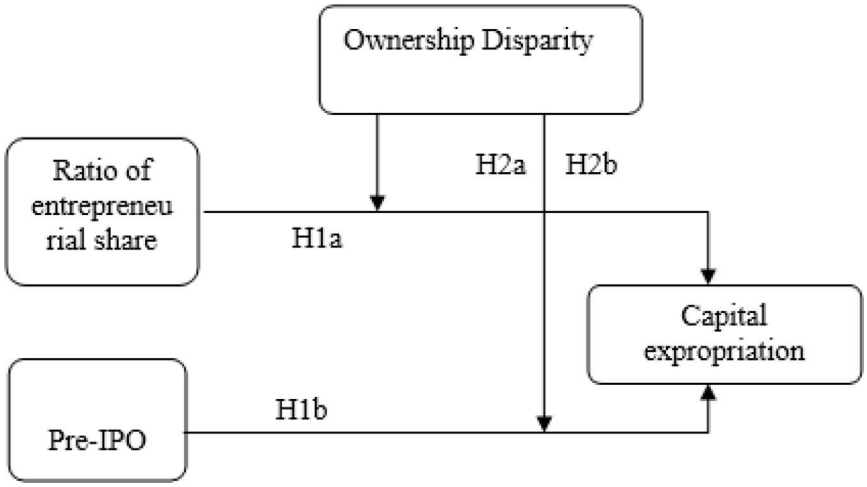

Figure 1 – Theoretical framework

3. Methodology

3.1. Data collection

We collected the data on firms listed in Growth Enterprise Market (GEM) of China. The data is from Stock Market Accounting Database (CSMAR) which is one of the most famous

databases in China. To test causality, we collected data on independents variables from the IPO to 2012. Accordingly, we also focus on our sampling in software and internet industry. We also excluded the firms without complete information. Finally, Data from 169 firms established by natural entrepreneurs rather than company are collected.

3.2. Measures

a. Dependent variable

Capital expropriation. The annual reports provide the information on how controlling shareholders extract capital from listed firms. In China, controlling shareholders extract capital through accounts receivable. Following Su et al., (2007), we measure capital expropriation by yearly averaging the accounts receivable.

b. Independent and moderating variables

1. Ratio of entrepreneurial share: We measure ratio of entrepreneurial share by calculating the percentage of entrepreneurial share.
2. Pre-IPO age: We measure Pre-IPO age by calculating the natural logarithm transform of the number of year from which the firm is established to the IPO year.
3. Ownership disparity: This research measures ownership disparity with ownership variation coefficient.
4. Ratio of independent directors: We measure it by calculating the percentage of independent directors.

c. Control variables

We controlled the firm size, industry, and location. We measure firm size by calculating the natural logarithm transform of the employee number. We measure industry by coding 1 when a firm is operating in high technology industry while 0 if else. We measure location by coding 1 when a firm locates in provinces in eastern China while 0 if else.

3.3. Analysis and results

Descriptive statistics and correlations analysis indicate that no correlation coefficient is above the 0.6 threshold, suggesting that our estimations are not likely to be biased by multicollinearity problems (table 1). Multivariate regression analysis and the moderated method were employed to test our hypotheses (Baron and Kenny, 1986). Table 2 presents the steps performed to test the hypotheses, and the results for each steps.

To test H1a and H1b, we ran mode1 and model2. In model1 we entered control variables. Model2 includes the ratio of entrepreneurial share and also firm Pre-IPO age. Model2 shows that the ratio of entrepreneurial share and Pre-IPO age have significant positive effects on capital expropriation. Therefore, H1a and H1b are both supported.

To test H2a and H2b, we included the interactions to model3. The model3 shows that the coefficients of two interactions with ownership disparity have significant negative effects on capital expropriation. This indicates that ownership disparity significantly reduces the effects of both the ratio of entrepreneurial share and Pre-IPO age on capital expropriation. To further test this moderating effects. According to the recommendation

of Aiken and West (1991), we plotted the relationships in Figure 2a and Figure 2b. As the Figure 2a shows, the effect of ratio of entrepreneurial share increases slower when ownership disparity increases. As the figure 2b shows, the effect of Pre-IPO age increases slower when ownership disparity increases. These results indicate that ownership disparity weakens the positive effects of the ratio of entrepreneurial share and Pre-IPO age on capital expropriation. Therefore, H2a and H2b are both supported.

^(	1	2	3	4	5	6	7	8
1. Firm Size	1.00							
2. Industry	0.05	1.00						
3. Location	-0.01	0.05	1.00					
4. Ratio of entrepreneurial share	-0.05	0.04	0.04	1.00				
5. Firm Pre-IPO age	-0.05	0.06	0.04	-0.03	1.00			
6. Ownership disparity	0.07	-0.02	0.03	0.207**	0.00	1.00		
7. Ratio of independent director	-0.01	-0.02	0.06	0.145*	0.00	0.130*	1.00	
8. Capital expropriation	0.04	0.02	-0.01	0.147*	0.15*	-0.01	-0.01	1.00
Mean	6.09	N/A	N/A	20.92	2.19	1.54	0.37	15.42
S.D	0.77	N/A	N/A	17.96	0.52	0.51	0.0.05	17.33

Notes: * (p<0.05), ** (p<0.01)

Table 1 – Provides descriptive statistics and correlations

	Capital expropriation (N=234)		
Variables	Model1	Model2	Model3
1. Firm Size	0.263***	0.270***	0.343***
2. Industry	-0.218*	-0.215*	-0.126
3. Location	-0.075	-0.064	0.019
4. Ratio of entrepreneurial share		0.177*	0.675***
5. Firm Pre-IPO age		0.264**	0.257**
6. Ownership disparity			-0.471**
7. Ratio of entrepreneurial share x Ownership disparity			-0.260+
8. Firm Pre-IPO age x Ownership disparity			-0.282**
R-square	0.118	0.189	0.325
F-value	2.127*	1.902*	2.203*

Note: +p<0.10; *p<0.05; **p<0.01; ***p<0.001

Table 2 – Indicates that the results support the four hypotheses

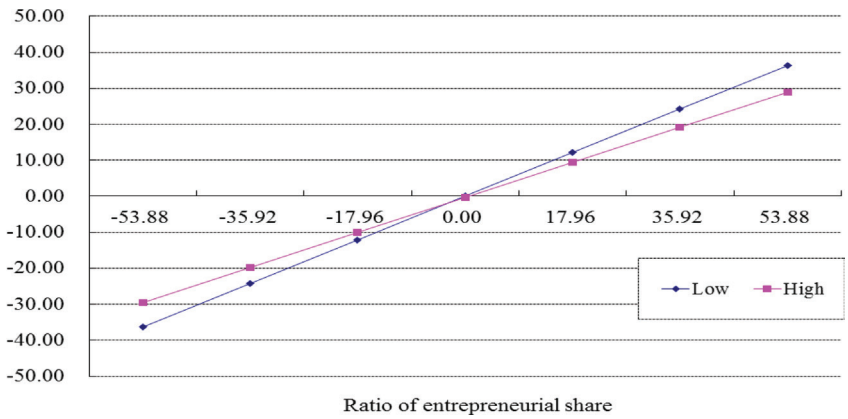

Figure 2a – The moderating effect of ownership disparity

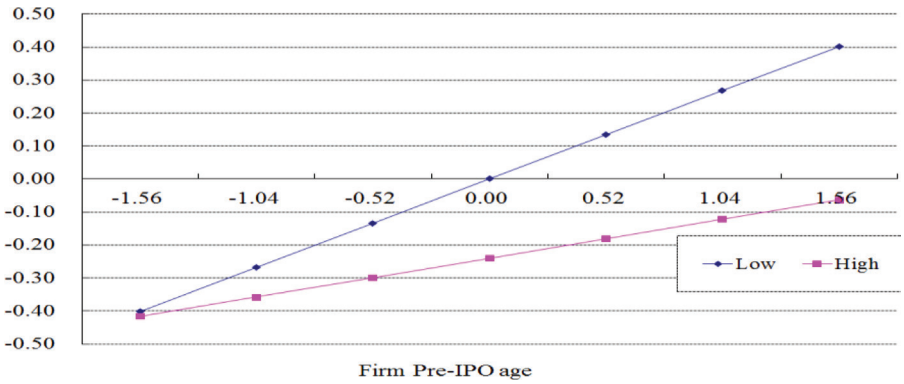

Figure 2b – The moderating effect of ownership disparity

3.4. Discussion

This paper aims to explain the capital expropriation from psychological ownership perspective beyond principal-principal theory. The results support the prediction of psychological ownership theory. We find pre-IPO age and the entrepreneur share both promote capital expropriation post-IPO. Besides, their effects are contingent on the ownership disparity. This paper extends previous literature by offering an alternative theoretical explanation for controlling shareholder's capital expropriation.

Our results also bear important managerial implications. First, according to our results we should reduce the psychological ownership of entrepreneur to reduce the controlling shareholder capital expropriation. The principal-principal theory suggests that we should rely on well-established institutions to remove controlling shareholder's capital expropriation. However, our results show that the controlling shareholder's capital expropriation should be also the results of psychological ownership inertia, especially for

firms with short Pre-IPO age, and concentrated ownership. Therefore, well-established institutions are not enough to remove the minority expropriation. Second, because we find that ownership disparity can reduce the influence of psychological ownership inertia, we should set standards for ownership disparity during IPO process.

This research also has some limitations, which should be addressed in future research. First, future research should explore other moderating effects. This paper just finds the moderating effects of ownership disparity. Other factors such as share of venture capital, director board composition, and also on may also have moderating effects. Second, more empirical sample is needed to extend the empirical context. This research just narrows the empirical context in software and internet industries to remove the industrial variance. However, this may limit the generalization validity of our results. Therefore, future research should find data from other industries to examine our model.

4. Conclusion

Aiming to extend our understanding on principal-principal conflicts and controlling shareholders' capital expropriation in transition economy, this study introduces psychological ownership theory to extant literature. This research argues that the expropriation is viewed as the result of entrepreneurial shareholders' psychological ownership. We find that ratio of entrepreneurial share and Pre-IPO age has positive effects on controlling shareholders' capital expropriation. Ownership Disparity and weakens the positive effects of ratio of entrepreneurial share and Pre-IPO age on controlling shareholders' capital expropriation.

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Study on Thought and Countermeasures of Ideological and Political Education of University Students Aided by Computers

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Abstract: starting with the study background and significance, this paper analyzes current study situation of ideological and political education in domestic and abroad colleges and universities in the network age, and mainly analyzes the concept of network and ideological and political education, relationship between network and ideological and political education on this basis, so as to describe new opportunity brought by network for ideological and political education in colleges and universities. Based on the aforementioned analysis of opportunity, I come up with challenges that colleges and universities may face in ideological and political education in the network age. And I also give some feasible measures.

Keywords: Ideological and Political Education, University Students, Computer Aided Education.

1. Introduction

With the coming of the network age, Internet has great impact on university students' politics, idea, emotion, quality and psychology due to its own features and hidden harmful factors (Kahn, 2006). Network age provides opportunity for the innovation of ideological and political education in colleges and universities, and it also brings impacts and challenges. How to improve and innovates the ideological and political education in colleges and universities and make them adapt to the requirements in the age have been an urgent task that colleges and universities are facing (Carey, 2003; Gonçalves et al., 2015). Study on ideological and political education in colleges and universities in the network age can help us understand more deeply of the behavior pattern, way of thinking, idea of value, psychological development and moral concept of college students (Journell, 2012). Colleges and universities, which are training and cultivating social elites and are facing the situation that network has impacted the young students, shall actively thinking of the opportunities and challenges of ideological and political education in colleges and universities due to network, and try to find a good way to adapt the ideological and political work in network age (Meier, 2012).

2. Connotation and function of ideological and political education in colleges and universities

2.1. Connotation of ideological and political education in colleges and universities

Firstly, ideological and political education, a subject of "soul engineering", involves education of cognition, emotion, will, faith and other aspects, and it also combines the education of politics, ethics, pedagogy, psychology and other directive, normative and conceptual education (Lin, Xing & Hauptmann, 2008). Through education on students' world outlook, outlook on life, moral outlook and value outlook and daily behaviors, we can train the students to improve their ability of rational reflection, and guide the students to concern themselves and society, understand, think and actively explore the value of life and true meaning of life, so the students can get qualitative change from "comfortable state" to "conscientious state" during the constant reflection and thinking. So the students can make their own development into social reality, forming perfect combination of cognitions, affections, thoughts and behaviors, and realize the organic unification of their own value concepts, moral feelings, ideas and faith (Zhang, 2015).

Secondly, ideological and political education can grab the mainstream position of ideology, and help students analyze and clear various wrong ideas through the Marxism standpoint, view and method, educate and lead students to correctly understand and treat Marxism, and have a strong belief of Marxism (Koc, 2005). At the same time, we can treat patriotism education as an important method to develop and expand national spirit and advanced culture, combine developing and expanding of national spirit and cultivating of time spirit. We can motivate the patriotism spirit of students, inherit the good virtues of the Chinese nation and inspire the national spirit through story preaching of kind and upright men and revolutionary martyrs (Bo and Sidanius, 1987). We can develop the students' national esteem, confidence and pride, strengthen national cohesion and creativity, strengthen students' national identity and sense of belonging, and motivate students' sense of historical mission and sense of social responsibility for realizing Chinese nation's great rejuvenation (Li, 2010).

2.2. Function of ideological and political education in colleges and universities

1. Value the informal communication of ideological and political education.

In ideological and political education, communication forms we used can often be simply divided into two categories, namely formal communication and informal communication (Jing, 2014). Whereas informal communication of ideological and political education is a routine working method, which means a daily communication method to weaken their colors of job roles and take communication of thought and information as the main content, so that ideological and political educators can solve some specific thought issues and actively work in the department, social life and work.

2. Put ideological and political education into professional and network class and emphasize the positive communication.

We can combine professional classes with ideological and political education. Teaching knowledge from professional courses are novel and objective, which can easily mobilize

the enthusiasm and enthusiasm of students (Liu & Liu, 2013). Personal charisma and professional skills of teachers of professional classes have great impact on the educated people. It can also act as the role of model demonstration. Teachers of professional classes have good professional skills in teaching process, and they also have good quality of professional ethics. They can teach through their actions and words and they have the unity of moral knowledge and practice (Engum et al., 2003).

3. Educate and cultivate the students to have a sound personality and healthy psychology with love (Zapata et al., 2014).

Mr. Tao Xingzhi once said: "True education is telesthesia activity. We can get to others heart only through our true heart." Students can get healthier growth only when the Ideological and political educators turn students from educational objects to learning subjects and replace the rational management by emotional education.

3. Network provides new opportunity for ideological and political education in colleges and universities

3.1. Promoting the development of university students' sense of independence

1. Bi-directional or multi-directional information transmission methods on the network can make students participate in the discussion independently, freely access to the required sites, and actively understand a variety of information resources (Kulik and Kulik, 1986). So university students can accept recommendations from different views, and integrate them and form their own point of view through their judgments. It promotes the establishment of students' open spirit.
2. The network breaks the geographical and time constraints, and spreads human excellent culture heritages, value outlook and code of conduct to the students in time by advanced electronic techniques (Strömberg et al., 2007). So young people can accumulate social knowledge in a wider social environment, develop and form their own personality and participate into the social life smoothly.
3. Bi-directional or multi-directional information transmission methods of Internet can make students participate in the discussion independently, freely access to the required sites, and actively understand a variety of information resources. So university students can accept recommendations from different views, as is shown in Figure 1.
4. The Internet is involved in area of real life, so that people can get one more choice between virtual and real world. Network greatly expand the thinking and behavior spaces of students, thereby it enhances freedom and flexibility of their actions (Boberg et al., 1995). So it helps to fully play the university students' personalities and strengthens their social independence. Why network attracts university students is that they can have more independent choice of information and it has bi-directional or multi-directional information transmission methods (Rahkila and Karjalainen, 1999). In virtual space, they can freely access to the required sites, participate in the discussion independently, freely and actively understand a variety of information resources, integrate them and form their own point of view through their judgments.

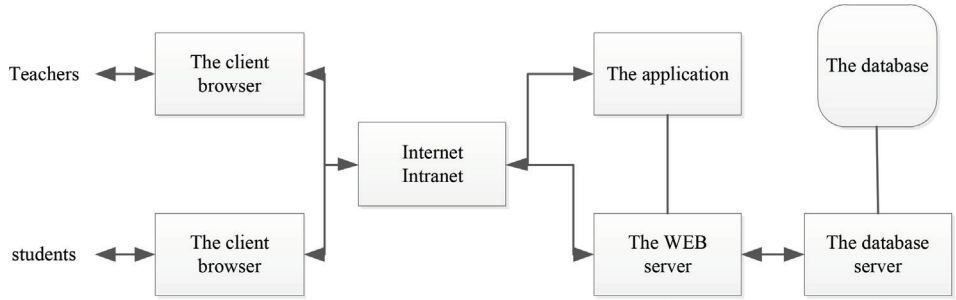

Figure 1 – Computer teaching platform structure

3.2. Improving the innovation quality of university students

Firstly, in cultivating university students' sense of innovation, network provides a superior space of cultural environment. In the 21st century, the rapid increase of science and technology knowledge, the emergence of new disciplines, especially the rapid development of computers and networks, has greatly promoted the development of social economy and times. Application of computer network can change our individual hazy imagination into a vivid and lifelike multimedia interface. Various tools can be provided through powerful software and our creative ability can be demonstrated fullest. University students can see the power of science and technology by Network through the deliberate innovation of Internet, active exploration and pursuing of perfect form. They can deeply understand the importance of high-tech knowledge. Thereby they can increase their positivity and initiative in study and stimulate their curiosity and sense of innovation more effectively.

Secondly, network has crossed the geographical and time constraints, builds a new online information space for people (Roh and Park, 2010). So people can obtain information through internet at any time. Rich information resources on the network can make students get nutrients, improve their knowledge structure, learn science and technology, management mode and advanced experience of developed countries, find and solve the problems with the help of experts, scholars, technicians and even ordinary people around the world.

3.3. Strengthening subject consciousness of university students and promoting better development of their personalities

With the development of science, people will continuously update their original understanding and concept. Pursuit of individual emancipation and comprehensive development of human beings are goals that human society has strived and pursued. Emerging and rapid development of network have provided a new way for realizing this goal. Through experiential observation, we find that network has actively accelerated the growth of university students' subject consciousness and development of their personalities. According to the survey, main motivations for college students to surf the Internet from least to the most important are: experience the modern life and study, affected by their classmates, seek novelty and follow the fashion. While the main

purposes for university students to surf the Internet from least to the most important are: receive and send e-mail, look for some information, chat, download a variety of software, broaden their vision and on-line shopping. Both of them show that when network comes into university students' livings and becomes an important part of their lives, university students surf the Internet not only to meet their study requirements, but also satisfy requirements for comprehensive development. University students can surf the Internet, study and entertain on the Internet at any time according to their wills, interests and arrangements. The study mode which puts teachers and classes as the center will be changed greatly. So it will strengthen the principal position of university students in education process. Under network conditions, acquisition and communication of information will rely more and more on university students' subjectivity. University students will rely more on the network. When they suffer setbacks and troubles, they may no longer or seldom ask their teachers or Party Organizations for help. But they choose on-line chatting, reading, publishing of articles and other forms to solve or free from the troubles. It shows that under network conditions, the traditional information mechanism "Teachers- Students" is weakening while a new information mechanism "Network- Students" is forming. This new information communication mechanism can make university students to express themselves incisively and vividly on the Internet, develop their personalities, and freely show their true characters which isn't shown

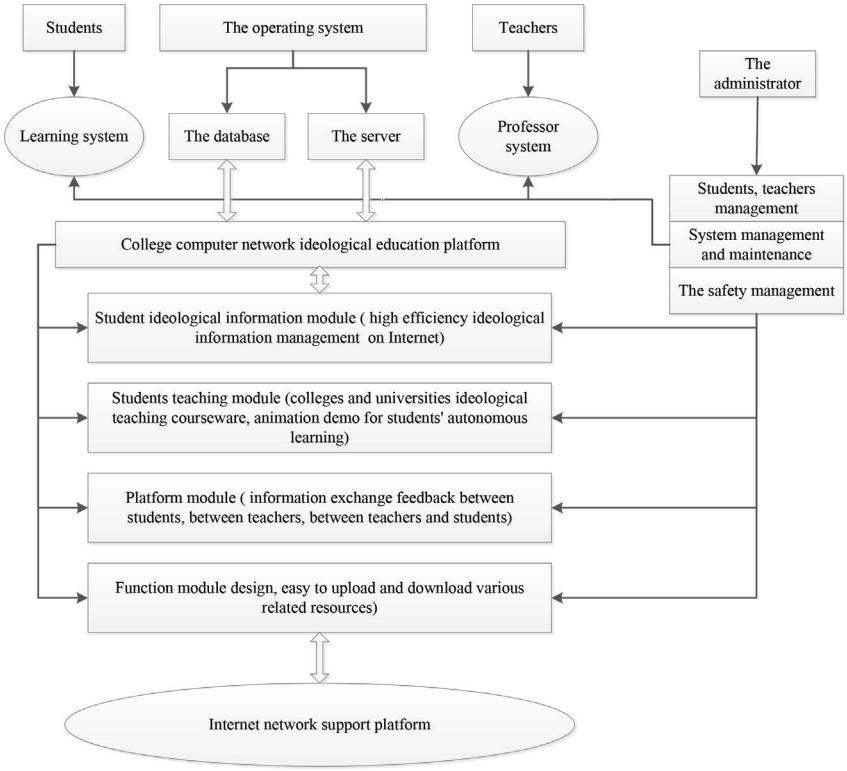

Figure 2 – College environment of network teaching platform structure

in actual life. That putting the comprehensive and free development of individual as the comprehensive development of human beings and premise to get to the Kingdom of Freedom, and putting the development of society as the continuous improvement for degree of personality freedom are the important ideas that Mars and Engels had emphasized repeatedly. While network has created new conditions for the liberalized, diversified and comprehensive development of university students' personalities and it helps to strengthen the self-education function of university students (seen in Figure 2).

4. Countermeasures of ideological and political education in colleges and universities in network age

The perfect combination of network with ideology and politics is the only way leading to the ideological and political education in colleges and universities at present. Facing the opportunities and challenges of ideological and political education brought by the network to colleges and universities, the work of ideological and political education in colleges and universities should be active and initiative in coping with, draw advantages and avoid disadvantages to build good public opinion environment through network and seize the cultural front of network. Through the improvement of attractions of network and under the assurance of strict and complete network management system, colleges and universities make efforts to train a batch of comprehensive ideological and political education staff so as to create a new situation of ideological and political education in colleges and universities with the help of the opportunity provided by network technology.

4.1. Resistance and prevention against the infiltration of western culture and ideology

1. Vigorously expanding information territory to master the rights of information monitoring

Our country is narrow in the information territory of internet and weak in the ability of network monitoring. In network, all netizens can enter into the space and carry out activities, making the conflicts and confrontations of the "soft territory" become quiet and with no traces, possess an obvious offensiveness and a greater danger. To it, on the one hand, we must strengthen the control rights of network information and the national security assurance ability and build laws and regulations and management system as well as network market standard which suit our China's national conditions. Coordinating with relevant departments of society, we need to strengthen the technical management measures and specially develop a kind of software that can prevent and filtrate all reactionary and harmful messages and a monitoring system that can prohibit all contents of obscenity, overthrow of government and other reactionary contents spreading on internet; we need to strengthen the international cooperation of punishing network crimes and set up information customs to prevent the invasion of information damage. On the other hand, we should carry out various online propagandas which are powerful, targeted and combat-worthy initiatively against those online anti-China propagandas from hostile forces and all kinds of public opinions resulting in harmful effects so as to punish those slanders and attacks from people with ulterior motives to our country.

2. Strengthening the propaganda of mainstream ideology by using network front

We should use the strong influence and filtrating power of network to build a propaganda network with distinct political stand and viewpoints, speed up the construction of network propaganda system of Chinese interface, actively create and overall plan websites such as news, propagandas to foreigners and theory culture, etc., expand the network propaganda contents and improve network propaganda art, strengthen government actions of achieving the shouting that there is Marxism scientific theory system and socialism value criteria showing online to ensure the leading role of mainstream ideology with Marxism as guideline in Chinese network. Thus, we can firmly resist the infiltration of non-Marxism, anti-party and anti-socialism ideology, smash the plots of making our country westernized, differentiated from hostile forces and plots of overthrowing party and government from reactionary forces and equip network as an important tool of propagandizing public opinions and an important mouthpiece of our consolidating and developing socialism ideology.

3. Increasing the input of network technology to improve the comprehensive competiveness in network field

Firstly, strengthen its own construction of network; the government shall make efforts to expand network size and optimize network structure to avoid repeated construction, making it develop towards the direction of integration, broadband and intelligence; Secondly, build and perfect an efficient network propaganda organization of socialism to support and encourage our more news media, newspapers, organizations of propaganda and culture to enter into the network and occupy the first time to continue to increase information output and let socialism ideology to seize network front. Build our own website well, richen information and increase functions, concentrate forces and support importantly, speed up the construction of a batch of famous websites which have significant influences at home and abroad, improve the offensive and defensive abilities of online ideology confrontation, attract netizens to visit our websites and use the mode of “development to open, expanding our online influences” to break the international trend of public opinions that western countries are strong and we are weak as soon as possible and make the socialism ideology play the leading role in network step by step.

4.2. Building a complete network supervision system on network system

In the network access, we should investigate and intercept contents such as reactionary, obscenity, feudal superstitions, etc. with technical means and improve the ability of finding, control, reconnoiter, evidence obtaining, attack and prevention; special organizations of the country supervise each portal website and business websites which supervise their subordinate service providers and personal homepages; service providers supervise each access point while each access point supervises netizens; public security departments check import and export information at each level from the view of national security and build an internet police team of unified command,

flexible and capable ability, modernization, normalization and actual combat, thus forming a supervision system matched with network.

4.3. Vigorously strengthening the team construction of network ideological and political education

The training of staff of network ideological and political education is the primary task of network ideological and political education construction. Staff of network ideological and political education should not only have the theory and practice experiences of ideological and political education, but also have basic theories of computer network and can conduct network operations skillfully; and they should not only have relatively high political and ideological qualities, but also have certain scientific sense and innovation ability, as is shown in Figure 3. The training of comprehensive talents to act as the staff of network ideological and political education is the primary and urgent task of network ideological and political education.

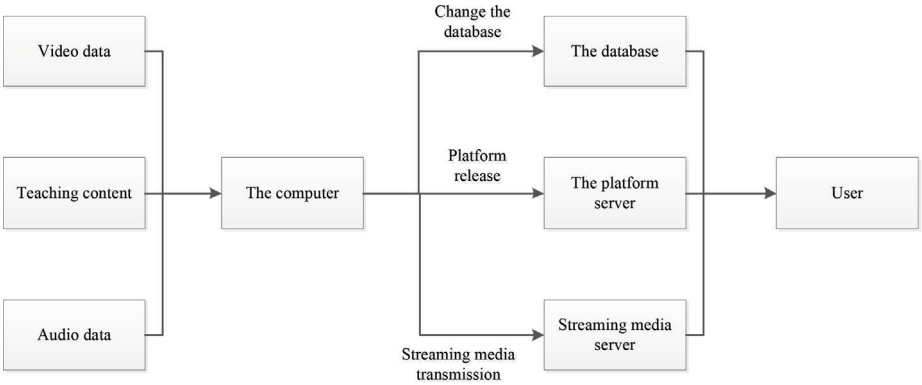

Figure 3 – Realization of the computer aided teaching modules

5. Conclusions

Network ideological and political education is a brand new subject. I try to find out where the law of ideological and political education in colleges and universities is in internet environment. However, with limited abilities, the research is not enough to be meticulous and deep going and defects and disadvantages in somewhere can not be avoided, which will be continuously improved in future working and studying. In a word, the springing up of network makes it still difficult for staff of ideological and political education in colleges and universities of our country to completely adapt to the new working environment and the research on ideological and political education of university students in network environment is far from being mature. Therefore, I advise staff of ideological and political education in colleges and universities to dedicate into the research on the aspect.

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Research of DHCP Flooding Attack Detection Technology Based on Improved Wavelet Analysis Method

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Abstract: Nowadays DHCP protocol is widely used, while DHCP flooding attacks bring severe threats to normal running of networks. Thus it is very important for LANs to detect and respond to DHCP flooding attacks timely. However, methods of DHCP flooding attack detection occurred have the flaw that the percentage of false positives or false negatives is high. To solve this problem, this paper proposes a new method to detect DHCP flooding attacks. This method improves the traditional wavelet analysis method. It analyzes network packet flows which contain DHCPDISCOVER messages and DHCPDECLINE messages, finds the pattern of change trend from these flows, and dynamically sets threshold value of detection according to this pattern. This paper uses a wireless campus network as object for examination to test the performance of DHCP flooding attack detection capacity. The result of examination shows that the proposed model can detect and response to DHCP flooding attacks which have different strength. Compares to traditional detection methods based on wavelet analysis, this method improves precision of detection, which in turn improves capacity of DHCP flooding attack prevention effectively.

Keywords: DHCP; flooding attack; wavelet analysis; traffic analysis; information security

1. Introduction

DHCP (Dynamic Host Configuration Protocol) is a protocol working in local area networks (LANs). Its main purpose is to allocate IP addresses to internal networks or internet service providers automatically. As the primary method of IP address management in LANs, DHCP has been widely used in TCP/IP protocol networks (Badias et al., 2009; Younes, 2016). DHCP adopts C/S pattern, the client applies for configuration parameters (e.g. IP address, subnet mask, default gateway and so on) to the server, the server returns the corresponding configuration information according to policies. The DHCP server in LAN can automatically set up network parameters such as IP addresses, subnet masks, gateways, DNS addresses and WINS for hosts access to the LAN, which simplifies network configuration and improves management efficiency (Lim et al., 1999; Chen and Mao, 2015; Tripathi and Hubballi, 2015). At the same time, however, problems of DHCP in management and use is gradually revealed, among them the most common is that the

DHCP server suffers from attacks, which lead users can not obtain IP addresses normally and even threat information security of users. Take DHCP flooding attack as example, an attacker can exhaust all of the available IP addresses managed by the DHCP server, thus the DHCP server can not provide service to users. The attacker can also hijack the DHCP server to provide wrong IP addresses, DNS addresses or default gateway information, which can redirect the network traffic to a designated node to achieve interception of network traffic (Duangphasuk et al., 2011; Issac, 2009; Dinu and Togan, 2015; Marques et al., 2012).

For DHCP flooding attacks, technical measures currently used mainly include limiting the number of switch port MAC addresses, preventing CAM (Content Addressable Memory) table from being flooded, or limiting the number of users on every single PVC (Permanent Virtual Circuit)/VLAN (Virtual Local Area Network). Through limiting the number of users access to PVC/VLAN, it can prevent the attacker from acquiring much IP addresses. However, the prior art have problems that these methods use switch to implement passive protection for flooding attacks against DHCP servers, but it can not trace and find DHCP attack sources already exist in network, thus it can not ultimately prevent DHCP attacks thoroughly. In addition, the methods using designated rules for prevention can only protect for known attack means, which have a rate of false negatives and false positives (Durdağı and Buldu, 2016; Nichols et al., 1998).

Aims at the above problems occur in DHCP flooding attack detection technologies currently, this paper proposes a detection model based on an improved wavelet analysis algorithm. This model improves the traditional wavelet analysis algorithm, and applies it to the field of DHCP flooding attack detection. This model captures DHCP traffic in network, analyzes the trend and patterns of its traffic changes, and predicts the condition of traffic in subsequent intervals and dynamically adjusts the threshold of attack detection. Compared with traditional detection methods, this model has higher detection accuracy, can response to DHCP flooding attacks exist in network more timely. Besides, this model can also cooperate with other security measures in LANs to investigate the potential attack sources in network and take actions to these attack sources according to corresponding security management policies, so as to prevent DHCP flooding attacks effectively.

The remainder of this paper is organized as follows. Section 2 introduces the operational principle of DHCP Protocol and two ways to implement DHCP Flooding Attacks. Section 3 mainly illustrates the attack detection algorithm we proposes, including self similarity which is an important property to network traffic, traditional detection algorithm based on wavelet analysis and its flaws, and the improvement we do on this method. Section 4 mainly introduces the DHCP flooding attack detection model, including its architecture and its operational procedure. In Section 5 an experiment is performed to test the performance of this model and analyze the experiment results. Section 6 summarizes the work done in this paper and prospects for the future work.

2. DHCP and DHCP Flooding Attacks

2.1. Operational Principle of DHCP

In the architecture of DHCP, the DHCP server is responsible for maintaining the IP address pool and other network parameters, such as subnet mask and default DNS. The scale of IP address pool and specific network parameters can be configured by the

network administrator. On the other hand, the DHCP client is responsible for requesting IP addresses and other network parameters to the DHCP server. When the DHCP client starts, it will broadcast DHCPDISCOVER messages to the network. When the DHCP server receives this message from the client, it will return a DHCPOFFER message to the client. This message contains the IP address the server assigns to the client. Subsequently, the client sends a DHCPREQUEST message to the server. This message is sent as a broadcast to all of the hosts in the network. It has two purposes, one is to inform the DHCP server that this client has accepted the IP address assigned by this server, the second is to inform other potential DHCP servers in the network that this client has been assigned an IP address, and it will not accept other IP addresses assigned by other DHCP servers. Thereafter the DHCP server will send a DHCPACK message to the client, this message contains the lease time of this IP address and other network configure information, such as default gateway and DNS address. The operational procedure of DHCP is illustrated by Figure 1 (Younes, 2016; Chen and Mao, 2015).

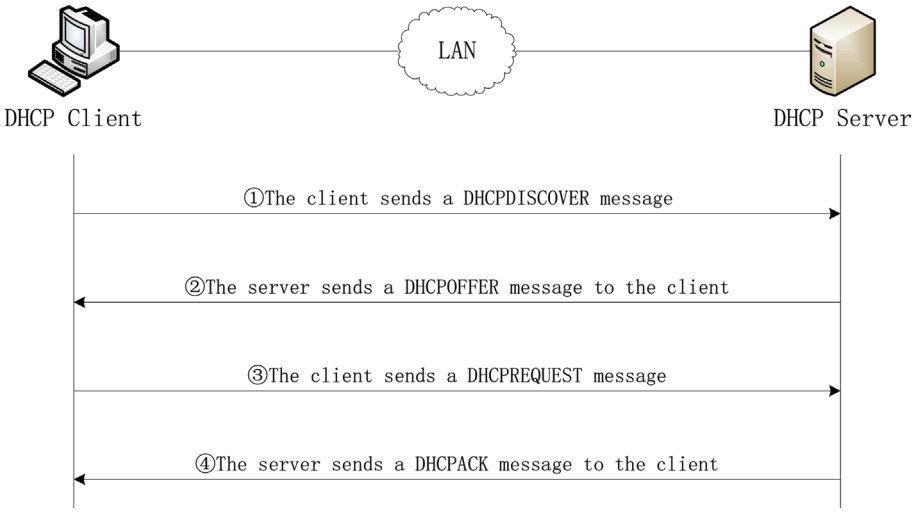

Figure 1 – Operational procedure of DHCP

2.2. Principle of DHCP Flooding Attack

DHCP flooding attacks can be implemented mainly by the following two kinds of ways (Tripathi and Hubballi, 2015):

1. Through forging MAC addresses. As there is not a fixed IP address for a host in the network, thus its MAC address becomes its unique identifier to distinguish a host from other hosts in the network. In this kind of attacks, an attacker can applies IP addresses for the DHCP server using a large number of fake MAC addresses until the IP addresses maintained in its IP address pool are fully occupied. At this time, legitimate users cannot access to the network because it cannot obtain an IP address.
2. Through forging DHCPDECLINE messages. DHCPDECLINE message is one kind of messages sent from the client to the server in DHCP. Its main purpose is

to tell the DHCP server that an IP address has been occupied by another client. In such attacks, an attacker can deceive the DHCP server via forging a large number of different DHCPDECLINE messages. It will make the DHCP server mistakenly believe that all of the IP addresses have been assigned, and it cannot assign IP addresses to other legitimate DHCP clients.

3. Attack Detection Algorithm Based on Improved Wavelet Analysis Method

3.1. Self Similarity of Network Traffic

Self similarity is a characteristic that the local structure of an object is complete or almost similar to its overall structure. Since 1990s when Leland et al first explicitly proposed that the network traffic has self similarity, researchers from many countries measure and analyze some of the existing networks around the world, and find that whatever the topology and service type a network is, its traffic has self similarity (Leland et al., 2016; Wang et al., 2015; Jaiswal et al., 2015). The self similarity of a network can be described by the following self similarity procedure.

Definition 1. For a random procedure $x(t)$, $\forall a > 0$, if $x(t) = a^{-H} x(at)$, then this procedure is called a self similarity procedure.

Wherein, a is called scale, H is called local scale coefficient, which is also known as Hurst coefficient, is a constant. Hurst coefficient is the unique parameter to describe self similarity characteristic. Typically, the range of H is (0.5,1). The larger the H, the more self similar the procedure is.

In network data traffic, many attribute parameters can be used to calculate Hurst coefficient, such as the number of packets received within unit time interval, the size of a packet, the rate of reception, and the composition ratio of each protocol in the network. When there is a DHCP flooding attack occurs in the network, as the attack packets in the network will block the normal transmission of packets in the network, it will make the number of DHCPDISCOVER messages and DHCPDECLINE messages received by the DHCP server in unit time interval increase greatly than that in normal situations. At this time the self similarity of data traffic in the network will decrease, causing the Hurst coefficient decreases. When the network is almost completely blocked by DHCP flooding attack, the Hurst coefficient at this time will tend to 0.5, that is to say, when a DHCP flooding attack occurs, the Hurst coefficient will change dramatically. Therefore, through solving the Hurst coefficient at different time in the network and compare it to the threshold of Hurst coefficient set in advance, if it is smaller than the threshold, it can be considered that there occurs DHCP flooding attack in the network, which in turn implement the detection of DHCP flooding attacks (Thakur et al., 2015; Nurohman and Purwanto, 2015).

3.2. Traditional Attack Detection Algorithm Based on Wavelet Analysis Method

In the procedure of solving the Hurst coefficient, the most commonly used methods include variance-time plot method, absolute values of the aggregated series, differenced variance method, regression residual method, R/S plot, periodogram, wavelet analysis

method and so on. Among them the wavelet analysis method is widely used because of its accuracy and efficiency of estimate result. When using wavelet analysis method to solve the Hurst coefficient, two aspects of factors need to be considered. One is the type of wavelet to be chosen, the other is the choice of wavelet vanishing moment. Studies have shown that, in solving the Hurst coefficient, when using the Daubechies wavelet and the vanishing moment is 3 (at this time this wavelet is called the *Db*(3) wavelet), the effect of solution is most satisfactory (Popa and Manea, 2015). From that the traditional DHCP flooding attack detection method based on wavelet analysis can be illustrated as follows (Buragohain et al., 2015; Lu and Ghorbani, 2009).

1. Adopt $Db(3)$ wavelet as the analysis wavelet to perform wavelet decomposition for 10 times.
2. Divide the network traffic sequence $X(t)$ into n subintervals $x_1(t), x_2(t), \cdots, x_n(t)$, for $\forall x_i(t) \in X(t)$, use the decomposition algorithm to perform wavelet decompose. The decomposition formula is shown in equation (1).

$$x_i(t) = \sum_k a_{ix}(J,k)\Phi_{J,k}(t) + \sum_{j=1}^{J}\sum_k d_{ix}(j,k)\Psi_{j,k}(t),$$

   Where, $i = 1,2,\cdots,n$, $\Phi_{J,k}(t)$ is the wavelet scale function, $\Psi_{j,k}(t)$ is the wavelet mother function, $a_{ix}(J,k)$ is the wavelet scale coefficient, $d_{ix}(j,k)$ is the wavelet coefficient.
3. When $i \le 10$, extract the wavelet coefficient. The definition of inner product of wavelet coefficient is shown in equation (2).

$$d_{ix}(j,k) = \langle x, \Psi_{j,k}(t) \rangle,$$

4. Solve the wavelet variance. Its solution is shown in equation (3).

$$D_j = \mathrm{var}\left[d_{ix}(j,k)\right],$$

5. Line fitting and then solve the Hurst coefficient. Fit a straight line taking j as independent variable and $2H+1$ as slope. According to the slope of straight line the H value can be calculated. The form of the straight line is shown in equation (4).

$$\log_2(D_j) = (2H+1)j + C,$$

Where C is a constant.

6. Compare the H value calculated in step 5 to the threshold predetermined. When the Hurst coefficient of the network traffic in one time interval is less than the threshold set in advance, it can be considered that the network is suffered from DHCP flooding attack.

3.3. Flaws of Traditional Detection Method and Improved DHCP Flooding Attack Detection Algorithm

As can be seen from the description in Chapter 3.2, the traditional DHCP flooding attack detection algorithm based on wavelet analysis is implemented by setting a threshold to detect whether the network is suffered from DHCP flooding attacks. However, as the threshold of the traditional method is fixed, it is prone to have false negatives and false positives in actual detection procedures. Especially when the force of DHCP flooding attack is weak, the situation of false negatives is particularly prominent (Ji et al., 2016; Dubey and Tripathi, 2015). Aims at this problem, this paper improve the traditional DHCP flooding attack detection algorithm. The operational procedure of the improved DHCP flooding attack detection algorithm is depicted in Figure 2.

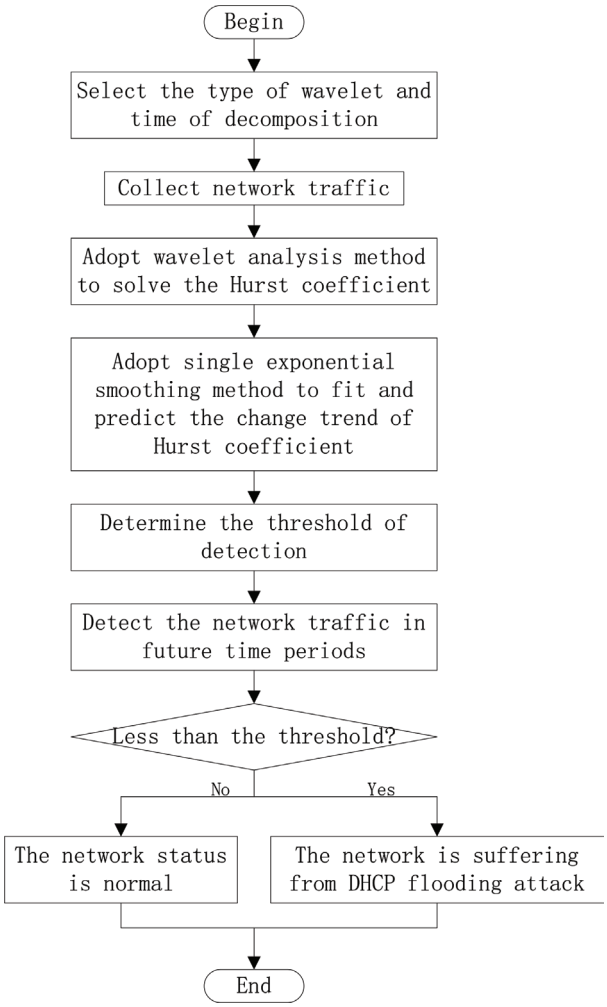

Figure 2 – Operational procedure of improved DHCP flooding attack detection algorithm

The operational procedure of the improved detection algorithm is explained as follows.

1. Take the $Db(3)$ wavelet as the analysis wavelet, and perform wavelet decomposition for 10 times.
2. Divide the network traffic sequence $X(t)$ into n subintervals $x_1(t), x_2(t), \cdots, x_n(t)$, for $\forall x_i(t) \in X(t)$, use the wavelet analysis method described in Chapter 3.2 to solve its Hurst coefficient, and obtain the Hurst coefficient sequence $H_1, H_2, \cdots, H_n$.
3. Use the single exponential smoothing method to predict the Hurst coefficient in future time intervals. The general calculation formula of single exponential smoothing is shown in equation (5).

$$H'_{i+1} = \alpha H_i + (1-\alpha) H'_i,$$

   Wherein, H'_i is the prediction value of Hurst coefficient in subinterval i. Through adjusting the weighting factor α, this prediction formula can fit the actual situation to the utmost.
4. For each prediction value of Hurst coefficient calculated, multiple this prediction value by 0.95 as the threshold, then we can get the detection threshold sequence $H_{t1}, H_{t2}, \cdots, H_{tn}$ of $X(t)$.
5. For the network traffic in a future time interval, calculate its Hurst coefficient, and compare it to the corresponding threshold. If it is smaller than the threshold, it can be considered that the network is suffered from DHCP flooding attack.

In the algorithm above, we predict the change of network traffic Hurst coefficient through single exponential smoothing method, and dynamically adjust its threshold according to the change of Hurst coefficient. This allows the detection algorithm still be able to detect attack actions occur in the network accurately even when the strength of attack is weak, thus can reduce the rate of false negatives and false positives of this detection algorithm effectively.

4. DHCP Flooding Attack Detection Model

4.1. Architecture of Attack Detection Model

This attack detection model mainly includes the following modules.

1. Network packet acquisition module. This module is mainly responsible for collecting data packets in the network, and counting the number of data packets containing DHCPDISCOVER message and DHCPDECLINE message in each time interval respectively according to the time interval set in advance. After that sends the two sets of data to Hurst coefficient calculation module to perform calculation.
2. Hurst coefficient calculation module. This module mainly uses the data sent from network packet acquisition module to calculate the corresponding Hurst coefficient, then sends the calculation result to the detection threshold

calculation module to perform threshold calculation, or sends it to the flooding attack detection module to determine whether an attack is in action.

3. Detection threshold calculation module. This module is responsible for performing single exponential smoothing for the Hurst coefficient sequence calculated by the Hurst coefficient calculation module, and predicts the Hurst coefficient of the network traffic in future time intervals, and thereby to determine the detection threshold of corresponding time intervals. After that sends the threshold to flooding attack detection module to perform determination.
4. Flooding attack decision module. This module is responsible for comparing the Hurst coefficient of the network traffic in one time interval calculated by the Hurst coefficient calculation module to the detection threshold of this time interval sent from the detection threshold calculation module. If the Hurst coefficient of the network traffic in this time interval is larger than the detection threshold, it is considered that the network status is normal in this time interval. If this coefficient is smaller than the detection threshold, we consider that the network is suffering from DHCP flooding attack in this time interval, and sends an alarm to the user at the same time.
5. Parameter configuration module. This module is mainly used for setting the primary parameters in the attack detection module, such as time interval of network traffic statistics.
6. Log information module. This module is mainly responsible for recording the detailed information of DHCP flooding attacks occur in the network, including the time the attack begins, the duration of the attack, the strength of the attack and so on. Thus it can provide confidence to network maintenance personnel to perform analysis and assessment of attacks.

The architecture of this attack detection model is depicted in Figure 3.

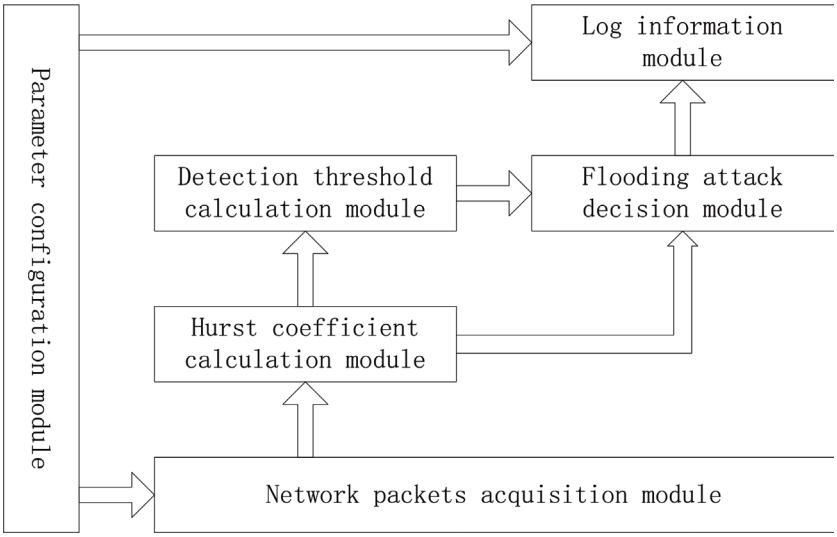

Figure 3 – The architecture of DHCP flooding attack detection model

4.1. Architecture of Attack Detection Model

The attack detection model proposed in this paper mainly works at the driver layer of the DHCP server. When a DHCP flooding attack detected is detected, this model can provide an alarm to the user, and alert the user to kill the viruses or perform other operations, or investigate the suspicious attack sources and take appropriate measures to these attack sources according to corresponding security management policies, which in turn can make the DHCP server prevent from DHCP flooding attacks effectively. The operational procedure of this model is shown in Figure 4.

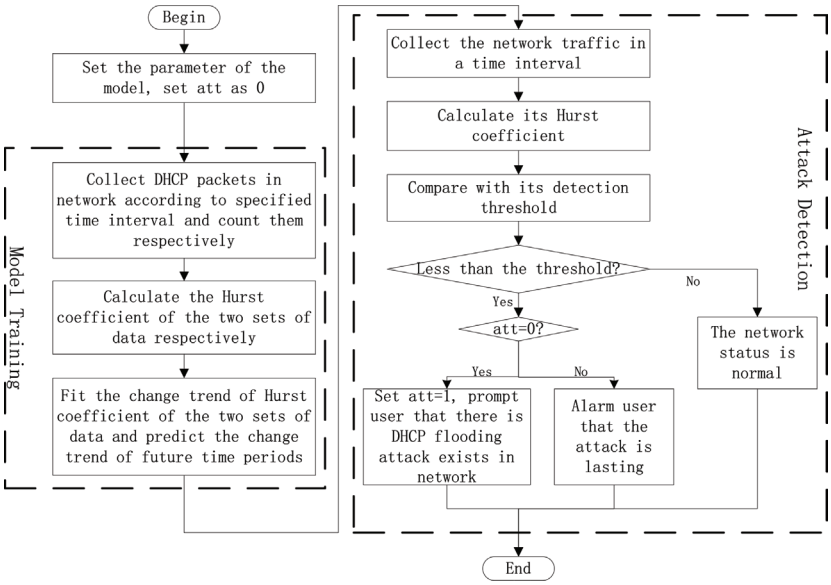

Figure 4 – The operational procedure of the attack detection model

The operational procedure of this model is as follows.

1. The user configures the parameters of the model such as time interval of network traffic statistics, and sets the attack status variable att to 0.
2. Training of the model.

   ① The network packet acquisition module collects the packets sent to the DHCP server, according to the time interval set before count the number of packets in the network containing DHCPDISCOVER message and DHCPDECLINE message in each time interval respectively. After that sends the two sets of data to Hurst coefficient calculation module to perform calculation.

   ② The Hurst coefficient calculation module calculates the Hurst coefficients of the two sets of data received respectively, and then sends these data to the detection threshold calculation module for processing.

   ③ The detection threshold calculation module fits the change of Hurst coefficient received from the Hurst coefficient calculation module, and predicts

the Hurst coefficient of the network traffic in future time intervals to determine the detection threshold.

3. Detection of attacks.

   ① The network data packet acquisition module counts the number of packets in one time interval, and sends the data to the Hurst coefficient calculation module to perform calculation.

   ② The Hurst coefficient calculation module calculates the Hurst coefficient according to the data received, and then sends the coefficient to the flooding attack decision module to perform judgment.

   ③ The flooding attack decision module compares the received Hurst coefficient to the threshold of Hurst coefficient at this time interval calculated by the detection threshold calculation module. If the calculation result is larger than the threshold, it means that the network status at this time interval is normal, then set att to 0; if it is smaller than the threshold, it means that there exists DHCP flooding attack in the network at this time interval. If att is 0 at this time, set att to 1, and prompt the user that there is DHCP flooding attack existing in the network. If att is 1, it is considered that the attack is continuing at this time, alarm the user that this attack is still ongoing.

After the attack detection model sends attack alarm information, the attack detection model will reserve the alarm information to help network maintenance personnel's searching and analysis. The network maintenance personnel can manage the network effectively through querying and analyzing the alarm information, to search the DHCP flooding attacks the network has or being suffered, and find the reason of this attack. The maintenance personnel can also strengthen the DHCP server in time through searching or analyzing the weak point of security in the network, to minimize the harm of DHCP flooding attacks, and to prevent these attacks actually.

5. Experiment and Analysis

In order to examine the effect of DHCP flooding attack detection model based on improved wavelet analysis method, and guarantee the objectivity of experimental evaluation, based on the model and algorithm designed in this paper, this paper select the wireless campus network of a school as the test object. The experiment chooses 5 minutes as an acquisition time interval, collects the network traffic situation of this network for a week, and from this obtains the change of Hurst coefficient of this network in one day, as shown in Figure 5.

From Figure 5 we can see that, the change of Hurst coefficient of this network in one day shows an obvious time characteristic. From 8 am to 10 pm every day, the Hurst coefficient is lower, while from 10 pm to 8 am next day, the Hurst coefficient is higher. After training the detection model using the network traffic situation in one week, we find that when the weighting coefficient α=0.65, the Hurst prediction general formula fits best to the change of the Hurst coefficient.

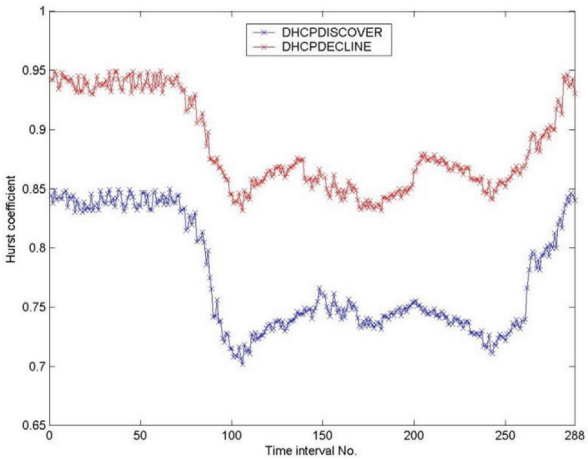

Figure 5 – The change of network traffic Hurst coefficient in one day

In this experiment, we adopt Dhcpstarv to simulate the DHCP flooding attacks. Dhcpstarv is an open source program running on Linux operating system. It can exhaust the IP address pool of the DHCP server through forging data packets including DHCPDISCOVER messages, thus lead the DHCP server cannot provide service normally (Fall & Stevens, 2011). In this experiment we modify the source code of this program to some extent, to make the program has the function to send packets including DHCPDECLINE messages, and can configure the rate of packet transmission. Thus it can simulate DHCP flooding attacks in different strength.

This experiment aims at the two sets of data packets the attack use to send in DHCP flooding attacks, i.e. DHCPDISCOVER data packets and DHCPDECLINE data packets. This experiment chooses three different flooding attack strengths respectively, and simulates attacks in several different time periods in one day respectively, to examine the sensitivity and accuracy of this detection model against flooding attacks in different time periods, and compares the effect to the one using the traditional attack detection method. The experimental result is shown in Table 1.

From the experimental result in Table 1 we can see that, regardless of the strength of the DHCP flooding attack, this attack detection model can detect the DHCP flooding attack occur in the network accurately, and can promptly issue an alarm to the user, so that this improved attack detection model has a higher detection accuracy.

6. Conclusions

As an important part of the TCP/IP stack, DHCP greatly improves the management efficiency of IP addresses, while at the same time there have been many security problems such as DHCP flooding attacks. This paper aims at the problems occur in

Type of attack data packets	Attack strength	Time interval No.	Calculation value of the Hurst coefficient	Traditional method		Improved method	
				Threshold	Detection result	Threshold	Detection result
DHCP-DISCO-VER	10 packets / min	50	0.7099	0.65	undetected	0.7935	detected
		100	0.6718	0.65	undetected	0.6796	detected
		200	0.6947	0.65	undetected	0.7167	detected
	50 packets / min	50	0.6385	0.65	detected	0.7935	detected
		100	0.6689	0.65	undetected	0.6796	detected
		200	0.6427	0.65	detected	0.7167	detected
	100 packets / min	50	0.5582	0.65	detected	0.7935	detected
		100	0.6295	0.65	detected	0.6796	detected
		200	0.5941	0.65	detected	0.7167	detected
DHCP-DECLI-NE	10 packets / min	50	0.8572	0.78	detected	0.8997	detected
		100	0.7694	0.78	detected	0.8031	detected
		200	0.7906	0.78	detected	0.8212	detected
	50 packets / min	50	0.8791	0.78	detected	0.8997	detected
		100	0.7508	0.78	detected	0.8031	detected
		200	0.8152	0.78	detected	0.8212	detected
	100 packets / min	50	0.6593	0.78	detected	0.8997	detected
		100	0.6084	0.78	detected	0.8031	detected
		200	0.6497	0.78	detected	0.8212	detected

Table 1 – Experimental result when transmitting attack data packets in different kinds of strength

current DHCP flooding attack detection, proposes a new DHCP flooding attack detection model. This model improves the traditional detection method based on wavelet analysis, through analyzing the data packet traffic containing DHCPDISCOVER messages and DHCPDECLINE messages in the network, find the rules of change trend from the network traffic, and dynamically configure the attack detection threshold according to the rules, thus improve the accuracy of attack detection. This model can be combined with other security protection measures in LAN to investigate potential attack sources in the network, and handle these attack sources according to corresponding security management policies, thus to prevent the network from DHCP flooding attacks effectively. In future works, this model can be applied to LANs configured DHCP, to improve the ability to resist DHCP flooding attacks in LANs.

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Cross-cultural Awareness in College English Teaching based on Computer Multimedia Technology

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Abstract: In order to have a comprehensive and deepening study on the "people-oriented" college student management work, a neat, scientific and complete theoretical framework must be set up. In order to establish this kind of scientific and comprehensive theoretical framework, the core concept of relevant problems must be fully recognized. Defining the "people-oriented" college student management work, going into the nature of student management work and correctly grasping factors that influence people-oriented college student management work are necessary premises to study people-oriented college student management work. After determining the basic frame work of the scientific and comprehensive people-oriented college student management work, we will begin to see the system problem of college student management work and its manifestations. According to the progress of the society and the development of the times, fully understanding about the existing problems in the college student management work and its causes, discussion on the subject of people-oriented college student management work and fully demonstration of college student management work with people-oriented as the subject are according with era development and realistic requirements. Constructive suggestions are proposed on ways and methods of achieving people-oriented college student management work. Have a profound understanding about student management work and the meaning of student management work to social and individual development. Elaborate the objectives of student management work and provide a scientific and reasonable theoretical way for achieving people-oriented student management work.

Keywords: Computer Multimedia Technology, College English teaching, Cross-cultural Awareness.

1. Introduction

Language and culture are inseparable. Language is not just a set of symbol system. The speech form of language is limited in its community custom, life style, behaviour way, concept of value, mode of thinking, religious faith, national psychology and personality and so on. Culture and language has a deep contact, a certain cultural background is

not only helpful to open the students' vision, enlarge their knowledge, learn more about the world, but also benefit the improvement of cultural literacy, prompt the application ability of language. Language and culture are like a twin brothers, they like two sides of a coin. They influence each other, and promote each other. Languages are the carrier, crystallization and the important part of culture; At the same time, the culture limits the form of language, language can't be independent from culture learning, and vice versa. To learn both of them is the shortcut to master a language. English is the most widely used language in the world, but for a long time, in the English teaching the relation between language and culture hasn't been given enough attention (Cadavid and Gómez, 2015; Mohsin et al., 2010).

Cross-cultural studies, sometimes called holocultural studies or comparative studies, is a specialization in anthropology and sister sciences (sociology, psychology, economics, political science) that uses field data from many societies to examine the scope of human behavior and test hypotheses about human behavior and culture (Ochieng et al., 2010). Cross-cultural studies are the third form of cross-cultural comparisons. The first is comparison of case studies, the second is controlled comparison among variants of a common derivation, and the third is comparison within a sample of cases. Unlike comparative studies, which examines similar characteristics of a few societies, cross-cultural studies use a sufficiently large sample so that statistical analysis can be made to show relationships or lack of relationships between the traits in question. These studies are surveys of ethnographic data.

With the development of globalization, cross-cultural communication is claiming a more and more important position. Researches reveal that foreign language learning is also a process of cross-cultural communication, and successful cross-cultural communication includes not only linguistic competence, which is conventionally taken as of capital importance in communicating with native speakers, but also other important components. The instances are not unfamiliar to us when an English learner, having a good command of English phonetics, grammar and vocabulary though, fails to achieve the expected communicative goal when communicating with a native English speaker. Language is influenced and shaped by culture; it reflects culture. We cannot be competent in the language if we do not also understand the culture that has shaped and informed it. We cannot learn a second language if we do not have an awareness of that culture, and how that culture relates to our own first language and first culture. It is not only therefore essential to have cultural awareness, but also cross-cultural awareness.

The main goals and contributions of this paper are use of multimedia network technology with computer to play an important role in the field of college language teaching. In college English multimedia network teaching, we combine with network, design a new teaching mode, pay attention to improving the students' subjective initiative and cognitive ability, and create conditions to cultivate students' cross-cultural awareness.

This work is organized as follows. In Section 2 we explain cultural differences in learning English language. In Section 3 the application of multimedia network technology in college English teaching is proposed. In Section 4, we analyse effect of new teaching mode. In Section 5 we conclude this paper.

2. Cultural differences in learning English language

Culture, in a broad sense, is an integrated pattern of human behavior that includes thoughts, communications, languages, practices, beliefs, values, customs, courtesies, rituals, manners of interacting and roles, relationships and expected behaviors of a racial, ethnic, religious or social group (Fageeh, 2010). As a culture is so inclusive, it permeates virtually every aspect of human life and influences predominantly people's behavior, including linguistic behavior.

This means that language is not only part of how we define culture, but it also reflects culture. Language and culture intrinsically depend on each other, they have evolved through the history (Wang et al., 2011). Their mutual interdependence can find proof in the rise of civilization, the development of writing and human communication (Myhill et al., 2012).

Language is a vehicle of cultural transmission. Different languages may reflect different cultures; different cultures entail different language expressions. Idioms, proverbs and metaphors in different languages derived from different origins, also demonstrate cultural differences. Different languages may have different idioms owing to different living environments, social conventions and literature tradition, etc. Thus, language learners cannot truly master the language until they have also mastered the cultural contexts in which the language occurs (Vooren et al., 2012).

But there are some cultural differences and conflict for students in learning English language (Rachel, 2007). Chinese people's concept of privacy is weak, they think personal belonging to the collective, with exquisite work relations, care about each other, very willing to understand other people's ups and downs, each other are also willing to be honesty. While westerners very pay attention to personal privacy, pay attention to personal space, don't want to too much to mention their own things to others. Chinese people often ask each other's age, marital status and children occupation and even income in first met, but in English culture, age, address, work unit of marriage and family income situation faith topic belongs to the category of personal privacy, such as taboo others asked. We pay attention to modest in communication when low statue of people, when faced with praise or congratulations, even in the heart glad, it is inevitable that the modest self-denigration has a mouth, which symbolizes modesty polite, think modesty is a virtue, not is disrespect for others. In the west, when people are praised, he will be glad to have a chance to say 'thank you to accept. When westerners heard Chinese so no others praise or hear about the denial of their own achievements, even belittle yourself, they will feel very surprised, think Chinese people don't honest, will misunderstand each other question their judgment. Chinese people use "thank you" far behind American and British people as frequently, only when someone else has helped with said. American and British people both between family members, and between higher and lower levels, between the span, for one small thing, even in all say thank you. The Chinese answer 'Thank you used to say, this is my duty. If the literal translation of it's my duty will make American and British people do not happy, because it' s my duty meaning is: I don't want to do this, but it is my duty to do, the proper answer is it's a pleasure. Some occasions said in English, "Please" don't use English "please", such as let others advanced door or when getting on or off, are usually said "After you", ask people to eat the food at the dinner table, smoke or drink, just to please people, generally with the "help yourself".

Cause of the differences between Chinese and western culture phenomenon is because the two sides have different cultural traditions of Chinese and western different historical background, which will bring people thought behavior for the differences, even conflict.

Notice to logic, and analysis the western mode of thinking, and thinking mode, show the intuitive wholeness of the east, so Chinese people tend to be particularly heavy depending on intuition, pay attention to experience and feeling in the process of understanding, often in contact with experience and feeling to his motivation. This kind of thinking mode, has obvious general and fuzzy and form a mind-set that can identify and simplify the process of the classification of the external perception, ignoring the difference of individual things, exaggerate and the other related to a particular social group cognitive attitude, often with emotion, accompanied by fixed creed (Graus et al., 2015).

In communication, people often to use its social norms to judge the rationality of the each other behavior, due to the differences between both sides of the code of conduct, often produce misunderstanding or unhappy, the best way to understand each other's code of conduct is to do as the Romans do. Such as the Chinese pat young children head said a friendly, but in the west. This is a kind of respect children.

Every culture value system can help people distinguish between beauty and ugliness good and evil. In Chinese culture, people respected modest and polite, pursue the happy-go-lucky, don't like competitive, line above all, a person will not, the collective orientation dominate. While western culture advocate individualism, let it is a sign of lack of enterprising spirit, is lazy incompetent synonym, advocate independent thinking independent judgment, think personal interests supreme.

The phenomenon of things and behavior evaluation and interpretation is built on the basis of culture itself, communication in intercultural communication people tend to ignore the pragmatic migration (Schulz, 2001). A kind of cultural standard specification can only be explained according to its specific conditions in their own, and not to describe another culture, the deep cause of the failure of the cross-cultural communication is that people lack of sensitivity to the social language differences.

3. The application of multimedia network technology in college English teaching

The multimedia and network technology has been developing rapidly in the past few years. Network resources should take an important role in college English teaching, of which the students-centered pattern should be promoted so that students' potential of autonomous learning can be developed. Multimedia computers can provide an accurate portrayal of the target language and provide learners with control and feedback. More importantly, they facilitate a methodological and theoretical advance emphasizing input and intake. Multimedia also provides a massive storehouse of records to facilitate authentic learning (Pusack et al., 1990). Besides, multimedia provides support for different learning styles of language learners by deploying different neuron-systems in learning through its reliance on sound, color, and animation.

Multimedia network technology is the core of modern education teaching techniques. Modern multimedia teaching has benefits like optimized teaching process, rich teaching

resources and improved teaching efficiency (Diane, 2012). College English teaching should not only teach English knowledge, but also attach great importance to English culture background, social communication, oral English teaching, to cultivate students' English comprehensive application ability, which is the core aim of present college English teaching. In English language and culture teaching, teachers can make use of the advantages of media technology, such as graphic elements and animation, and infiltrate the US and UK national social culture and language habits in English language classroom teaching. Let students broaden their cultural horizons in learning English language knowledge at the same time, and students' learning and understanding language and culture is of great help to improve their English communication ability.

For example, some festival cultures in western countries are different from ours. Each country has its own unique festivals. One more grand festival is Thanksgiving Day. Thanksgiving Day is a unique western festival. Teachers in teaching this part can use multimedia devices to play a video clip of Family Album USA. Stewart families on Thanksgiving Day are around the table to eat. Turkey and pumpkin pie are the most interesting foods at the dinner table, and families greet each other: "Happy Thanksgiving Day". The entire picture shows a busy festive mood. Multimedia graphic, animation and other advantages may generate a comprehensive stimulus to students. Students can realize the immerse feeling in using visual and auditory abilities. This is very good for arousing students' interest in learning. Students can really realize western festival culture through multimedia animation display, and thus produce seeking knowledge desire, and actively explore western culture, such as the origin of Thanksgiving and Thanksgiving customs. Then they may have a deeper understanding of the social culture of western countries.

When there are cultural background differences, the word meaning and metaphor of English also have many differences, so in addition to introduce social culture in English culture teaching, we must focus on cultural connotation of English vocabulary. In different cultural backgrounds, the same word may represent different meanings. If communicators don't understand key words' culture and context in the process of specific communication, it is easy to cause deviations in understanding, and eventually lead to communication failure. For example, "They are willing to talk Turkey and end the war". Turkey is common in the west, but the Chinese know little. It is hard to understand the words on the lexical meaning. What is the relationship between Turkey and war? Key vocabulary cultural connotation is required here. Western countries people are inspired by Turkey courtship behavior directly, so the phrase is to describe "straightforward, frank." In addition, different cultural background may cause differences in values and ways of thinking. These are reflected in language. For example when praised by others (" What delicious food you've made "), due to differences in Chinese and western ideas, the Chinese will answer "there are nothing special" to be modest; While westerners will answer "Thanks. I am glad you like it" to say thank you. So by comparing, the striking differences of Oriental culture and western culture can be seen. Teachers in the process of English teaching should make Chinese and western culture comparison in combination with the teaching content to cultivate students' cross-cultural communication consciousness.

Though the classroom remains an important environment for students, it is not in itself a thoroughly authentic learning context. The Internet, however, provides the possibility

of creating a virtual reality for students. The vivid images of virtual classroom could fuel students' motivation to learn English.

So the new college English teaching mode based on multimedia and network technology provides students ample opportunity to practice their English listening, speaking, writing and reading comprehension. In addition to face to face interaction with one another, students may speak English in a virtual reality setting using the software of English Autonomous Learning Center, as well as chatting online with other communities of English learners in China and abroad. The authenticity of the learning environment provides students with the chance to study English through doing rather than learning.

Network serves as a supplementary tool to give students larger room to study autonomously. Under the network environment, students can choose learning materials according to their own will, their activeness and creativeness can be cultivated, thus passive in-class learning can be changed into autonomous out-of class learning.

Multimedia and network teaching breaks the limitation of synchronic learning and motivates students to focus their attention on the vivid listening and speaking materials, so that students' eagerness of pursuing study can be stimulated, and this will become an inner power to push them forward.

A student-centered teaching mode taking multimedia and network as the teaching assistance is shown in Figure 1.

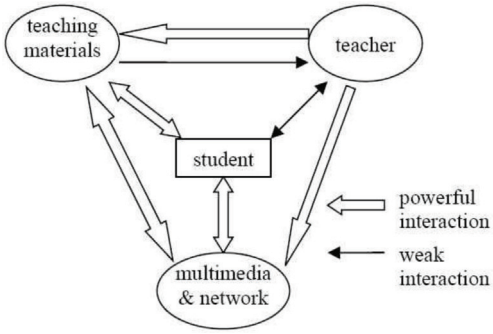

Figure 1 – A student-centered teaching mode

Anyway, multimedia and network technology plays an important part in the new teaching mode of college English. The teacher interacts with students by guiding, supervising and managing on the Internet. The new teaching mode can be shown in Figure 2.

The new teaching mode has the following advantages:

The new teaching mode of college English based on multimedia and network technology has remodelled the traditional teaching mode of "textbook + blackboard + chalk". The new mode is informative, student-centered, and all classroom activities are focusing on students so that the students are in the best English language learning environment. As a result, students can learn English in a very relaxed and effect way by using all their senses. During the teaching experiment, the researcher found that the students in the

pilot classes were no longer passive, silent, isolated learners, but active participants and autonomous learners. Furthermore, in the process of teaching, the teacher provides the students with a variety of realistic autonomous learning approaches, which is feasible in a real learning process, and teachers also develop students' autonomous learning interest in knowledge self-construction process by giving students opportunities to think individually and independently.

The new teaching mode brings the learners' initiative into full play by letting them do interesting and meaningful tasks that are close to real life events. Carefully designed and well-graded, the tasks not only give the learners a chance to use the language in real communication, but also enhance their ability for creative thinking and problem-solving. They become real participants while the instructor is reduced to the status of a designer, organizer, counsellor, and facilitator. This approach, seemingly shifting the burden onto learners, is in fact more demanding for the teacher, as the designing of good tasks and on-the-spot organization calls for more alertness and resourcefulness.

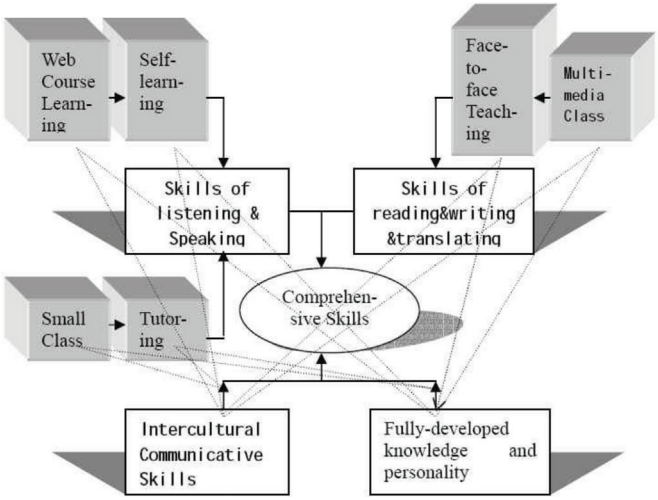

Figure 2 – The new teaching mode

4. Effect of new teaching mode analysis

In the researcher's university, 16 classes are chosen at random to be pilot classes which adopt the new teaching mode by using multimedia and network technology. After 2 years' teaching practice, the effect is quite good, and the teaching achievements are improved year by year. We compared students who have used the electronic course (the experimental class) and those who have not (the control class). Through the questionnaire research and by applying Statistics, we analyzed the means, range, maximum score, minimum score and the standard deviation of every test, and the result truly represents the importance of the electronic teaching mode that has played in the College English course.

The comparison of experimental class with control class is shown as following Tables.

Class	Listening	Reading	Vocabulary	Blank Filling	Writing	Total Score
4131	17.8	30.2	11.9	7.9	11.6	79.6
4132	15.0	29.7	10.0	6.9	11.0	72.7
4231	14.7	29.6	10.9	6.5	10.2	72.3
4232	15.6	29.9	11.6	7.1	7.7	72.1
4234	14.2	29.9	9.9	7.0	9.8	71.0

Table 1 – Experimental class (Eclassroom 1)

Class	Listening	Reading	Vocabulary	Blank Filling	Writing	Total Score
3431	15.3	28.9	11.1	6.2	10.8	72.6
3432	15.0	29.9	11.2	6.8	11.7	74.9
3832	13.9	26.8	10.4	5.7	8.0	65.2
7331	14.7	28.4	11.3	7.3	9.7	71.7

Table 2 – Experimental class (Eclassroom 2)

Class	Listening	Reading	Vocabulary	Blank Filling	Writing	Total Score
3731	13.5	27.1	10.0	5.5	8.4	64.8
8237	12.6	26.8	9.5	6.4	10.4	66.0
11831	13.5	30.2	10.4	6.3	9.7	70.3
13531	14.4	26.8	10.6	6.8	10.1	68.9

Table 3 – Control Class (Traditional Classroom)

From above Tables, we can see the nine small classes (4131, 4132, 4231, 4232, 4234, 3431, 3432, 3832, 7331), which formed two big eclassrooms, got very high average scores, and one small class (4131) even ranked as the top class among the 143 small classes in the Grade. In contrast, the four traditional small classes (3731, 8237, 11831, 13531), which formed a big traditional class, got unsatisfying scores, only one small class (11831) had got an average score higher than 70.

Our experiments had covered the four terminal tests ranging from the year of 2013 to the year of 2015, and around 3,800 subjects have been involved. Besides, the teaching effects of the eclassrooms and the traditional classroom have been tested as well. Such kind of stereoscopic experiments can to a great extent truly represent the efficiency of the new teaching mode of college English, and convince us of the application of multimedia techniques.

5. Conclusions

The application of multimedia and computer network technology in college English language teaching is not only the shift of teaching activities or teaching methods but also the shift of teaching ideas. It is a kind of shift from teacher-centered teaching mode which emphasizes language knowledge and skills to student-centered teaching mode which pays more attention to developing language applied ability and autonomous learning. Teachers in the process of college English teaching must pay attention to cultivate students' intercultural consciousness, improve students' English cultural quality, and improve their ability of cross-cultural communication. So to the cultivation of students' cross-cultural awareness in college English teaching should make full use of multimedia network technology. Make full play to the advantages of multimedia network technology with a variety of ways to cultivate students' intercultural consciousness and improve students' cross-cultural communicative competence.

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Application of GA-based Projection Pursuit Model in the Comprehensive Evaluation of Governance Level of "Peasant-to-citizen" Community

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Abstract: As a livelihood project for China's urban-rural overall development and urban-rural integrated construction, the "peasant-to-citizen" project has a very important realistic significance. The governance level of "peasant-to-citizen" community is the key determining whether this livelihood project can be promoted continuously. In order to make a scientific and correct evaluation on the governance level of "peasant-to-citizen" community in Jiangxi province, the "peasant-to-citizen" communities in Nanchang and Jiujiang were selected as the objects of research; after field investigation and collection of original data, the GA-based (genetic algorithm-based) projection pursuit model was used to evaluate the index system built. It is found through the research that there are some differences in the governance level of "peasant-to-citizen" communities in the two cities; besides, with the assistance of optimized projection direction, it indicates the difference of all level-II evaluation indexes in the overall judgment of samples; this also shows that the governance level of "peasant-to-citizen" community is influenced by multiple factors, which have different degrees of effect.

Keywords: peasant-to-citizen; community governance; projection pursuit model

1. Introduction

With the continuous promotion of urbanization process and rapid implementation of overall rural-urban development, rural-urban integrated development and other policies concerned, on the one hand, the extensive requisition of land in the suburban areas and urban villages leads to a large number of land-lost peasants; on the other hand, the urban migrant workers live in cities. To settle down in cities for a long time, the two groups of people need to live in cities finally, so the former village system is changed

into the community system and unique “peasant-to-citizen” communities are formed. Because of the different subjects of community, there are significant differences between the “peasant-to-citizen” community and the general urban community (Sá et al., 2016). Meanwhile, in consideration of the short existence of such communities and relatively complicated community conditions, the governance requirements for “peasant-to-citizen” communities are stricter. In order to build a harmonious “peasant-to-citizen” community relationship and effectively carry out the “peasant-to-citizen” policy, good “peasant-to-citizen” community governance is not only the basic connotation promoting land-lost peasants to become urban residents but also the necessary requirement of the new urbanization road.

According to the current research content, scholars have obtained abundant achievements after making a series of studies on China’s “peasant-to-citizen” problem. Their studies mainly focus on the group satisfaction analysis of “peasant-to-citizen” community, “peasant-to-citizen” cost estimation, “peasant-to-citizen” community management and “peasant-to-citizen” level analysis etc. From the perspective of range of study, the provincial studies mainly analyze the people citizenization from the view angle of inclusive growth and give policy suggestions on people citizenization from many aspects (Wang, 2016); the municipal studies mainly discuss the employment issue of “peasant-to-citizen” residents and emphasize the government’s major responsibility for the employment issue (Ding, 2013). From the perspective of research methods, mainly the data analysis method, comprehensive index evaluation method and factor analysis method are included. The data analysis methods is to collect, analyze and systemize the original data of some urban “peasant-to-citizen” costs so as to explore and discuss the major influencing factors of “peasant-to-citizen” project (Wei and Sui, 2015). The comprehensive index evaluation method is used to build the satisfaction evaluation index system and analyze the community residents’ satisfaction for “peasant-to-citizen” community (Xia and Xu, 2010). The factor analysis method is to analyze the issues in “peasant-to-citizen” communities and explore the measures and approaches to optimize the community management system (Xu and Lu, 2007). In addition to such frequently-used methods, there are also methods such as analytic hierarchy process (AHP) (Geng, 2007), fuzzy evaluation method (Chen, 2015), game theory (Lu, 2015) and AHM algorithm (Wang, 2013) based on specific problems. The existing research achievements have solved some issues in the “peasant-to-citizen” process and provided a new thought for the subsequent researches.

Based on the analysis and systemization of the existing research content, we know that “peasant-to-citizen” policy is a new population policy benefiting people is different in various areas, so the “peasant-to-citizen” community governance measures also need to be adjusted based on the local conditions and proper ways and measures are required for governance; therefore, the region-restricted researches concerned are also needed. From the perspective of research methods, there are some defects in the frequently-used methods currently. For instance, there is artificial subjective assumption in determining the weight evaluation index in AHP; the fuzzy evaluation method lacks recognition for some positive factors; the factor analysis method involves the loss of reliability of indexes when processing the index data. Such defects also limit the research achievements’ interpretability and further expansion of research content. For this reason, this research plans to evaluate the governance level of “peasant-to-citizen” community

in Jiangxi province with the GA-based projection pursuit model, contrastively analyze the governance levels of three typical "peasant-to-citizen" communities in Nanchang County with the multiple index data demission deduction method, and infer the relevant factors influencing the community governance level through the result of comparison.

2. Building the comprehensive evaluation projection pursuit model

The GA-based projection pursuit model, which organically combines the genetic algorithm with the projection pursuit model, is a sample data-driven exploratory data analysis method, which can project high-dimensional data to a low-dimensional space through a combination. As for the projected configuration, the projection index function is used to describe the possibility that the projection reveals a certain classification and sorting organization of the original system and to find out the projection value which can optimize the projection index function (namely, reflect the high-dimensional data structure or characteristics); then, the characteristics of classification structure of high-dimensional data can be analyzed based on the project value (Ma, 2014). When reducing dimensions, the projection pursuit model can keep the data stability and realize that low dimension can also faithfully reflect the architectural characteristics of data. The projection pursuit model based on the genetic algorithm can not only obtain the comprehensive evaluation quality, but also optimize the projection direction and analyze the degree of influence of all evaluation indexes on the overall judgment of samples.

2.1. Normalization of index sample data

Based on the specific characteristics of this research and to show the governance level of "peasant-to-citizen" community, the initial evaluation sample set built by using communities as objects of research is {X*(i, j) | i=1, 2, 3,..., n; j=1, 2, 3,...,p}. X*(i, j) is the evaluation index j of "peasant-to-citizen" community i. "n" and "p" respectively denote the number of "peasant-to-citizen" communities and the quantity of evaluation indexes. In order to eliminate the dimension of each index value and to unify the range of variation of each index, extremums can be normalized according to formula (1) and formula (2).

As for a benefit-oriented index, the bigger index value will be the better. Numerical values should be normalized according to formula (1):

$$x_{ij} = \frac{x_{ij}^{*} - \min(x_j)}{\max(x_j) - \min(x_j)} \tag{1}$$

As for a cost-oriented index, the smaller index value will be the better. Numerical values should be normalized according to formula (2):

$$x_{ij} = \frac{\min(x_j) - x_{ij}}{\max(x_j) - \min(x_j)} \tag{2}$$

In the formula above, $\min(x_j)$ and max( ) are respectively the minimum and maximum of original index data j among n "peasant-to-citizen" communities.

2.2. Building the projection index function

The GA-based projection pursuit model is to synthesize the P-dimensional data {X*(i, j) | i=1, 2, 3,...,n; j=1, 2, 3,...,p} into the one-dimensional projection value Z(i) in the projection direction a={a(1), a(2),..., a(p)}. its expression is shown in formula (3).

$$Z(i)=\sum_{j=1}^{p}a(j)\bullet X(i,j) \quad i=1,2,3,\cdots,n \tag{3}$$

In the formula above, a is the unit length vector. At the synthetical projection value, the distribution characteristics of projection value are required to be as follows: the local projection points should be possibly intensive and would better gather into some point clusters; however, on the whole, the projection points and clusters should possibly disperse. On the basis of this, the projection index function can be built below:

$$Q(a)=S_z\bullet D_z \tag{4}$$

In the formula above, S_z is the standard deviation of projection value $Z(i)$; is the local density of projection value $Z(i)$. The calculation formulas for the two are shown below:

$$S_z=\sqrt{\sum_{i=1}^{n}(z(i)-Ez)^2/(n-1)} \tag{5}$$

$$D_z=\sum_{i=1}^{m}\sum_{j=1}^{n}(R-r_{ij})u(R-r_{ij}) \tag{6}$$

In formula (4), z is the mean value of sequence $\{z(i)|i=1,\cdots,m\}$. Formula (5) is the local width parameter determined based on the data feature. When the space among points r_{ij} is less than or equal to R, it can be calculated as one type; otherwise, it should calculated according to different types; $r_{ij}=|z(i)-z(j)|$; the sign function $u(R-r_{ij})$ is the unit step function; when $R\geq r_{ij}$, the function value is 1; otherwise, the function value is 0.

2.3. Optimization of projection index function

Based on the characteristics of projection pursuit, the optimal projection direction should be the projection direction that maximally reveals a certain feature structure of high-dimensional data. In this research, the high-dimensional global optimization problem can be carried out by simulating the rules of the survival of the fittest of creatures and the accelerated genetic algorithm (AGA) of chromosome information exchange mechanism inside a group. When the sample set of all index values is set, the projection index function Q(a) only changes with the change in the projection direction a. The optimal projection direction which maximally reveals a certain feature structure of high-dimensional data can be estimated by solving the maximization problem of

projection index function. Thus, the optimized projection index function expression (7) can be obtained.

$$\begin{cases} Max: Q(a^*) = S_z D_z \\ s.t: \sum_{j=1}^{p} a^2(j) = 1 \end{cases} \tag{7}$$

2.4. Evaluation on governance level

When the optimal projection direction a^* in Step III is put into formula (1), the projection value $z(i)$ of each sample point can be obtained. The whole process of dimension reduction is shown in Fig. 1. Verify and analyze the modeling process based on the model verification process put forward by Tomás San Feliu, a Spanish scholar (Tomás, 2016). Then, judge the samples according to the projection value; besides, after normalizing the samples to be evaluated through the comprehensive evaluation method for the governance levels of "peasant-to-citizen" communities built, calculate the actual projection value. $z^*(i)$ can also be compared pair wise; if the two are more approximate, samples are more likely to be classified into one category.

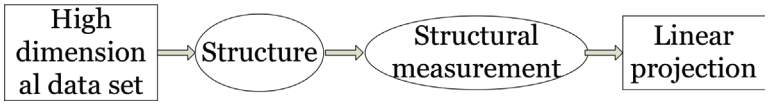

Figure 1 – Process of structure-based projection dimension reduction

3. Evaluation index system

3.1. Selection of sample index

In combination with the existing research achievements and based on China's development strategy of new urbanization, we know that raising the governance level of "peasant-to-citizen" community plays an important role in facilitating population urbanization and realizing the overall rural-urban development. Compared with the ordinary urban community, the "peasant-to-citizen" community is specially characterized by resettlement. Strengthening the "peasant-to-citizen" community governance is a key part to improve residents' cultural quality and living quality as well as maintaining the urban social stability and harmonious development. Based on the basic requirements of community governance, the comprehensive evaluation index system for the governance level of "peasant-to-citizen" community is established according to the scientific, reasonable, correct and effective basic principle with a proper scope (Zhou, 2015). The primary indexes with four dimensions, including community life, environment, management and customs, are set; under the primary indexes, N secondary indexes are set correspondingly. In addition, as a livelihood policy to resettle land-lost peasants in cities, the "peasant-to-citizen" policy varies based on different local conditions. Jiangxi province was selected as the region of this research. Therefore, when building the comprehensive evaluation index system, it is required to combine the specific features of "peasant-to-citizen" community governance in Jiangxi province and

reasonably construct the comprehensive evaluation system for the governance level of "peasant-to-citizen" community (Table 1).

Primary index	Secondary index	Original index
Community life (A)	Life convenience A1	Expressage points per one hundred households (Nr.)
	Living facilities A2	Quantity of entertainment and fitness facilities per one hundred households (Nr.)
	Health security A3	Number of doctors per one hundred households (persons)
Community environment (B)	Human settlement environment B1	Per capita green area (m2)
	Overall community environment B2	Green coverage ratio of community (%)
	Community garbage disposal B3	Domestic sewage treatment ratio of community (%)
Community management (C)	Safety management C1	Number of security guards per one hundred households (persons)
	Democratic management C2	Treatment rate of residents' complaints of community (%)
	Employment service management C3	Total employment rate of community residents (%)
Community customs (D)	Cultural activities D1	Annual average number of times of recreational and sports activities of community (times)
	Civilization appraisal D2	Number of "five-virtue" families (Nr.)
	Legal compliance D3	Number of criminal cases (Nr.)

Table 1 – Comprehensive evaluation system for the governance level of "peasant-to-citizen" community in Jiangxi

3.2. Collection of original data

The "peasant-to-citizen" policy is an effective method proposed to help land-lost peasants to become urban residents under the macro policies of overall rural-urban development and rural-urban integrated construction. Moreover, the "peasant-to-citizen" realization rate is closely linked with the local urbanization level. In consideration of the differences in the urbanization development level of each local city, the "peasant-to-citizen" realization rate and the implementation of "peasant-to-citizen" policy at each region are also different. For this reason, it is required to fully consider the differences of all regions when selecting samples and choose the most representative samples. The agricultural population accounts for a large part of the population in Jiangxi province, an important big agricultural province in the middle part of China. As shown in the data issued by the Jiangxi Survey Corps of National Bureau of Statistics, the migrant workers exceed 10,000,000 persons in Jiangxi, including 3,500,000 migrant workers

in all prefecture-level cities in the province; especially, the number of migrant workers in Nanchang and Jiujiang accounts the largest proportion (National Bureau of Statistics, 2014). Nanchang and Jiujiang has relatively high urbanization levels in Jiangxi province and their economic strength and social development level are among the best in the whole province, so the two cities can easily attract migrant workers to settle down here and they are very representative. For this reason, 10 "peasant-to-citizen" community samples in Nanchang and Jiujiang were selected as objects of research in this research.

Interviews and investigations were carried out for the 5 sample communities in Nanchang and Jiujiang respectively. Residents are randomly interviewed from these "peasant-to-citizen" communities. Based on the questionnaires and data collected during interviews, the statistical data of the two prefecture-level cities were combined; through the analysis and systemization, we can know that the basic conditions of investigation samples are shown in Fig. 2. The male/female ratio of respondents in "peasant-to-citizen" communities was appropriate. As the community residents were land-lost peasants prior to the realization of "peasant-to-citizen" policy, the majority of respondents has a low educational level and mainly serves as clerk and salesman etc.

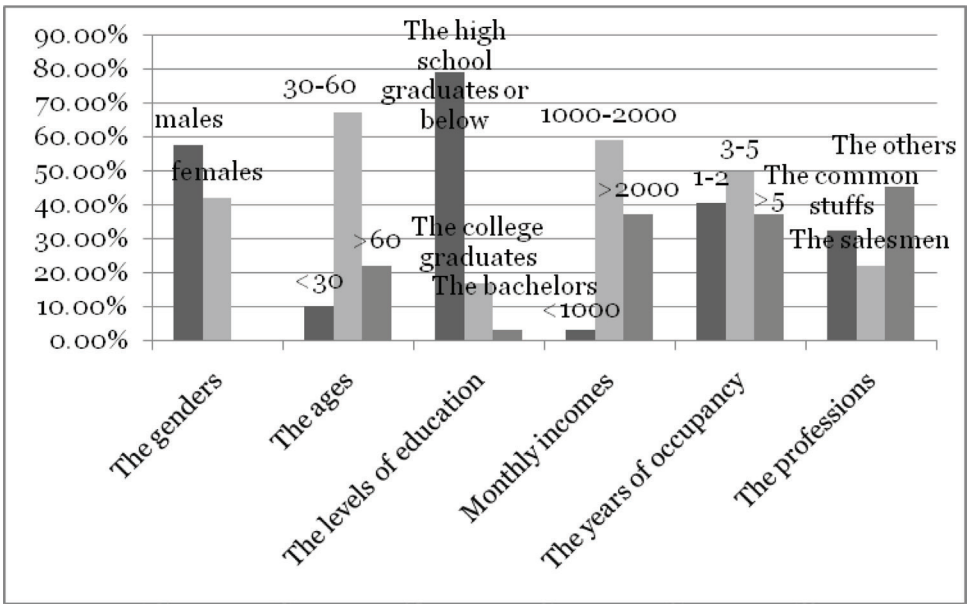

Figure 2 – Basic conditions of investigation samples

3.3. Data processing

Totally 10 "peasant-to-citizen" communities in Nanchang and Jiujiang were used as analytical units. According to the selection typicality of "peasant-to-citizen" communities, the conclusion of field investigation and the principles of reasonable distribution of community location, approximate community completion time and consistent

community scales, the "peasant-to-citizen" communities were selected. Finally, Xingfu Yayuan Community, Tangzhuang Community, Lianhua Jiayuan Community, Yijing Jiayuan Community and Xiangyang Community were selected in Nanchang; Chaishang Community, Liansheng Community, Zhaojia Huayuan Community, Binjiang Huayuan Community and Wanfu Huayuan Community were selected in Jiujiang. The basic information on the governance levels of "peasant-to-citizen" communities in Nanchang and Jiujiang was obtained by choosing the original data gathered through interviews and investigations and combining the statistical data related to the two prefecture-level cities, using the calculating method of fraction and frequency and comprehensively using SPSS23.0. See Table 2 for such information.

Sample community	**A1**	**A2**	**A3**	**B1**	**B2**	**B3**	**C1**	**C2**	**C3**	**D1**	**D2**	**D3**
Xingfu Yayuan	0.61	0.24	0.87	0.94	1.00	0.71	1.00	0.75	8.0	0.87	0.67	1.00
Tangzhuang	0.34	0.11	0.75	1.00	0.74	0.35	0.65	0.81	7.4	1.00	0.45	1.00
Lianhua Jiayuan	0.54	0.07	0.64	0.87	0.98	0.74	0.59	0.47	6.1	0.54	0.71	1.00
Yijing Jiayuan	0.24	0.25	0.82	0.89	0.87	0.48	0.73	0.59	9.3	0.74	0.75	0.98
Xiangyang	0.39	0.31	0.78	0.96	0.94	0.55	0.81	0.89	7.4	0.77	0.51	0.87
Chaisang	0.27	0.09	0.66	0.84	0.82	0.49	0.68	0.94	8.2	1.00	0.43	1.00
Liansheng	0.14	0.14	0.74	0.78	0.91	0.76	0.51	0.57	6.5	0.62	0.29	1.00
Zhaojia Huayuan	0.18	0.21	0.79	0.99	0.56	0.84	0.43	0.62	6.7	0.43	0.57	1.00
Binjiang Huayuan	0.22	0.16	0.83	1.00	0.73	0.69	0.22	0.74	5.1	0.71	0.46	0.99
Wanfu Huayuan	0.25	0.06	0.71	0.78	0.69	0.24	0.29	0.28	6.8	0.46	0.43	1.00

Note: Some data were normalized.

Table 2 – Basic information on governance levels of 10 "peasant-to-citizen" communities

Based on the basic information on the governance levels of "peasant-to-citizen" communities in Table 2, there is significant difference in the governance levels of communities in the two prefecture-level cities, Nanchang and Jiujiang and obvious difference in the two dimensions, community life and management. The health security of community life as well as the employment service management and assistance management of community management also need to be improved. However, there is a relatively small difference in legal compliance under the dimension of community customs.

4. Analysis on the empirical result

Projection measurements were made respectively for the comprehensive evaluation indexes of governance levels of 10 "peasant-to-citizen" communities in Nanchang and Jiujiang based on the basic information in Table 2 and the basic steps of GA-based comprehensive evaluation projection pursuit model described above; the maximum index values obtained through measurements for the two cities were respectively 1.2154 and 0.8703. Meanwhile, some data were normalized; besides, the optimal projection direction (a^*) was obtained via optimized calculation; then, the weights η of all secondary indexes under the four dimensions were calculated based on formula (7).

$$\eta = \left[\frac{a_i^*}{\sum_{i=1}^{n} a_i^*} \right] \times 100 \tag{8}$$

In the formula above, n is the number of secondary indexes. There are 12 secondary indexes in total.

It can be seen from the conditions defined in this research that the optimal projection direction reflects the effect degree of all secondary indexes on the comprehensive evaluation on the governance level of "peasant-to-citizen" community. In order to make a contrastive analysis on the governance levels of "peasant-to-citizen" communities in Nanchang and Jiujiang, an arrangement can be made based on the size order of optimal projection direction a^* (see Table 3). The difference in ranking shows the difference in the influence of primary indexes to some degree; namely, the difference in the weights of primary indexes shows the difference in the governance level of "peasant-to-citizen" community.

The difference in ranking of projection directions in Nanchang and Jiujiang can reflect the difference in the governance levels of "peasant-to-citizen" communities in the two cities; the difference can be specifically shown in the difference in some aspects of governance level and focus. To figure out the difference in the governance levels of "peasant-to-citizen" communities in the two cities more clearly, the optimal projection a^* of Nanchang and Jiujiang was used as independent variable and put into the projection index function; besides, the Matlab 2010b was used for programming; finally,

Nanchang				Jiujiang			
Secondary index	**Project direction**	**Ranking**	**Weight**	**Secondary index**	**Project direction**	**Ranking**	**Weight**
A1	0.248	1	10.61	A1	0.197	4	9.81
A2	0.158	10	9.54	A2	0.145	10	9.54
A3	0.215	5	6.15	A3	0.207	3	8.46
∑	0.621	—	26.3	∑	0.549	—	27.81
B1	0.147	11	10.11	B1	0.125	12	10.57
B2	0.256	4	7.14	B2	0.194	5	7.29
B3	0.175	7	6.22	B3	0.173	7	6.61
∑	0.578	—	23.47	∑	0.492	—	7.29
C1	0.165	9	7.57	C1	0.151	9	6.79
C2	0.246	2	5.23	C2	0.229	2	7.17
C3	0.145	12	8.01	C3	0.137	11	7.63
∑	0.556	—	27.29	∑	0.517	—	28.07
D1	0.243	3	7.82	D1	0.237	1	5.45
D2	0.213	6	6.85	D2	0.186	6	7.69
D3	0.138	13	8.27	D3	0.119	13	6.51
∑	0.594	—	22.94	∑	0.542	—	19.65

Table 3 – Project directions and weights of all index factors of Nanchang and Jiujiang

the protection values $z^*(i)$ of the governance levels of "peasant-to-citizen" communities in the two cities can be obtained, as shown in Table 4.

Nanchang		Jiujiang	
Xingfu Yayuan	3.742	Chaisang	1.157
Tangzhuang	2.564	Liansheng	2.836
Lianhua Jiayuan	3.191	Zhaojia Huayuan	2.354
Yijing Jiayuan	1.738	Binjiang Huayuan	1.847
Xiangyang	2.217	Wanfu Huayuan	1.463

Table 4 – Projection values of governance levels of "peasant-to-citizen" communities in Nanchang and Jiujiang

Both Nanchang and Jiujiang have a good development momentum on the background of the integrated macro policy. In Jiangxi province, the two cities, which have relatively high new urbanization levels, are the major cities for the construction of "peasant-to-citizen" community. Besides, they are the major cities where migrant workers are attracted to settle down. The governance level of "peasant-to-citizen" community directly

concerns the success or failure of migrant workers' settling down in cities. Moreover, the community governance level involves numerous factors, including way of community governance, community governance system and government's supporting policy etc. Even though both Nanchang and Jiangxi are the major cities for the construction of "peasant-to-citizen" community in Jiangxi province, their different local policies and humanistic environments etc. inevitably lead to the different governance levels of "peasant-to-citizen" communities. To clearly express the difference in the governance level, the projection values of community governance levels are specially divided into four different grades: the projection value between 0~1.5 means the elementary level; the projection value between 1.5~2.5 means the intermediate level; the projection value between 2.5~3 means the senior level; the projection value over 3.5 means the excellent level. The original data in Table 4 were draw into a histogram (as shown in Fig. 3) in a proper order. As shown in the histogram for governance levels of "peasant-to-citizen" communities in Nanchang and Jiujiang in Fig. 3, the governance levels of the 5 "peasant-to-citizen" communities in Nanchang are distributed in the intermediate and senior levels on the whole; even, the governance level of Xingfu Yayuan Community has reached the excellent level and is the highest among the 10 "peasant-to-citizen" communities. However, the governance levels of the 5 "peasant-to-citizen" communities in Jiujiang are distributed in the elementary and intermediate levels; only the governance level of Liansheng Community has reached the senior level. As a whole, there is a large space to improve the governance levels of "peasant-to-citizen" communities in Jiujiang.

According to the conditions reflected in Table 4 and Fig. 3, there are some differences in governance level of "peasant-to-citizen" communities in Nanchang and Jiujiang. The governance levels of the 5 "peasant-to-citizen" communities in Nanchang are higher than those in Jiujiang. Meanwhile, the great difference in the community governance levels within a region shows the difference in management among different "peasant-to-citizen" communities in a region. The reasons for the above-mentioned differences are from the social development, economic structure, humanistic environment, population policy and other aspects of cities. As the only national innovation-oriented city in Jiangxi province, Nanchang has many national-level industrial zones, which are the important cornerstones attracting the employment of migrant workers and can relatively guarantee both the employment rate and posts of migrant workers; this also can help to lay the material foundation for migrant workers to settle down here and indirectly facilitate the construction of "peasant-to-citizen" communities. Meanwhile, to support migrant workers to settle down in the city, Nanchang government also issued a series of supportive policies, which have largely raised the governance level of "peasant-to-citizen" community. As a fertile "land of fish and rice", Jiujiang has great advantages in its agricultural production; as a result, some peasants don't want to abandon agricultural production and work in cities is also their interim departure from their hometowns. The secondary industries in Jiujiang are dominated by the textile, printing and other light industries, whose post wages cannot meet migrant workers' life demands in the city, so the "peasant-to-citizen" process is affected in the area. The main reasons for the low governance level of "peasant-to-citizen" community in Jiujiang are the imperfect social security and unsound community management system; therefore, it is required to further improve the "peasant-to-citizen" community management structure and continuously enhance the governance level of "peasant-to-citizen" community.

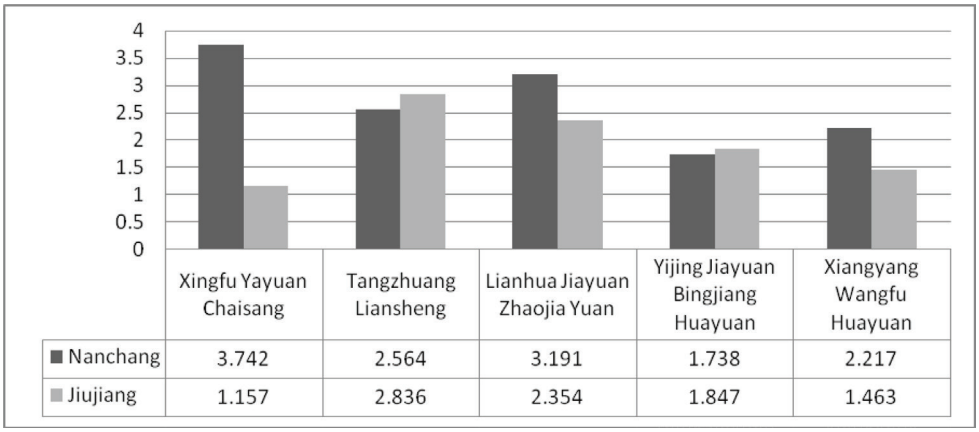

Figure 3 – Grading of governance levels of "peasant-to-citizen" communities in Nanchang and Jiujiang

5. Conclusion

Based on the interviews and investigations on 10 "peasant-to-citizen" communities in Nanchang and Jiujiang and the practical "peasant-to-citizen" conditions in Jiangsu, this paper comprehensively evaluated the governance level of "peasant-to-citizen" communities from the four dimensions, which are respectively community life, environment, management and customs, successively established 12 evaluation indexes, made a quantitative evaluation on the governance levels of investigation sample communities by using the GA-based projection pursuit model, and made the conclusion below.

Firstly, the application of the GA-based projection pursuit model in the comprehensive evaluation on the governance level of "peasant-to-citizen" community can effectively reflect the advantages and disadvantages in the governance levels of "peasant-to-citizen" communities in Nanchang and Jiujiang. It can be seen from the maximum projection values of the two cities, the governance level of "peasant-to-citizen" community in Nanchang is higher than that in Jiujiang and the difference in the community governance level is highly related to the practical conditions of development levels of new urbanization in the two cities. As the leading city of economic development in Jiangxi, Nanchang attracts migrant workers to live here because of its abundant employment opportunities. Meanwhile, with the government's policy guidance, the "peasant-to-citizen" governance has become more scientific and standardized. By contrast, due to the incomplete laws and policies and poor community supervision, the governance level of "peasant-to-citizen" community in Jiujiang is low and needs to be continuously improved in the next management so as to build the "peasant-to-citizen" community into a safe, comfortable and convenient livelihood project.

Secondly, the optimized projection direction of the GA-based projection pursuit model can not only reflect the degrees of influences of all secondary indexes on the comprehensive evaluation on the governance level of "peasant-to-citizen" community

but also be dynamically regulated based on changes in practical conditions so that the evaluation result will be more scientific and effective. Even though Nanchang and Jiujiang are major cities for the construction of "peasant-to-citizen" community in Jiangsu province, the different economic development levels, industrial compositions and structures and humanistic environments of society lead to different focuses on the comprehensive evaluation indexes of governance level of "peasant-to-citizen" community. As for this, we can modify it by adjusting the weight coefficient of evaluation index so that the evaluation system will be more applicable to the practical conditions.

Finally, based on the actual result of research in this paper, the application of the GA-based projection pursuit model in the comprehensive evaluation on the governance level of "peasant-to-citizen" community is extremely effective. The method avoids the lack of systematic theory, calculating process disorder and other issues when some evaluation models are determining the index weight, effectively lowers the degree of influence of subjective factors in the evaluation process, meanwhile, can adjust evaluation indexes based on different regional conditions, and raises the scientificity and validity of the evaluation system.

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Research on Multi-Parties Competition and Cooperation in Mobile Payment Market

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Abstract: Mobile payment has many advantages, such as convenience, attracting more and more people to use. Mobile payment market is vast, containing huge profit and chance. Besides banks, telecom carriers and third-party payment companies are chasing this market, they all want to earn more money in this market. They all compete and cooperate with each other. In the process of game, the government play an important role in it. This paper mainly studies the game between telecom carriers and third-party payment companies, through building the static game model of perfect information, then we analyze the model Nash equilibrium comprehensively. At last, considering the actual situation, we get the main factors of the model which affect Nash equilibrium and choose which operation model the two sides will take.

Keywords: Telecom carrier, Nash equilibrium, Third party payment company, Game.

1. Introduction

Mobile payment is a brand new payment method. In China, the industry chain of mobile payment mainly comprises the following parties: the financial institution (mainly commercial banks), the third party payment company (Alipay, Tenpay et al.,), the telecom carrier, the equipment supplier, the seller and the user, etc. The term "telecom carrier" refers to the provider of network services. The third party company provides a trading platform completely independent of the financial institution and the communication operator. Upon signing agreements with major banks, the third party company provides membership users with backstage support in various payment scenarios so that the user can successfully pay for the commodity he/she has selected. The third party company is able to notify the seller of when the payment will arrive at his/her account, remind the seller to send out the commodity on time, and transfer the payment to the seller's account after the buyer verifies the quality of the commodity. Being an effective guarantee of the security of the seller and the buyer, the third party company is a valuable complement to China's electronic payment system and credit system (Li and Bai, 2011).

The operating mode of mobile payment is rarely the object of foreign researchers. In China, however, scholars mainly conduct the following studies on the topic: Zou Zongsun

believes that China's mobile payment market is still in the early stage of development, featuring no definite mode in the absence of applicable laws and regulations. Wang Huihong points out that there are many subjects involved in the value chain of mobile payment in China, and to accelerate the development of mobile payment services, the financial institution, the third party company and the telecom carrier should strengthen cooperation. Jiang Yong (2014) recommends an operating mode for China's value chain of mobile payment through the construction of a game model, and an analysis with game theory. Zhang et al., (2014) also conduct an analysis of the game between the financial institution and the third party company on the industry chain of mobile payment. Establishing a static game model and analyzing the coopetition between the financial institution and the third party company, the two scholars conclude that the best strategy is to let the two parties jointly operate and lead the mobile payment platform. In light of game theory, Yao and Deng (2014) study the game cooperation mechanism between the telecom carrier, the financial institution and the third-party payment company in the industry chain of mobile payment, and draw the conclusion that a reasonable mechanism of resource sharing and income distribution leads to a win-win for all the three parties. In view of the above research, this paper firstly establishes a game model for the telecom carrier and the third party payment company and obtains the Nash equilibrium by solving the model, secondly acquires the constraint conditions of mobile payment between the two parties through analysis of the influencing factors of the two parties, and finally draws the appropriate application model (Barkhordari et al., 2016; Rivest and Shamir, 2010; Salas, 2016; Zhou, 2011).

2. Two Party Game in Mobile Payment Market

2.1. Two Party Game Model

Assumed conditions as follows:

Condition 1: We assume that there are only one telecom carrier and one third party payment company, both of them want to get the dominant power of mobile payment market in the game. Both are limited ration economic men, they are pursing the most profit by adjusting their strategies and choices.

Condition 2: We assume that there are two strategies for both sides to choose: cooperation or noncooperation.

Condition 3: We assume that the game is static game of perfect information, that is to say, both sides know the market uniformly. However, they do not know which strategy the counter-party will take, so the process of choosing strategy is independent.

Based on the assumed conditions above, the profits of telecom carrier and third party payment company are $\prod_{mc}$, $\prod_{pc}$ when they cooperate with each other, while the profits of the telecom carrier and the third party payment company are $\prod_{mn}$, $\prod_{pn}$ when they do not cooperate with each other. C_m and C_p denote the costs of the telecom carrier and the third party payment company.

It must be pointed out that if customers want to use mobile payment, they should download certain information through the air interface of the communication network

which is maintained by the telecom carrier, so if there is no permission of the telecom carrier, the third party mobile payment will not be realized. As a result, the profit of the third party company would be zero without the cooperation with the telecom carrier, that is $\prod_{pn}=0$. Compared with the third party payment company, the telecom carrier can build and operate mobile payment platform independently, it do not have the dependence on the third party payment company, that is $\prod_{mn}\neq 0$.

1. Both of the telecom carrier and the third party payment company choose the cooperation strategy

   The third party payment company is responsible for the building and operating of the mobile payment platform, as a result, the cost of the telecom carrier is almost zero, it can be neglected. In this situation, the costs of the telecom carrier and the third party company are $\prod_{mc}$ and $\prod_{pc}$-C_p.

2. The third party payment company takes the cooperation strategy, the telecom carrier takes the noncooperation strategy

   The third party payment company should invest a large sum of money in purchasing the equipment and updating the system, the cost is C_p, while if the telecom carrier do not cooperate with the third party payment company, the profit $\prod_{pn}=0$, and the overall profit of the third party payment company is -C_p. If the telecom carrier do not cooperate with the third party payment company, it should also invest a large sum of money in purchasing the equipment and updating the system, as a result, the overall profit of the telecom carrier is $\prod_{mn}-C_m$.

3. The third party payment company takes the noncooperation strategy, the telecom carrier takes the cooperation strategy

   The third party payment company do not run mobile payment business without the cooperation with the telecom carrier, as a result, in this situation the overall profit of the third party payment company is absolutely zero; Although the telecom carrier wants to cooperate with the third party payment company, the third party payment company does not want to do so, as a result, the telecom carrier cannot run mobile payment business without the support of the third party payment company's payment platform, in this situation, the overall profit of the telecom carrier is absolutely zero too.

4. Both of the third party payment company and the telecom carrier take noncooperation strategy

   The third party payment company cannot run mobile payment business because the telecom carrier do not cooperate with it. As a result, the overall profit of the third party payment company is zero; meanwhile, both of them do not want to cooperate with each other, so if the telecom carrier want to run the business independently, it must invest a large sum of money in purchasing and maintaining the equipment and the system, it will cost C_m. As a result, it's overall profit is $\prod_{mn}-C_m$.

Assuming that the probability of cooperation for the telecom carrier is α, thus the probability of noncooperation is 1-α, the probability of cooperation for the third party payment company is β, thus the probability of noncooperation is 1-β. Game matrix is like this:

2.2. Nash Equilibrium of Two Party Game

1. If $\prod_{mc}<\prod_{mn}-C_m$, that is to say, the telecom carrier chooses to cooperate with the third party payment company and achieves the maximization of profit. Therefore, the best strategy for it is cooperation strategy, and there exists the only one Nash equilibrium (cooperation, noncooperation). In this situation, the overall profits of the telecom carrier and the third party payment company is $\prod_{mn}-C_m$ and zero.
2. If $\prod_{mc}>\prod_{mn}-C_m$, that is to say, the telecom carrier chooses not to cooperate with the third party payment company and achieves the maximization of profit, in this situation, there does not exist Pure Strategy Nash Equilibrium, but Mixed Strategy Nash Equilibrium instead.

The probability of choosing cooperation strategy for the telecom carrier is assumed to be a certain value α, thus the probability of noncooperation is 1-α, under this circumstance, the expected revenue(profit) of the third party is $\prod_p$:

$$\prod_p = \beta\left[\alpha\times\left(\prod_{pc}-C_p\right)+\left(1-\alpha\right)\left(-C_P\right)\right]+\left(1-\beta\right)\left[0\times\alpha+0\times\left(1-\alpha\right)\right]$$

The third party payment company wants to achieve the maximization of profit, so $\prod_p$ derivation of β is zero, it means $\alpha\times(\prod_{pc}-C_p)+(1-\alpha)(-C_p)=0$, it can lead to $\alpha=(C_p)/(\prod_{pc})$.

The probability of choosing cooperation strategy for the third party payment company is assumed to be a certain value β, thus the probability of noncooperation is 1-β, under this circumstance, the expected revenue(profit) of telecom carrier is $\prod_m$:

$$\prod_m = \alpha\left[\beta\times\prod_{mc}+\left(1-\beta\right)\times 0\right]+\left(1-\alpha\right)\left[\left(\prod_{mn}-C_m\right)\times\beta+\left(\prod_{mn}-C_m\right)\times\left(1-\beta\right)\right]$$

The telecom carrier want to achieve the maximization of profit, so $\prod_m$ derivation of α is zero, it means $\beta\times\prod_{mc}-[(\prod_{mn}-C_m)\times\beta+(\prod_{mn}-C_m)\times(1-\beta)]=0$, it can lead to $\beta=(\prod_{mc})/(\prod_{mn}-C_m)$.

We can arrive at some conclusions based on above analysis:

① When the probability of the third party payment company chooses cooperation strategy $\beta<(\prod_{mc})/(\prod_{mn}-C_m)$, then $\alpha=0$, the profit of the telecom carrier is maximum. Under this circumstance, the best strategy which the telecom carrier chooses is noncooperation strategy.

② When the probability of the third party payment company chooses cooperation strategy $\beta>(\prod_{mc})/(\prod_{mn}-C_m)$, then $\alpha=1$, the profit of the telecom carrier is maximum. Under this circumstance, the best strategy which the telecom carrier chooses is cooperation strategy.

③ When the probability of the third party payment company chooses cooperation strategy $\beta=(\prod_{mc})/(\prod_{mn}-C_m)$, then $\alpha=(C_p)/(\prod_{pc})$, the profit of the telecom carrier is maximum. Under this circumstance, the best strategy which the telecom carrier chooses is cooperation strategy with the probability of $(C_p)/(\prod_{pc})$, and noncooperation strategy with the probability of $1-((C_p)/(\prod_{pc}))$. This is understandable, in real world, there are many telecom carriers and many third party payment companies, if there are M telecom carriers and N third party payment companies, thus $M\times((C_p)/(\prod_{pc}))$ telecom carriers choose to cooperate with third party companies, and $N\times((\prod_{mc})/(\prod_{mn}-C_m))$ third party companies choose to cooperate with telecom carriers.

If $\prod_{mc}=\prod_{mn}-C_m$, it means the profits of the telecom carrier are equal whether it chooses to cooperate with the third party payment company or not. Under this circumstance, the third party payment company chooses to cooperate with the telecom carrier because it can get the profit $\prod_{pc}-C_p$, if it chooses other strategies, it would not get any profit. The telecom carrier and the third party company are not competitors, therefore, the telecom carrier should choose to cooperate with the third party payment company. As a result, (cooperation, cooperation) is the unique solution of Pure Strategy Nash Equilibrium.

2.3. Analysis of the Main Factors Affecting Nash Equilibrium

According to the analysis of the previous section, the input cost C_m is the main factor affecting the decision-making of the telecom carrier due to its direct effect on the profit of the carrier. C_m stands for the total cost covered by the telecom carrier in support of mobile payment services, which consists of hard cost (e.g. transit network construction, POS terminal deployment, etc.), and soft cost (e.g. application for mobile payment license, promotion of mobile payment service, etc.). The analysis of C_m is as follows:

1. If the input cost of the telecom carrier C_m is small, it is very easy to achieve the conditions for $\prod_{mc}<\prod_{mn}-C_m$. According to the above analysis, the game strategy of the two parties should be (non-cooperation, non-cooperation), mainly because of the significant cost advantage of the carrier, as showcased by the low input cost, especially in remote mobile payment. The advantage is demonstrated by the unparalleled connectivity and accessibility of the mobile internet, the complete billing and account management system established by the carrier in the past, and the popularity of cellular phones with Wi-Fi function. Besides, it is easier for the telecom carrier to obtain a mobile payment license on the mobile internet than the third party company and the financial institution. Because of the above-mentioned advantage, the telecom carrier is more willing to carry out the mobile payment business on its own. What is more, as the carrier keeps a firm grip on the customer resources and customer-related data, if it refuses to cooperate with the third-party payment company, then the latter has no choice but to give up the market. Therefore, with the carrier occupying the vantage point in remote mobile payment, the third party payment company has to exit the market, i.e. not get involved in the business of the market. In the mobile remote payment services, communication operators have an active position, third-party payment companies are basically out of the market, which is not involved in the market business.

2. If the input cost of the telecom carrier C_m is big, it is very easy to achieve the conditions for $\prod_{mc}>\prod_{mn}-C_m$. According to the above analysis, the game strategy in this case is mixed strategy Nash equilibrium. The probability that the telecom carrier choose to cooperate stands at $(C_p)/(\prod_{pc})$, and that of the third party payment company, $(\prod_{mc})/(\prod_{mn}-C_m)$. The strategy is illustrated by the co-opetition between the carrier and the third party company in the local mobile payment market. In order to promote local mobile payment, both the carrier and the third party company have to invest a high amount to upgrade terminal equipment and transform the system. The terminal equipment is not limited to the cellular phones in the pocket of the user and the POS terminals installed in big shopping malls. Meanwhile, increasingly fierce competition is everywhere, such as declining commission charged on the seller by banks, resulting in smaller and smaller profit of local mobile payment and higher sensitivity of service industry sellers, which rely mostly on local mobile payment, to payment price. Stuck in the dilemma between gaining low profit despite high investment and maintaining quality customers, the telecom carrier may or may not choose to cooperate with the third party company. The third party company will choose cooperation as long as the carrier does not harm its existing interests in mobile payment. In Japan, the telecom carrier develops the local mobile payment business independently, while in the US, the telecom carrier chooses to cooperate with the third party company.

3. Conclusions

This paper establishes two party game model, the static game model between the telecom carrier and the third party payment company, and focuses on the influence of the input cost of mobile operation and the influence of the government coordination on the decision-making of the carrier and the third party company. The conclusions are as follows:

1. If the telecom carrier can develop a mobile payment platform at a low cost, both the carrier and the third party company tend to develop their own platforms.
2. If the telecom carrier has to invest a huge amount of money to develop a mobile payment platform, i.e. at a high input cost, the carrier and the third party company will choose partial cooperation to make use of the advantages of the other party and jointly dominate the mobile payment market, and at the same time choose competition, i.e. non-cooperation, on other parts of the business. This is the optimal strategy because it maximizes the profit generated from the mobile payment value chain.

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Power Network Structure Evaluation Based on Voltage Sag and Network Loss

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Abstract: In order to alleviate the voltage sag and reduce the grid loss, the evaluation index of power grid structure is put forward to guide the operation, planning and transformation. Firstly, the evaluation index of power grid structure based on voltage sag is proposed. Then the weight of voltage sag and the weight of network loss are introduced to evaluate the structure of power network, the evaluation index of power grid structure considering network loss and voltage sag is proposed. The proposed index can evaluate the superiority of grid structure. On the basis of the IEEE14 bus system, the grid structures changed by power access are evaluated by the proposed index. It is proved that the proposed evaluation index is feasible and guide the grid safe operation, planning and transformation effectively, and achieve the economic and security of power grid operation.

Keywords: grid structure; evaluation; voltage sag; grid loss

1. Introduction

With the increase of sensitive load in industrial load, the problems caused by voltage sag become more and more serious, and the voltage sag has become the most complaints of power quality problem in the home and abroad. The voltage sag can make low voltage protection of frequency converter mis-operation, programmable logic controller failure, contactor tripping, computer storage data loss, motor shutdown, may even make the entire production line interrupt, it is difficult to estimate the economic losses caused by voltage sag for enterprises. Mitigation of voltage sag (Ambra et al., 2000; Su et al., 2013; Li et al., 2004; Li et al., 2011; Naidu et al., 2012; Xiao et al., 2009) has been widely concerned by researchers. A new effective measure to alleviate voltage sag in literature (Shun, 2008) is that closed loop design and open loop operation with multi chip and multi power supply is implemented in power distribution system. The different operation modes of transformer neutral point in the system and the influence of generator unit start and stop on voltage sag are studied in literature (Chen and Zhao, 2014). In the view of the voltage sag caused by busbar fault, the evaluation index of power network structure is proposed in literature (Ma et al., 2015). How to ease the voltage sag by optimizing the power network structure has been widely concerned by researchers.

The traditional network reconfiguration is to find the optimal power network structure in order to reduce the network loss and improve the economic benefit of power system. According to the normal operation condition, the dispatcher achieves the optimal network structure by adjusting the switch states. The purpose is to balance the load, eliminate the overload, improve the quality of the power supply voltage, on the other hand, to reduce the network loss and improve the economic performance of the system.

Power network structure not only affects the economic operation of the system but also affects the security and stability of the system, Literature (Nesrallh et al., 2010) combined network reconfiguration with static var compensator to alleviate voltage sag. Genetic algorithm in literature (Sanjay et al., 2007) is used to optimize network structure to reduce the economic losses caused by voltage sag. Therefore the analysis and evaluation of the multi objective power grid structure considering the mitigation of voltage sag and the reduction of the network loss is needed to be paid attention.

The evaluation index of power grid structure is put forward in this paper to alleviate the voltage sag and reduce the grid loss. Firstly, based on the fault point method, four types fault are set up at each busbar of the power grid, and the vulnerability area matrixes of voltage sag are established, the evaluation index of power network structure based on voltage sag is proposed. The weight of voltage sag and the weight of network loss are introduced to evaluate the power network structure, the evaluation index of power network structure is proposed, which can reduce the network loss and alleviate the voltage sag. The proposed index can evaluate the superiority of grid structure. On the basis of the IEEE14 bus system, the different network structures constructed by power supply access node changed are evaluated by the proposed index. It is proved that the proposed evaluation approach is feasible and guides the grid safe operation, planning and transformation effectively, and achieves the economic and security of power grid operation (Hernández et al., 2016).

2. The Evaluation Index of Power Grid Structure Based On Voltage Sag Caused by Busbar Faults

It is assumed that there are 4 kinds of faults on each busbar of the power grid, and the voltage sag value of the busbar is calculated respectively. The busbar voltage sag matrix $U^{(m)}$ (Ma et al., 2014) is established accordingly. (m=1, 2, 3, 4 respectively, on behalf of single phase grounding short circuit, two-phase short circuit, three-phase short circuit, two phase grounding short circuit)

$$U^{(m)} = \begin{bmatrix} U_{11}^{(m)} & U_{12}^{(m)} & \cdots & U_{1j}^{(m)} & \cdots & U_{1n}^{(m)} \\ U_{21}^{(m)} & U_{22}^{(m)} & \cdots & U_{2j}^{(m)} & \cdots & U_{2n}^{(m)} \\ \vdots & \vdots & \cdots & \vdots & \cdots & \vdots \\ U_{i1}^{(m)} & U_{i2}^{(m)} & \cdots & U_{ij}^{(m)} & \cdots & U_{in}^{(m)} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ U_{n1}^{(m)} & U_{n2}^{(m)} & \cdots & U_{nj}^{(m)} & \cdots & U_{nn}^{(m)} \end{bmatrix}_{n\times n} \tag{1}$$

In which $U_{ij}^{(m)}$ represents the A, B, C three-phase voltage value of busbar j when m type fault occurs on busbar i. Set the threshold value of the voltage sag as U_{thre}, As long as

there is any one voltage value of $U_{ij}^{(m)}$ below the threshold value, it is considered that voltage sag occurs on the bus *j*, order $Z_{ij}^{(m)}$=1, otherwise, $Z_{ij}^{(m)}$=0, thus the depression domain matrix $Z^{(m)}$ is acquired.

$$Z^{(m)} = \begin{bmatrix} Z_{11}^{(m)} & Z_{12}^{(m)} & \cdots & Z_{1j}^{(m)} & \cdots & Z_{1n}^{(m)} \\ Z_{21}^{(m)} & Z_{22}^{(m)} & \cdots & Z_{2j}^{(m)} & \cdots & Z_{2n}^{(m)} \\ \vdots & \vdots & \cdots & \vdots & \cdots & \vdots \\ Z_{i1}^{(m)} & Z_{i2}^{(m)} & \cdots & Z_{ij}^{(m)} & \cdots & Z_{in}^{(m)} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ Z_{n1}^{(m)} & Z_{n2}^{(m)} & \cdots & Z_{nj}^{(m)} & \cdots & Z_{nn}^{(m)} \end{bmatrix}_{n\times n} \tag{2}$$

Similarly, for different power network structures, the corresponding *m* type voltage sag matrix and its depression domain matrix can be established.

m type power network structure evaluation index $D^{(m)}$ based on voltage sag caused by *m* type fault on basbar is as follow.

$$D^{(m)} = \sum_{i=1}^{n}\sum_{j=1}^{n} Z_{ij}^{(m)} \tag{3}$$

The average evaluation index of power grid structure considering four types fault on busbar is as follow.

$$D = \sum_{m=1}^{4} \lambda_m D^{(m)} \tag{4}$$

In which λ_m is the probability of the *m* type busbar fault.

The evaluation index $D^{(m)}$ and D can be reflected the voltage sag in the power network structure, the bigger the index data, the more serious the voltage sag is in the power network structure. These indexes can be used to analyze and evaluate the power network structure changed by various factors, and can be used as one of the indexes to judge the merits of power grid structure, effectively guide the safe operation of the power grid, planning and transformation.

3. The Calculation of Power Network Loss

Power network loss consists of the active power loss and reactive power loss, reducing the power network loss is to reduce the active power loss. The active power loss of the network includes the active power loss of the line and the active power loss of the transformer.

Total active power loss of network line

$$\Delta P_{LINE} = \sum_{i=1}^{L} I_i^2 R_i \tag{5}$$

In which I_i is the current flowing through the *i* line, R_i is the resistance of the *i* line, *L* is the total number of line.

The total active power loss of the network transformer includes the winding resistance loss and no-load loss of the transformer.

$$\Delta P_T = \sum_{j=1}^{H} (I_j^2 R_{Tj} + \Delta P_{0j}) \tag{6}$$

In which I_j is the current of the *j* transformer, R_{Tj} is the winding resistance of the *j* transformer, ΔP_{0j} is the no-load loss of the *j* transformer, *H* is the total number of transformer.

The active power loss of the network ΔP is as follow.

$$\Delta P = \Delta P_{LINE} + \Delta P_T \tag{7}$$

4. Multi Objective Evaluation Index of Power Network Structure

Multi objective evaluation index S for network structure which consider of mitigating voltage sag and reducing network loss is as follow.

$$S = \alpha D + \beta \Delta P \quad (\alpha + \beta = 1 \tag{8}$$

In which α is the weight of the network structure evaluation index D based on voltage sag, β is the weight of the network loss ΔP, the value of α and β can be set according to the actual needs. The smaller the evaluation index D, the better the effect of power network structure to alleviate the voltage sag. The smaller ΔP, the smaller the network loss of the power network structure. Therefore, the index S can be considered as one of the indicators of power grid planning, operation and improvement of the power network structure to mitigate the voltage sag and reduce the network loss.

5. Example analysis and evaluation

In order to verify that the proposed indicators can be analyzed and evaluated for different power grid structures, based on the IEEE14 node system, the different structure of the power network is constructed by the change of the power supply access point.

5.1. The IEEE14 Node System and Parameters

The IEEE14 busbar system is shown in Figure 1, and the system parameters are found in the literature (Zhang and Chen, 1996). The system contains 110 kV and 23 kV voltage levels, and consists of 4 generating units, 14 buses, 17 lines and 3 transformers, all transformers with Y0/Y0 connection mode.

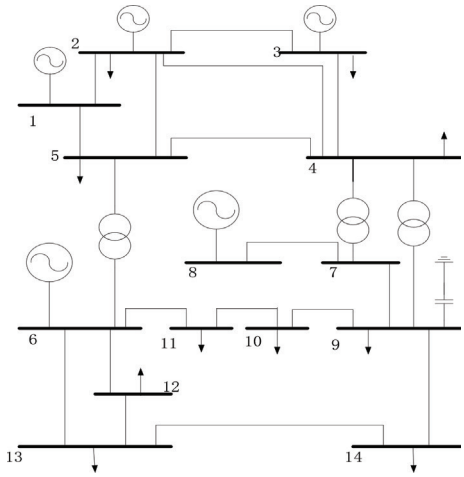

Figure 1 – IEEE14 node test system

The threshold of the power network voltage sag is set as 0.7. Assuming the weight of voltage sag is 0.6, the weight of network loss is 0.4, the probabilities of the four type busbar fault are shown in Table 1.

Fault Type	**M= 1**	**M=2**	**M=3**	**M=4**
probability	0.83	0.08	0.04	0.05

Table 1 – The probabilities of the four type busbar fault

In order to analyze the influence of power access point on voltage sag and network loss, assume that the active power of the supply is 20MW, the voltage is 1.022, $Q_{max} = 30MVar$, $Q_{min} = -15MVar$. The power supply is the PV node, the power supply is respectively accessed to 10, 11, 12, 13, 14 node, five different power network structures are obtained, the five network structures are analyzed and evaluated by the above proposed network structure evaluation index. The evaluation data are shown in Table 2.

Index	D	ΔP	S
busbar10	81	0.124	48.65
busbar11	89.08	0.133	53.5
busbar12	94.7	0.121	56.87
busbar13	86.28	0.147	51.83
busbar14	83.81	0.121	50.33

Table 2 – Evaluation results of different network structure caused by power access point changed

The above data shows that evaluation index S of the network structure whose power supply access to the 10 node are less than those of the network structure power to access to the remaining nodes. In spite of the network loss of the network structure whose

power supply access to the 10 node is not the least, by the weight values, the network loss is considered, at the same time the mitigation of voltage sag is payed more attention, the network structure evaluation index based on the voltage sag of the power supply access to 10 node is the smallest. Therefore select the 10 node as the power access point.

6. Conclusions

The evaluation method and evaluation index are proposed in this paper, which can evaluate the structure of power network with the consideration of voltage sag and the network loss. Based on the IEEE14 node system, the different structures of the power network constructed by the change of the power supply access node are evaluated by the proposed evaluation method and evaluation index. It is proved that the proposed evaluation index is feasible and can be used as one of the index to assess the power network structure, and guides the grid safe operation, planning and transformation effectively, and the economic and security of power grid operation are achieved.

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Hybrid generalized function projective delay synchronization in complex dynamical networks via feedback control

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Abstract: In this paper, we investigate the hybrid generalized function projective delay synchronization in complex dynamical networks with time delay and disturbance. When the complex network exist disturbance, a feedback controller is designed to realize hybrid generalized function projective delay synchronization and parameters identification for complex dynamical networks. Numerical simulations are provided to show the effectiveness of the proposed method.

Keywords: complex dynamical networks, hybrid generalized function projective delay synchronization, numerical simulations

1. Introduction

The complex networks consist of coupled nodes. The complex networks with the same or different types and structure (Qian et al., 2013; Xiao et al., 2013; Jia et al., 2013; Puello et al., 2016; Wang et al., 2013; Chen et al., 2012; Fu et al., 2011). Synchronization is one of the phenomena in complex networks (Du et al., 2013; Park and Kwon, 2009; Park, 2009; Wu et al., 2009). So, a various of synchronization were proposed. A synchronization is generalized function projective synchronization, which is a more general definition of chaotic synchronization, it encompasses function projective synchronization.

Time delay is ubiquitous in many systems (Tae et al., 2012; Dong et al., 2013; Li and Chen, 2004) due to finite signal propagation time in networks, finite reaction times, memory effects and so on. The time delay can lead to undesirable dynamic behaviors such as oscillation, instability and poor performance. All the nodes in complex dynamical networks contain parameters, the parameters of nodes and complex network all exist disturbance. Therefore, the synchronization problem of complex dynamical networks with time delays and disturbance has become a research topic. When synchronization appears in complex dynamical networks with time delay and disturbance, the different component of vector can exist different time delay synchronization. Up to now, few paper research time delay synchronization for the different component of vector in complex dynamical networks with time delay and disturbance. In this paper, hybrid generalized function projective delay synchronization of complex dynamical networks will be investigated, which means that the different component of vector could be

synchronization up to different generalized function projective delay synchronization function via hybrid feedback control.

2. The model description and preliminaries

A complex dynamical networks consisting of N linearly coupling nodes are:

$$\dot{\boldsymbol{x}}_i(t) = \boldsymbol{f}(\boldsymbol{x}_i(t)) + \boldsymbol{g}(\boldsymbol{x}_i(t))\boldsymbol{\alpha} + \sum_{j=1}^{N} c_{ij}\boldsymbol{\Gamma}\boldsymbol{x}_j(t-\tau), \quad i = 1,2,\ldots,N, \tag{1}$$

where $\boldsymbol{x}_i(t) = (x_{i1}(t), x_{i2}(t), \ldots, x_{in}(t))^T \in R^n$ is the ith node state variable, $\boldsymbol{f} : \boldsymbol{R}^n \to \boldsymbol{R}^n$ and $\boldsymbol{g} : \boldsymbol{R}^n \to \boldsymbol{R}^n$ are differentiable vector function, $\boldsymbol{\alpha} \in \boldsymbol{R}^l$ is unknown parameter vector, τ is time delay, $\boldsymbol{\Gamma}$ is coupled matrix, $\boldsymbol{\Gamma} = diag(\gamma_1, \gamma_2, \ldots, \gamma_n)$ is diagonal matrix and $\|\tilde{\mathbf{A}}\| > 0$, $\boldsymbol{C} = (c_{ij})_{N\times N}$ is external coupled matrix, c_{ij} is defined as : $c_{ij} > 0$ if there is a connection between node i and node j, otherwise $c_{ij} = c_{ji} = 0$, and the diagonal elements c_{ij} is defined as

$$c_{ii} = -\sum_{j=1, j\neq i}^{N} c_{ij}, \; i = 1,2,\ldots,N. \tag{2}$$

A controlled complex networks with time delay and disturbance as follows:

$$\dot{\boldsymbol{y}}_i(t) = \boldsymbol{F}(\boldsymbol{y}_i(t)) + \boldsymbol{G}(\boldsymbol{y}_i(t))(\boldsymbol{\beta} + \Delta\boldsymbol{\beta}_i) + \boldsymbol{d}_i(t) + \sum_{j=1}^{N} d_{ij} \quad \boldsymbol{y}_j(t-\tau) + \boldsymbol{u}_i(t), \boldsymbol{\Gamma}\, i = 1,2,\ldots,N, \tag{3}$$

where $\boldsymbol{y}_i(t) = (\boldsymbol{y}_{i1}(t), \boldsymbol{y}_{i2}(t), \ldots, \boldsymbol{y}_{in}(t))^T \in R^n$ is state variable of ith node, $\boldsymbol{\beta} \in \boldsymbol{R}^m$ is unknown parameter vector, $\Delta\boldsymbol{\alpha} \in \boldsymbol{R}^m$ is unknown parameter disturbance vector, $\boldsymbol{d}_i(t)$ is internal disturbance, τ is time delay, $\boldsymbol{\Gamma}$ is internal coupled matrix, $\boldsymbol{\Gamma} = \tilde{d}iag(\ _1, \ _2, \ldots, \ _n)$ is diagonal matrix and $\|\boldsymbol{\Gamma}\| > 0$, $\boldsymbol{D} = (d_{ij})_{N\times N}$ is external coupled matrix, d_{ij} is defined as follows: $d_{ij} > 0$ if there is a connection between node i and node j, otherwise $d_{ij} = d_{ji} = 0$, and the diagonal elements d_{ii} is defined as follows

$$d_{ii} = -\sum_{j=1, j\neq i}^{N} d_{ij}, \; i = 1,2,\ldots,N. \tag{4}$$

Definition 1 The drive dynamical networks (1) and response dynamical networks (2) is said to achieve hybrid generalized function projective delay synchronization if there exists a diagonal matrix $\boldsymbol{P} = diag(P_1, P_2, \ldots, P_n)$, $\boldsymbol{P} \in \boldsymbol{R}^{n\times n}$ and $\boldsymbol{Q}$ is $n \times 1$ order constant matrix such that

$$\lim_{t\to\infty} \|\boldsymbol{e}_i(t)\| = \lim_{t\to\infty} \|\boldsymbol{y}_i(t) - \boldsymbol{P}\boldsymbol{x}_i(t-\tau_{i'}) - \boldsymbol{Q}\| = 0, \; i = 1,2,\ldots,N, \tag{5}$$

where $\tau_{i'}$ is time delay,

$\boldsymbol{x}_i(t-\tau_{i'}) = (\boldsymbol{x}_{i1}(t-\tau_1), \boldsymbol{x}_{i2}(t-\tau_2), \ldots, \boldsymbol{x}_{in}(t-\tau_n))^T, \tau_1, \tau_2, \ldots, \tau_n \geq \tau$.

Lemma 1[30]. For any vectors $\boldsymbol{x}, \boldsymbol{y} \in \boldsymbol{R}$ and positive definite matrix $\boldsymbol{Q} \in \boldsymbol{R}^{(n\times n)}$, the following matrix inequality holds:

$$2\boldsymbol{x}^T\boldsymbol{y} \le \boldsymbol{x}^T\boldsymbol{Q}\boldsymbol{x} + \boldsymbol{y}^T\boldsymbol{Q}^{-1}\boldsymbol{y}. \tag{6}$$

3. Synchronization

The complex networks with unknown parameters and time-varying coupling delay can be described as,

$$\dot{\boldsymbol{x}}_i(t) = \boldsymbol{f}(\boldsymbol{x}_i(t)) + \boldsymbol{g}(\boldsymbol{x}_i(t))\boldsymbol{\alpha} + \sum_{j=1}^{N} c_{ij}\,\boldsymbol{\Gamma}\boldsymbol{x}_j(t-\tau(t)), \quad i = 1, 2, \ldots, N. \tag{7}$$

A controlled complex networks with time-varying coupling delay, unknown parameters disturbance and internal disturbance as the response networks, which can be described as follows,

$$\dot{\boldsymbol{y}}_i(t) = \boldsymbol{F}(\boldsymbol{y}_i(t)) + \boldsymbol{G}(\boldsymbol{y}_i(t))(\boldsymbol{\beta} + \Delta\boldsymbol{\beta}) + \boldsymbol{d}(t) + \sum_{j=1}^{N} d_{ij}\tilde{\mathbf{A}}\boldsymbol{y}_j(t-\tau(t)) + \boldsymbol{u}_i(t),\ i = 1, 2, \ldots, N, \tag{8}$$

where $\tau(t) > 0$ is the time-varying delay.

Theorem 2. The networks (7) and networks (8) can realize hybrid generalized function projective delay synchronization by the following control law:

$$\boldsymbol{u}_i(t) = \boldsymbol{u}_{i1}(t) + \boldsymbol{u}_{i2}(t), \tag{9}$$

with

$$\boldsymbol{u}_{i1}(t) = \boldsymbol{P}f(x_i(t-\tau_{i'}(t))) + \boldsymbol{P}\boldsymbol{g}(x_i(t-\tau_{i'}(t)))\hat{\boldsymbol{\alpha}} + \sum_{i=1}^{N} b_{ij}\boldsymbol{\Gamma}y_i(t-\tau(t)) + \dot{\boldsymbol{P}}x_i(t-\tau_{i'}(t)), \tag{10}$$

$$\boldsymbol{u}_{i2}(t) = \xi_i\boldsymbol{e}_i(t) - \boldsymbol{G}(y_i(t))\hat{\boldsymbol{\beta}} - \boldsymbol{d}_i(t) - \boldsymbol{F}(y_i(t)) - \boldsymbol{G}(y_i(t))\Delta\boldsymbol{\beta}_i, \tag{11}$$

$$\dot{\boldsymbol{\xi}} = -\frac{k_i}{2(1-\xi)}\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t), \tag{12}$$

$$\dot{\hat{\boldsymbol{\alpha}}} = -\frac{1}{N}\sum_{i=1}^{N}\frac{1}{2(1-\xi)}\boldsymbol{g}^T(x_i(t))\boldsymbol{P}\boldsymbol{e}_i(t), \tag{13}$$

$$\dot{\hat{\boldsymbol{\beta}}} = \frac{1}{N}\sum_{i=1}^{N}\frac{1}{2(1-\xi)}\boldsymbol{G}^T(y_i(t))\boldsymbol{e}_i(t), \tag{14}$$

$$\dot{\boldsymbol{b}}_{ij} = -\frac{\delta_{ij}}{2(1-\xi)}\boldsymbol{e}_i^T(t)\boldsymbol{\Gamma}y_i(t-\tau(t)),\ i=1,2,\ldots,N,\ j=1,2,\ldots,N\,, \tag{15}$$

where k_i, δ_{ij} are positive constant, $\hat{\boldsymbol{a}}, \hat{\boldsymbol{\beta}}$ are estimation of unknown parameters $\boldsymbol{\alpha}$, $\boldsymbol{\beta}$. $\boldsymbol{u}_{i1}(t)$ is time delay feedback controller and $\boldsymbol{u}_{i2}(t)$ is non-delayed feedback controller .

Proof. Due to $\sum_{j=1}^{N} c_{ij} = 0,\ i=1,2,\ldots,N$, we have

$$\begin{aligned}&\sum_{j=1}^{N} c_{ij}\boldsymbol{\Gamma}\boldsymbol{y}_i(t-\tau(t)) - \boldsymbol{P}\sum_{j=1}^{N} c_{ij}\boldsymbol{\Gamma}\boldsymbol{x}_j(t-\tau(t)-\tau_{i'})\\ &= \sum_{j=1}^{N} c_{ij}\boldsymbol{\Gamma}(\boldsymbol{y}_i(t-\tau(t)) - \boldsymbol{P}\boldsymbol{x}_j(t-\tau(t)-\tau_{i'}) - \boldsymbol{Q}) = \sum_{j=1}^{N} c_{ij}\boldsymbol{\Gamma}\boldsymbol{e}_j(t-\tau(t)).\end{aligned} \tag{16}$$

We define the error term

$$\boldsymbol{e}_i(t) = \boldsymbol{y}_i(t) - \boldsymbol{P}\boldsymbol{x}_i(t-\tau_{i'}) - \boldsymbol{Q},\ i=1,2,\ldots,N\,, \tag{17}$$

where $\tau_{i'}$ is the time delay, $\boldsymbol{x}_i(t-\tau_{i'}) = (x_{i1}(t-\tau_1), x_{i2}(t-\tau_2),\ldots,x_{in}(t-\tau_n))^T$.
The time derivative of Eq. (17), we have

$$\dot{\boldsymbol{e}}_i(t) = \dot{\boldsymbol{y}}_i(t) - \dot{\boldsymbol{P}}\boldsymbol{x}_i(t-\tau_{i'}) - \boldsymbol{P}\dot{\boldsymbol{x}}_i(t-\tau_{i'}),\ i=1,2,\ldots,N\,. \tag{18}$$

Substituting Eq. (7), Eq. (8) into Eq. (18), according to Eq. (16), we have

$$\begin{aligned}\dot{\boldsymbol{e}}_i(t) =& \boldsymbol{F}(y_i(t)) + \boldsymbol{G}(y_i(t))\boldsymbol{\beta} + \boldsymbol{G}(y_i(t))\Delta\boldsymbol{\beta}_i + \sum_{j=1}^{N}(d_{ij}-c_{ij})\boldsymbol{\Gamma}\boldsymbol{y}_j(t-\tau) - \dot{\boldsymbol{P}}\boldsymbol{x}_i(t-\tau_{i'}(t))\\ &- \boldsymbol{P}\boldsymbol{f}(x_i(t-\tau_{i'}(t)) - \boldsymbol{P}\boldsymbol{g}(x_i(t-\tau_{i'}(t))\boldsymbol{\alpha} + \sum_{j=1}^{N} c_{ij}\boldsymbol{\Gamma}\boldsymbol{e}_j(t-\tau(t)) + \boldsymbol{u}_i(t) + \boldsymbol{d}_i(t).\end{aligned} \tag{19}$$

Substituting Eq. (9) into Eq. (19), we have

$$\begin{aligned}\dot{\boldsymbol{e}}_i(t) =& -\boldsymbol{G}(y_i(t))(\hat{\boldsymbol{\beta}} - \boldsymbol{\beta}) + \boldsymbol{P}\boldsymbol{g}(x_i(t-\tau_{i'}(t)))(\hat{\boldsymbol{\alpha}} - \boldsymbol{\alpha})\\ &+ \sum_{j=1}^{N}(d_{ij}-c_{ij}+b_{ij})\boldsymbol{\Gamma}y_j(t-\tau) + \sum_{j=1}^{N} c_{ij}\boldsymbol{\Gamma}\boldsymbol{e}_j(t-\tau(t)) + \xi_i\boldsymbol{e}_i(t).\end{aligned} \tag{20}$$

Define the following Lyapunov function

$$V(t)=\frac{1}{2(1-\xi)}\sum_{i=1}^{N}\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t)+\sum_{i=1}^{N}\sum_{j=1}^{N}\frac{1}{2\delta_{ij}}(d_{ij}-c_{ij}+b_{ij})^2+\frac{N}{2(1-\xi)}\sum_{i=1}^{N}\int_{t-\tau(t)}^{t}\boldsymbol{e}_i^T(s)\boldsymbol{e}_i(s)ds$$
$$+\sum_{i=1}^{N}\frac{1}{k_i}(\xi_i+d)^2+N(\hat{\boldsymbol{\alpha}}-\boldsymbol{\alpha})^T(\hat{\boldsymbol{\alpha}}-\boldsymbol{\alpha})+N(\hat{\boldsymbol{\beta}}-\boldsymbol{\beta})^T(\hat{\boldsymbol{\beta}}-\boldsymbol{\beta}), \tag{21}$$

where d is a positive value to be determined.

The time derivative of Eq. (21), we have

$$\dot{V}(t)=\frac{1}{2(1-\xi)}\sum_{i=1}^{N}2\boldsymbol{e}_i^T(t)\dot{\boldsymbol{e}}_i(t)+\sum_{i=1}^{N}\sum_{j=1}^{N}\frac{1}{\delta_{ij}}(d_{ij}-c_{ij}+b_{ij})\dot{b}_{ij}+\frac{N}{2(1-\xi)}\sum_{i=1}^{N}\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t)+\sum_{i=1}^{N}\frac{2}{k_i}(\xi_i+d)\dot{\xi}_i$$
$$-\frac{N(1-\dot{\tau}(t))}{2(1-\xi)}\sum_{i=1}^{N}\boldsymbol{e}_i^T(t-\tau(t))\boldsymbol{e}_i(t-\tau(t))+2N(\hat{\boldsymbol{\alpha}}-\boldsymbol{\alpha})^T\dot{\hat{\boldsymbol{\alpha}}}+2N(\hat{\boldsymbol{\beta}}-\boldsymbol{\beta})^T\dot{\hat{\boldsymbol{\beta}}}. \tag{22}$$

$$\dot{V}(t)=-\frac{1}{2(1-\xi)}\sum_{i=1}^{N}2d\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t)+\frac{1}{2(1-\xi)}\sum_{i=1}^{N}\sum_{j=1}^{N}2\boldsymbol{e}_i^T(t)c_{ij}\Gamma\boldsymbol{e}_j(t-\tau(t))$$
$$+\frac{N}{2(1-\xi)}\sum_{i=1}^{N}\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t)-\frac{N(1-\dot{\tau}(t))}{2(1-\xi)}\sum_{i=1}^{N}\boldsymbol{e}_i^T(t-\tau(t))\boldsymbol{e}_i(t-\tau(t)). \tag{23}$$

Let $\boldsymbol{Q}=\boldsymbol{I}$, by **Lemma 1**, we have

$$\sum_{i=1}^{N}\sum_{j=1}^{N}2\boldsymbol{e}_i^T(t)c_{ij}\boldsymbol{\Gamma}\boldsymbol{e}_j(t-\tau(t))\le\sum_{i=1}^{N}\sum_{j=1}^{N}\boldsymbol{e}_i^T(t)c_{ij}^2\boldsymbol{\Gamma}^2\boldsymbol{e}_i(t)+\sum_{i=1}^{N}\sum_{j=1}^{N}\boldsymbol{e}_j^T(t-\tau(t))\boldsymbol{e}_j(t-\tau(t)), \tag{24}$$

substituting Eq. (24) into Eq. (23), we have,

$$\dot{V}(t)\le-\frac{1}{2(1-\xi)}\sum_{i=1}^{N}2d\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t)+\frac{1}{2(1-\xi)}\sum_{i=1}^{N}\sum_{j=1}^{N}\boldsymbol{e}_i^T(t)c_{ij}^2\Gamma^2\boldsymbol{e}_i(t)+\frac{1}{2(1-\xi)}\sum_{i=1}^{N}\sum_{j=1}^{N}\boldsymbol{e}_j^T(t-\tau(t))\boldsymbol{e}_j(t-\tau(t))$$
$$+\frac{N}{2(1-\xi)}\sum_{i=1}^{N}\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t)-\frac{N(1-\dot{\tau}(t))}{2(1-\xi)}\sum_{i=1}^{N}\boldsymbol{e}_i^T(t-\tau(t))\boldsymbol{e}_i(t-\tau(t)). \tag{25}$$

From **Assumption 1**, we get $\frac{1-\dot{\tau}(t)}{2(1-\xi)}\ge\frac{1}{2}$, thus we have $\frac{N(1-\dot{\tau}(t))}{2(1-\xi)}\ge\frac{N}{2}$, the Eq. (25) can be deduced as follows,

$$\dot{V}(t)\le-\frac{1}{2(1-\xi)}\sum_{i=1}^{N}2d\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t)+\frac{1}{2(1-\xi)}\sum_{i=1}^{N}\sum_{j=1}^{N}\boldsymbol{e}_i^T(t)c_{ij}^2\Gamma^2\boldsymbol{e}_i(t)+\frac{N}{2(1-\xi)}\sum_{i=1}^{N}\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t)$$
$$\le\sum_{i=1}^{N}\left(\frac{N}{2(1-\xi)}-\frac{2d}{2(1-\xi)}+\frac{1}{2(1-\xi)}+N\sigma\right)\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t), \tag{26}$$

where $\boldsymbol{ó} = \lambda_{\max}(\boldsymbol{\Gamma}^2)\max_{1\le i,j\le N}\left\{c_{ij}^2\right\}$. Let $\boldsymbol{e}(t) = (\boldsymbol{e}_1^T(t), \boldsymbol{e}_2^T(t), \ldots, \boldsymbol{e}_N^T(t))^T$, Let

$d = \frac{N}{2} + \frac{1}{2} + (N\sigma + 1)(1-\xi)$,

then

$$\dot{V}(t) \le -\boldsymbol{e}^T(t)\boldsymbol{e}(t), \tag{27}$$

So the error system (38) is asymptotically stable. This complete the proof.

4. The simulation research

We take a chaotic Lorenz system as nodes of complex dynamical networks (25),

$$\begin{aligned}\begin{pmatrix}\dot{x}_{i1}(t)\\ \dot{x}_{i2}(t)\\ \dot{x}_{i3}(t)\end{pmatrix} &= \begin{pmatrix}0\\ -x_{i1}(t)x_{i3}(t)\\ x_{i1}(t)x_{i2}(t)\end{pmatrix} + \begin{pmatrix}x_{i2}(t)-x_{i1}(t) & 0 & 0\\ 0 & x_{i1}(t) & 0\\ 0 & 0 & -x_{i3}(t)\end{pmatrix}\begin{pmatrix}a\\ b\\ c\end{pmatrix} + \sum_{j=1}^{3} c_{ij}\boldsymbol{\Gamma}\boldsymbol{x}_j(t-\tau(t))\\ &= \boldsymbol{f}(x_i(t)) + \boldsymbol{g}(x_i(t))\boldsymbol{\alpha} + \sum_{j=1}^{3} c_{ij}\boldsymbol{\Gamma}\boldsymbol{x}_j(t-\tau(t)),\ i=1,2,3,\end{aligned} \tag{28}$$

Taking a chaotic Chen system as nodes of complex dynamical networks (26),

$$\begin{aligned}\begin{pmatrix}\dot{x}_{i1}(t)\\ \dot{x}_{i2}(t)\\ \dot{x}_{i3}(t)\end{pmatrix} &= \begin{pmatrix}0\\ -x_{i1}(t)x_{i3}(t)\\ x_{i1}(t)x_{i2}(t)\end{pmatrix} + \begin{pmatrix}x_{i2}(t)-x_{i1}(t) & 0 & 0\\ -x_{i1}(t) & 0 & x_{i1}(t)\\ 0 & x_{i3}(t) & 0\end{pmatrix}\begin{pmatrix}d+\Delta d_i\\ e+\Delta e_i\\ f+\Delta f_i\end{pmatrix} + \begin{pmatrix}d_1\\ d_2\\ d_3\end{pmatrix} + \sum_{j=1}^{3} d_{ij}\boldsymbol{\Gamma}\boldsymbol{y}_j(t-\tau(t)) + \boldsymbol{u}_i(t)\\ &= \boldsymbol{F}(\boldsymbol{y}_i(t)) +)\boldsymbol{G}(\boldsymbol{y}_i(t))(\boldsymbol{\beta} + \Delta\boldsymbol{\beta}_i, \boldsymbol{y} + \boldsymbol{d}_i(t) + \sum_{j=1}^{3} d_{ij}\boldsymbol{\Gamma}\boldsymbol{y}_j(t-\tau(t)) + \boldsymbol{u}_i(t),\ \ i=1,2,3,\end{aligned} \tag{29}$$

The controller $\boldsymbol{u}_i(t)$ of **Theorem 2** are,

$$\boldsymbol{u}_i(t) = \boldsymbol{u}_{i1}(t) + \boldsymbol{u}_{i2}(t),$$

$$\boldsymbol{u}_{i1}(t) = \boldsymbol{P}f(x_i(t-\tau_{i'}(t))) + \boldsymbol{P}\boldsymbol{g}(x_i(t-\tau_{i'}(t)))\hat{\boldsymbol{\alpha}} + \sum_{i=1}^{3} b_{ij}\boldsymbol{\Gamma}y_i(t-\tau(t)) + \dot{\boldsymbol{P}}x_i(t-\tau_{i'}(t)),$$

$$\boldsymbol{u}_{i2}(t) = \xi_i\boldsymbol{e}_i(t) - \boldsymbol{G}(y_i(t))\hat{\boldsymbol{\beta}} - \boldsymbol{d}_i(t) - \boldsymbol{F}(y_i(t)) - \boldsymbol{G}(y_i(t))\Delta\boldsymbol{\beta}_i,$$

$$\dot{\xi} = -\frac{k_i}{2(1-\xi)}\boldsymbol{e}_i^T(t)\boldsymbol{e}_i(t), \dot{\hat{\boldsymbol{\alpha}}} = -\frac{1}{3}\sum_{i=1}^{3}\frac{1}{2(1-\xi)}\boldsymbol{g}^T(x_i(t))\boldsymbol{P}\boldsymbol{e}_i(t), \dot{\hat{\boldsymbol{\beta}}} = \frac{1}{3}\sum_{i=1}^{3}\frac{1}{2(1-\xi)}\boldsymbol{G}^T(y_i(t))\boldsymbol{e}_i(t),$$

$$\dot{\boldsymbol{b}}_{ij} = -\frac{\delta_{ij}}{2(1-\xi)}\boldsymbol{e}_i^T(t)\boldsymbol{\Gamma}y_i(t-\tau(t)),\ i=1,2,3,\ j=1,2,3,\ \text{Let}\ \tau_1=1,\ \tau_2=2,\ \tau_3=3.$$

$$\Delta\boldsymbol{\beta}_i = (\Delta d_i, \Delta e_i, \Delta f_i)^T = (0.01i\sin t, 0.02i\cos t, 0.01i\sin t + 0.02i\cos t)^T (i=1,2,3),$$

$$\boldsymbol{P} = diag(sint, cost, sint+cost),\ \boldsymbol{x}_i(0) = (3,6,9)^T,$$

$$\boldsymbol{Q} = diag(1,2,3),\quad \boldsymbol{y}_i(0) = (4,7,10)^T (i=1,2,3).$$

$b_{ij}(0) = 4\ (i,j=1,2,3), \boldsymbol{\alpha} = (a,b,c)^T = (10,28,8/3)^T, \boldsymbol{\beta} = (d,f,e)^T = (35,28,3)^T, \boldsymbol{d}_i(t) = (d_{i1}, d_{i2}, d_{i3})^T,$

d_{i1}, d_{i2}, and d_{i3} are stochastic number of (0,1)

$$\hat{\boldsymbol{\alpha}} = (\hat{a},\hat{b},c)^T = (4,6,8)^T, \hat{\boldsymbol{\beta}} = (d,f,e)^T = (15,17,10)^T.$$

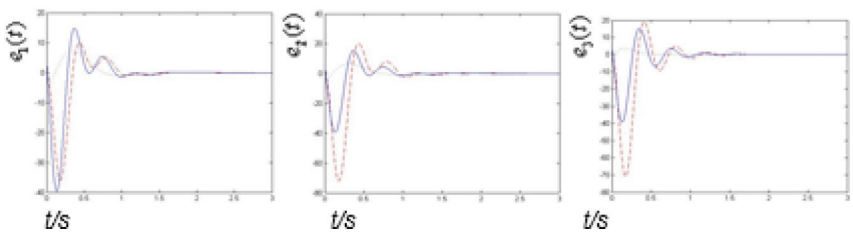

Figure 1 – Synchronization error with time-varying coupling delay

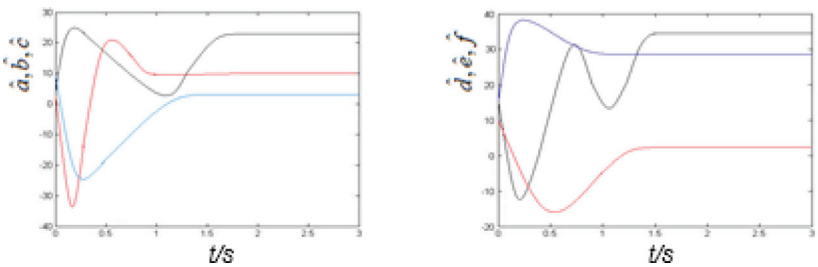

Figure 2 – Parameters identification with time-varying coupling delay

4. Conclusions

In this paper, hybrid generalized function projective delay synchronization of complex dynamical networks are discussed. When the parameters and the interior of complex dynamical networks exist disturbance, a hybrid feedback controller is designed to realize synchronization. Numerical simulations are provided to show the effectiveness of the proposed method.

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The Research on the College Physical Education Teaching Quality Evaluation based on the IAHP Method

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Abstract: The evaluation of the college physical education teaching quality plays a role of the value guidance, supervision and management. Today, all the colleges and universities are more and more attention to the physical education. The evaluation of the physical education teaching quality becomes very important. In this paper, firstly, we establish the evaluation index of the college physical education teaching quality. Then, we combine the improved entropy method, AHP method with the fuzzy comprehensive evaluation method and propose the IAHP method. In the experimental part of this paper, we use the evaluation index and the evaluation method to evaluate the college physical education teaching quality. Finally, the evaluation result is satisfactory.

Keywords: IAHP method, evaluation index, AHP algorithm.

1. Introduction

The sports can not only exercise the body, but also can cultivate the sentiment (Sun et al., 2016)). Under the background of the quality education, every university begins to pay more attention to the college physical education teaching quality (Dong et al., 2012). The level of the college physical education teaching quality will directly affects the physical education level and the physical quality (Zhou et al., 2011)). Today, every college begins to develop the college physical education teaching. All colleges and universities need to assess the physical education teaching quality in order to find their own shortcomings and improve their teaching quality.

As a kind of mainstream evaluation method, AHP algorithm has been welcomed by many scholars (Kim et al., 2013) when it was been proposed. After the continuous development, AHP method has combined with many methods and got the new algorithms. For example, there were Fuzzy-AHP (Wu et al., 2013), AHP-TOPSIS (Yu et al., 2013)) and AHP-DEA (Lee et al., 013) etc. At present, the AHP method has been widely used in many fields. The fuzzy comprehensive evaluation method was a method which introduced the fuzzy theory into the evaluation (Carvalho et al., 2015; Wu et al., 2016). The method described and quantified the fuzzy uncertainty factors. Therefore, it overcomes the fuzziness of the evaluation object (Wang et al., 2015)). The method had

the excellent performance in dealing with the various problems that were difficult to describe with the mathematical methods.

In this paper, we establish the evaluation index of the college physical education teaching quality. Then, we use the IAHP method that is proposed by this paper to evaluate. The evaluation result is accurate and effective.

2. Establishment of the evaluation index

Before evaluating the college physical education teaching quality, we establish the evaluation index. According to the literature at home and abroad and the teaching practice, the evaluation indexes of the college physical education teaching quality are as follows.

First evaluation index	Second evaluation index	Third evaluation index
College physical education teaching quality evaluation	Class teaching	Teaching content
		Teaching method
		Teaching mode
		Teaching management
		Project performance
	Student self-assessment	Love for sportd
		Autonomous Learning
		Evaluation for Teachers
	Teaching effectiveness	physical quality
		Comprehensive ability
		Skill mastery
		cultivation of the unity cooperation spirit
		Physical exercise after class
	Other	Site condition
		awards
		Teaching style
		Teachers strength

Table 1 – Evaluation indexes of the college physical education teaching quality

3. Basic algorithm

3.1. AHP algorithm

The analytic hierarchy process was proposed by the United States T.L.Satty in 1970s. It was a systematic and hierarchical analysis method which combining the qualitative analysis with the quantitative analysis.

The basic steps of the AHP algorithm are as follows.

The first step is to establish the analytic hierarchy model. For the general system, the hierarchical structure model can be roughly divided into three layers.

1. The highest level is called as the target layer. In this layer, there is only one factor. That is, the system analysis wants to achieve the desired results and the ideal goals. It indicates the system purpose.
2. The middle layer is also called as the criterion layer. The layer is composed of multiple sub layers. Therefore, it also has the criteria and the sub-criteria.
3. The lowest layer is also called as the program layer. This level includes the programs, the measures, and the decisions which are to be used to achieve the desired goals.

The step 2: According to the 1-9 scale method, we establish two-two comparison matrix and construct the judgment matrix.

We assume that the factors B_1, B_2,..., B_n in one layer are belongs to the factor α in the upper level A. According to comparing the relative importance, we can obtain the judgment matrix B of this layer. We use the table to express the judgment matrix.

By the structure of the judgment matrix, we can know that they have the following properties.

$$b_{ij} > 0 \tag{1}$$

$$b_{ij} = 1/b_{ij} \tag{2}$$

$$b_{ii} = 1 \tag{3}$$

The step 3 is to calculate the index weight.

According to the matrix theory, we can judgment that the weight coefficient of each factor is the characteristic vector w of the judgment matrix. The maximum eigenvalue that the matrix corresponds to is λ_{max}. The weight coefficient of each factor can be calculated by the following formula.

$$Bw = \lambda_{\max} \tag{4}$$

Because the root mean square method has an important theoretical significance, it has the simple calculation and is used widely. This paper will adopt the root mean square method to calculate the index weight coefficient. The calculation steps are as follows.

1. By multiplying each element of the judgment matrix, we can get M_i.

$$M_i = \prod_{j=1}^{n} b_{ij} \tag{5}$$

2. Open the n roots for M_i,

$$\widetilde{w_i} = \sqrt[n]{M_i} \tag{6}$$

3. Normalized processing $W = (\widetilde{w}_1, \widetilde{w}_2, \cdots, \widetilde{w}_n)^T$,

$$w_i = \frac{\widetilde{w}_1}{\sum_{i=1}^{n} \widetilde{w}_1} \tag{7}$$

Then, we get the matrix $W = (w_1, w_2, \cdots, w_n)^T$. It is the characteristic vector of judgment matrix. That is to say, it is the weight coefficient of each index.

4. We obtain the maximum eigenvalue of the judgment matrix.

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(BW)_i}{nw_i} = \frac{1}{n} \sum_{i=1}^{n} \frac{(BW)_i}{w_i} = \frac{1}{n} \sum_{i=1}^{n} \frac{\sum_{j=1}^{n} b_{ij} w_j}{w_i} \tag{8}$$

The step 4 is to check the consistency of the judgment matrix.

The steps to check the consistency of the judgment matrix is as follows.

1. Calculating the consistency index

$$CI = \frac{\lambda_{\max} - n}{n - 1} \tag{9}$$

2. Querying *RI*
3. Calculating the consistency ratio

$$CR = \frac{CI}{RI} \tag{10}$$

When the consistency ratio value is smaller, it shows that the consistency of the judgment matrix is better.

3.2. Fuzzy comprehensive evaluation method

The fuzzy comprehensive evaluation method is a method that uses the fuzzy transformation principle analysis and the evaluation fuzzy system.

1. Dividing the factor theory domain into *s* sub-sets according to some kind of attribute.

$$\begin{cases} U = \{U_1, U_2, \cdots, U_s\} \\ U_i \cap U_j = \phi \end{cases} \tag{11}$$

2. For each factor subset, we make the single level fuzzy comprehensive evaluation. We set the evaluation hierarchy,

$$V = \{v_1, v_2, \cdots, v_n\} \tag{12}$$

The weight vector of the factor u_{ij} is,

$$A_i = \{a_{i1}, a_{i2}, \cdots, a_{im}\} \tag{13}$$

The single factor evaluation matrix is R_i. The fuzzy evaluation result of the subset U_i is,

$$B_i = A_i \cdot R_i = (b_{i1}, b_{i2}, \cdots, b_{in}) \tag{14}$$

3. We take each subset U_i as a comprehensive factor. We use B_i as the result of the single factor evaluation. Then, we can get the affiliation Matrix.

$$\widetilde{R} = \begin{bmatrix} B_1 \\ B_2 \\ \vdots \\ B_s \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ b_{s1} & b_{s2} & \cdots & b_{sn} \end{bmatrix} = \begin{bmatrix} \tilde{r}_{11} & \tilde{r}_{12} & \cdots & \tilde{r}_{1n} \\ \tilde{r}_{21} & \tilde{r}_{22} & \cdots & \tilde{r}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{r}_{s1} & \tilde{r}_{s2} & \cdots & \tilde{r}_{sn} \end{bmatrix} \tag{15}$$

4. We set the weight vector of the comprehensive factor U_i is w=(w_1, w_2, ..., w_s). The results of the second fuzzy comprehensive evaluation are as follows.

$$w \cdot \widetilde{R} = (w_1, w_2, \cdots, w_s) \cdot \begin{bmatrix} \tilde{r}_{11} & \tilde{r}_{12} & \cdots & \tilde{r}_{1n} \\ \tilde{r}_{21} & \tilde{r}_{22} & \cdots & \tilde{r}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{r}_{s1} & \tilde{r}_{s2} & \cdots & \tilde{r}_{sn} \end{bmatrix} \tag{16}$$

4. IAHP algorithm

In this paper, in order to make a better evaluation on the physical education teaching quality, we combine the improved entropy method, AHP method with the fuzzy comprehensive evaluation method. Then, we propose the IAHP algorithm.

When the traditional entropy weight method calculates the index weight $H_j \to 1$, the tiny change will cause the multiple change of the entropy weight. Aiming at the problem of the traditional entropy weight method, we propose an improved entropy method.

$$w_j = \begin{cases} (1-\overline{H})w_{oj} + \overline{H}w_{3j}, H_j < 1 \\ 0, \qquad\qquad\qquad H_j = 1 \end{cases} \tag{17}$$

Where, w_j is the weight of the j index. H_j is the entropy value of the j index. $\overline{H}$ is the average value that the entropy value is not 1.

$$w_{oj} = \frac{1 - H_j}{\sum_{j=1}^{n}(1 - H_j)} \tag{18}$$

$$w_{3j} = \frac{1 + \overline{H} - H_j}{\sum_{k=1, H_k \neq 1}^{n}(1 + \overline{H} - H_k)} \tag{19}$$

Therefore, the steps of the improved IAHP algorithm are as follows.

The step 1 is to establish the evaluation index.

The step 2 is to construct the judgement matrix.

The step 3 is to calculate the index weight according to the improved entropy method.

The step 4 is to calculate the evaluation results according to the fuzzy comprehensive evaluation method.

The step 5 is to calculate the final evaluation results according to the evaluation results of each subset.

5. Experiment

We evaluate the physical education quality of one certain university. According to the evaluation index and IAHP algorithm, firstly, we calculate the weight of each index. The weight calculation results are shown in the following table.

After getting the weights, according to the fuzzy comprehensive evaluation method, we evaluate it and the results are as follows.

$$B_1 = w^1 \cdot R^1 = (0.21, 0.35, 0.15, 0.17, 0.12) \cdot \begin{bmatrix} 0 & 0.2 & 0.4 & 0.4 & 0 \\ 0 & 0.2 & 0.3 & 0.4 & 0.1 \\ 0 & 0.5 & 0.2 & 0.3 & 0 \\ 0 & 0.1 & 0.5 & 0.4 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0.2 & 0.4 & 0.4 & 0 \\ 0 & 0.2 & 0.3 & 0.4 & 0.1 \\ 0 & 0.5 & 0.2 & 0.3 & 0 \\ 0 & 0.1 & 0.5 & 0.4 & 0 \\ 0.1 & 0.5 & 0.4 & 0 & 0 \end{bmatrix}$$

$$= (0.021, 0.309, 0.388, 0.337, 0.035)$$

$$B_2 = w^2 \cdot R^2 = (0.48, 0.31, 0.21) \cdot \begin{bmatrix} 0 & 0.4 & 0.4 & 0.2 & 0 \\ 0 & 0.5 & 0.3 & 0.2 & 0 \\ 0 & 0.1 & 0.3 & 0.4 & 0.2 \end{bmatrix} = (0, 0.368, 0.348, 0.242, 0.042)$$

Second evaluation index	Weight of second evaluation index	Third evaluation index	Weight of third evaluation index
Class teaching	0.35	Teaching content	0.21
		Teaching method	0.35
		Teaching mode	0.15
		Teaching management	0.17
		Project performance	0.12
Student self-assessment	0.30	Love for sportd	0.48
		Autonomous Learning	0.31
		Evaluation for Teachers	0.21
Teaching effectiveness	0.30	physical quality	0.18
		Comprehensive ability	0.31
		Skill mastery	0.25
		cultivation of the unity cooperation spirit	0.14
		Physical exercise after class	0.12
other	0.05	Site condition	0.27
		awards	0.12
		Teaching style	0.38
		Teachers strength	0.23

Table 2 – Evaluation index weight

$$B_3 = w^3 \cdot R^3 = (0.18, 0.31, 0.25, 0.14, 0.12) \cdot \begin{bmatrix} 0.2 & 0.4 & 0.4 & 0 & 0 \\ 0 & 0.3 & 0.4 & 0.2 & 0.1 \\ 0 & 0.4 & 0.4 & 0.1 & 0.1 \\ 0 & 0 & 0.5 & 0.3 & 0.2 \\ 0 & 0.4 & 0.6 & 0 & 0 \end{bmatrix} = (0.036, 0.313, 0.438, 0.129, 0.084)$$

$$B_4 = w^4 \cdot R^4 = (0.27, 0.12, 0.38, 0.23) \cdot \begin{bmatrix} 0 & 0.4 & 0.5 & 0.1 & 0 \\ 0 & 0.3 & 0.6 & 0.1 & 0 \\ 0 & 0.5 & 0.3 & 0.1 & 0.1 \\ 0 & 0.6 & 0.3 & 0.1 & 0 \end{bmatrix} = (0, 0.472, 0.390, 0.100, 0.038)$$

$$S = w \cdot R = (0.35, 0.30, 0.30, 0.05) \cdot \begin{bmatrix} 0.021 & 0.309 & 0.388 & 0.337 & 0.035 \\ 0 & 0.368 & 0.348 & 0.242 & 0.042 \\ 0.036 & 0.313 & 0.438 & 0.129 & 0.084 \\ 0 & 0.472 & 0.390 & 0.100 & 0.038 \end{bmatrix}$$
$$= (0.0181, 0.3361, 0.3911, 0.2343, 0.0519)$$

$$F = V \cdot S^T = (90,80,70,60,50) \cdot (0.0181,0.3361,0.3911,0.2343,0.0519)^T = 72.547$$

Therefore, the score of the physical education teaching quality evaluation is 72.547.

6. Conclusion

In recent years, many colleges and universities begin to pay attention to the physical education of College students. When making the college physical education, it is very necessary to evaluate the college physical education quality. College physical education evaluation can guide the university physical education. In this paper, we propose IAHP method and establish the quality evaluation index of the college physical education teaching. In the experimental part, we use this method to evaluate the college physical education, quality and obtain the ideal results. The results show the reliability and validity of the method which is proposed in this paper.

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Research on Influence of Information Technology Strengthening on College Student Management Work under Computer Network Environment

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Abstract: for the features of network environment and combining the new situation appeared in college student management work in network era, college student manage work has to explore new ideas and adopt new countermeasures on the basis of inheriting the successful theoretical experience of traditional college student management work. College student management work can only increase own affinity, attraction, persuasion and charm under network environment by adapting to the operation features of network carrier, fully playing the benefit of network and trying to remove the shortage of network.

Keywords: information technology, college student management, computer network environment.

1. Introduction

With the increasing popularization of network, colleges and universities are entering network era at an amazing speed as other social fields. As a special group with higher cultural level, college students are the group who accept network at fastest speed and are affected deepest by network. In China, colleges and universities are sites with the highest degree of whole society informatization, college students are with the closest contact with network. The rapid development of network and its application in colleges and universities cause great changes in the internal and external environment of college student management work. Construct and share new network environment, occupy network new position, strengthen and improve college student management work under network environment, which is not only the development of traditional college student management work in form and means, but also the exploration for the new realm of college student management work (Jamero et al., 2009). How can colleges and universities face the new environment of college management work for network, make the best use of the situation, drawn on the advantages and avoid disadvantages and make use of the advantages of network technology to improve the timeliness of college student management work and promote the innovative development of college student management work with the advancing of time has become an important subject in current college student management work in colleges and universities (Ates, 2013).

2. Make use of network advantage to promote the need of reform for college student management work

At present, our social components are becoming increasingly complicated, different classes and interest groups have different thoughts and ideas. Even in the same class and same interest group, there are also advanced and backward, progressive and conservative, proletarian and non-proletarian and other multiple thoughts. The same as colleges and universities, if they want to unify the thoughts of college students, it needs to reform the thoughts of college students through college student management work (Cho et al., 2014). Network is a visual society dominated by people; both its charm and damage power is rooted in people. Just because people bring the existing thought value idea of real society, a series of ideological problems like information selection, network communication and network addiction etc. have been derived (Svetsky et al., 2013). These ideological problems need college student management work to involve in network actively and solve by making use of the advantages of network college student management work.

1. Good for strengthening the subject consciousness of college students

   Information acquisition and communication under network environment will depend on the play of the subject consciousness of college students more, traditional information communication mechanism from teacher to student is weakening, while the new information communication mechanism from network to student is forming gradually.

2. Good for expanding the communication space of college students

   Under network environment, people no matter who are they and what position are they in can make two-way communication with equal identity. In the communication and discussion process, they can exchange opinions, communicate ideas, learn from others' strong points and close the gap, make mutual study, improve together and form new communication mode of two-way interaction and equal participation.

3. Good for adjusting the value orientation of college students

   After college students contacting cultural arguments and ideas originated from western developed countries in network, it is usually in conflict with our traditional cultural concept accumulated in mind consciously and unconsciously, which will make part of value produce tilt and offset. Continuous penetration of western capitalist values and decadent culture through network will have certain impact on the formation of college student values.

4. Good for solving the psychological alienation of college students

   The freedom and non-controllability of network enables the netizen to contact various kinds of useful and useless information freely. When netizen contact

some bad information, they will be affected naturally (White et al., 2015). If the spread information on internet are different or even completely opposite to the content inculcated by college student management workers, it will cause the ideological confusion of audience inevitably (Cretulescu et al., 2015). College students are with strong thirst for knowledge and are sensitive to new things with active thoughts, they can't discriminate between good and bad for the accepted information, which may induce the psychological alienation of college students and bring about certain barrier for the healthy physical and psychological development of college students.

5. Good for improve the moral qualities of college students

   If do not pay attention to the correct guidance for internet use of college student netizen, a small number of college students will forget social responsibility, lose moral restraint and cause some behaviors of moral anomie in the hidden network environment. The problem of network moral anomie existed among college students will cause the shortage of moral personality and disorder of value orientation if do not take effective measures (Alkazemi and Grami, 2012). Under such situation, implementing network college student management work will be an undoubted antidote for ensuring the good ideological and moral quality of college student in network virtual world. For this, colleges and universities should make full use of "network" carrier as well as the education functional advantages of network to strengthen network moral education and try to shape ideal moral personality for college students (Apte, 2004).

3. Influence of network on college student management work

The aim of implementing network college student management work among college students is to improve the ideological and political consciousness of college students through implementing a series of targeted college student management work as planned. To realize this aim, it needs to fully understand the influence of network on college student management work. As the fourth media after broadcast, TV and press, network has brought about great convenience for the study and life of college students. Pros and cons symbiosis exists in the generation and development of new things, so it is the network. The great function of network can be realized correctly and promote the development and application of network in colleges and universities can be promoted with an active psychology by viewing the useful aspect of network for college students objectively (Meadows et al., 2000).

To clarify the opinions of college students on the opportunities and challenges brought about by network for college student management work, this paper has made questionnaire for "the necessity of implementing network college student management work among college students" and also set the content of five validation items for two aspects of "influence of network on college student management work". The specific investigation results are as shown in table 1:

The survey	Confirm the items	Data (%)	The survey	Confirm the items	Data(%)
The opportunities brought by network to college students' management work	Expand the coverage of management work	93.2	The challenge of network brings to college students' management work	Contributed to the western ideology online penetration	96.5
	enhance the effectiveness of management work	94.5		Hindered the higher level of moral responsibility	96.2
	Rich sources of information management work	96.2		Targeted to reduce the traditional management	93.2
	Opens a new way of management	96.8		Increasing the difficulty control bad information online	96.4
	promote the modernization of ideological work	93.6		The mode of traditional political socialization	95.8

Table 1 – On the impact of network on college students' ideological and political work results

It can be seen from the statistical results that interviewed college students mainly have five cognitive tendencies in two aspects for "influence of network on college student management work". Investigation data has shown that over 95.6% respondents believe that network will bring about five aspects of opportunities for college student management work. Over 96.1% respondents believe that network will bring about five aspects of challenges for college student management work. The analysis of above cognitive tendency for respondents is as following.

3.1. Opportunities for college student management work under network environment

1. Expand the coverage of college student management work

   The appearance and development of network makes the college student management work break former temporal and spatial limits and broaden the coverage of education. The development of network technology breaks the restriction of time and space for information communication, which enables college student to attain the required knowledge from any place with terminal at any time and quickly understand foreign and domestic information in various aspects of politics and economy etc (Du and Feng, 2012). Network resource can be shared by netizens, which can broaden the former narrow work space of college student management for colleges and universities, further expand the communication channels of college student management workers and audience and then expand the coverage of college student management work.

2. Strengthen the timeliness of college student management work

One foreign test has shown that most of learners are used to study with one single sensory method like sense of touch, hearing or vision. The study efficiency will be improved in times once the learner study with all sensory methods. Network media can realize complementary advantages for traditional media and can act on human senses with various visual, auditory and tactile sensations etc (Petkari, 2015). This kind of multiple stimulus function enables the college students perceive the education content through multiple senses at the same time, while the study effect perceived with various senses is obviously superior to the study effect with single sense, as is shown in Figure 1.

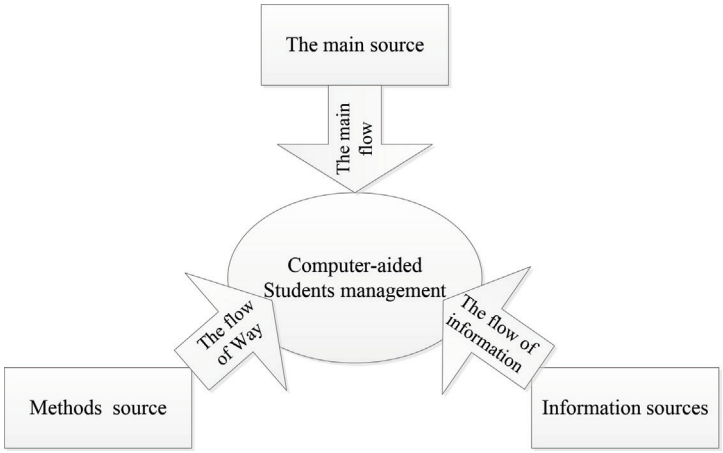

Figure 1 – Students Management in colleges and universities method

3. Enrich the information source of college student management work

Network provides great space and enriched information; it is with fast update speed and can realize instant retrieval; it is easy to check the information, convenient and fast. Our traditional college student management work is usually carrying on at the same time in a centralized way and the spread of education information is limited, however, the spread of network information is not restricted by time and space, can also shorten the time and space distance of information communication. College student management workers at colleges and universities can make use of network, fully play the quick, vivid, convenient and open advantage conditions of network etc, select the information with close relationship with college students thought to process and use targeted, attractive and persuading college student management work information to guide and regulate the thought of college students (seen in Figure 2).

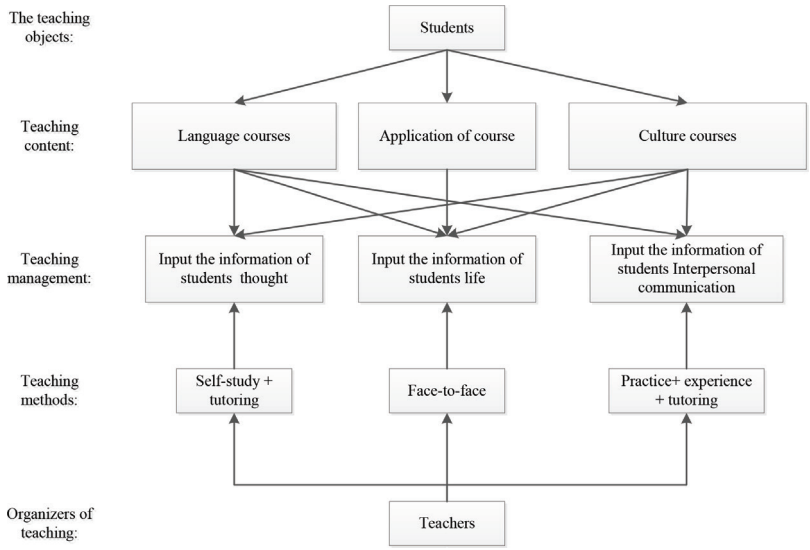

Figure 2 – Computer-aided college student management method

4. Open up new channels for college student management work

   Network breaks the traditional college student management work method, which is focusing on instillation and preaching. Most of traditional college student management work adopts classroom teaching method of presenting facts and reasons, which makes "one-size-fits-all" instilling education for students in the relatively closed classroom. The students are only taken as the passive storage of knowledge; therefore, it greatly decreases the initiative and enthusiasm of students receiving education. College student management work is a work of "teaching students in accordance with their aptitude" with personalized color. The multiple source and high degree of sharing features of network information provides a brand new education method for implementing college student management work under network environment. One outstanding feature of this education channel is that college student management workers and college students can make equal and two-direction interaction in information communication process and then fully play the mutual education function in college student management work.

5. Promote the modernization of college student management work

   Network era has to make use of the advantages of network to make effective management and education for the thought of college students to realize the modernization of college student management work. Practice has shown that implementing college student management work with information network is with features of extensive range, wide radiating surface and strong impact force etc, which presents the college student management work in front of students in a new gesture and make the college student management work move forward

continuously. It can be said that the organic combination of network and college student manage work is one of the important methods for college student management work to realize modernization (Management, 1987). It presents the requirements for the modernization of college student management work and modernizes the concept, content, form and means of college student management work.

3.2. Challenges for the college student management work under network environment

1. Intensify the internet penetration of western ideology

   The rapid development of information network provides convenience for western capitalist countries to implement "peaceful evolution" for socialist countries. They make full use of their advantage positions in information communication, speed up to promote policy of political and cultural expansion in network and make ideological and cultural penetration for socialist countries with network. Our country is the biggest socialist country, which make us become the focus and target of network penetration of western ideology naturally. Western countries make use of the global network with rapid development, make malicious attack for our political system and slander the leadership of The Communist Party wantonly under the banner of "democracy", "freedom" and "human rights". Because the western ideology information may be different or even opposite to what the college student management workers advocate, this will cause the thought confusion of college student inevitably. Some weak willed college students will be bewitched and poisoned if do not take effective measures to deal with the network penetration of ideology of western hostile forces.

2. Impede the improvement of self-moral responsibility

   Network is a multiple virtual society and various kinds of information communicated on internet can be invented into active intelligent symbols completely. Netizens can get rid of the binding of various human relations in real society, hide own real background completely, make free communication and interaction with others based on own ability of understanding things and judging right and wrong in the special "virtual" environment of internet as an "invisible man" and they do not need to bear any moral and legal liability (Yen et al., 2007). Therefore, netizens are easy to indulge themselves in internet, lose effective moral judgment ability when facing various kinds of information, abuse rights and freedom on internet and make some unscrupulous things like making impertinent remarks, online defamation, plagiarize academic achievements, sales of thesis etc. which are not advocated by moral norms and even forbidden by laws.

3. Increase the difficulty of controlling the influence of bad information on internet

   In network era, it becomes extremely difficult to control and filter information in network. Under network environment, various kinds of information can be presented and spread on internet, which makes the information environment

around college students become more complicated and the space of college student management work in school easier to be polluted. Facing with the uneven network information, the screening and selection ability of most of college students is correct, but they are affected by some negative, extreme and reactionary information inevitably as they are inexperienced with limited life experience and weak political sensitivity, and then cause thought confusion of college students (Padilla-Meléndez et al., 2008).

4. Countermeasure innovation for the network college student manage work among college students

4.1. Concept innovation for the network college student management work among college students

1. Change from unidirectional dominant to two-way interaction

   Under network environment, teaching resource at colleges and universities is not mastered by teacher individually, which decrease the former advantage position of teacher in the possession of information resource. In addition, with the continuous strengthening of the independent and autonomous consciousness of college students as well as the increasing expansion of social interaction, college students are changing from completely passive acceptance to acquiring knowledge actively gradually. Therefore, the way of college student management work is changing from unidirectional instillation method to two-way communication mode.

2. Change from social standard to individual standard

   Traditional college student management work is more inclined to social standard, but considers less individual standard of college students, which causes inadequate internal motivation for social expectation among college students. If college student management work only emphasizes on social standard and neglects human factor, it is easy to be misled (Panet et al., 2005). Therefore, college student management work should change from social standard to individual standard and insist on people oriented.

3. Change from closed mode to open mode

   College student management work under network environment is difficult to adapt to the demand of network social development if it still insists on the closed college student management work model all the time and does not make reform and innovation for college student management work mode (Malta and Sousa, 2010). For this, college student management work has to change the concept, change the traditional closed mode into open mode under network condition, make college student management work face to the network virtual world directly and expand the thought value vision of college student netizens through communication, collision and integration among various kinds of network information.

4.2. Content innovation for network college student management work

1. Strengthen education of socialist core value system and use Marx doctrine to occupy network position

   The innovation of college student management work should take the socialist core value system as foundation. The construction of core value system for college students can't be separated from college student management work; college student management work is an important means of constructing socialist core value system. The construction of socialist core value system is always at the dominant position, which determines the nature and direction of college student management work system.

2. Put emphasis on network moral education and cultivate the ideological and moral quality of college students

   The reasons for some ideological and behavioral unethical problems of college students under network environment is that part of students are with low ideological and moral quality and lacking self-discipline and self-control ability. Therefore, it has to adopt various kinds of forms to implement network moral education with "self-discipline" as feature, advocate college students to follow the network ethics suitable for our national situation consciously, cultivate the network self-discipline ability of college students, improve their ideological and moral quality and strengthen their ability of judging right and wrong and cultivate moral self-discipline.

3. Put emphasis on realistic education and guide the role conversion of college students between virtual network and reality

   The virtual property of network also induces netizens to have an impulse to do whatever they want on internet and some of them even make some moral anomie behavior which is forbidden by real society, as shown in Figure 3. This

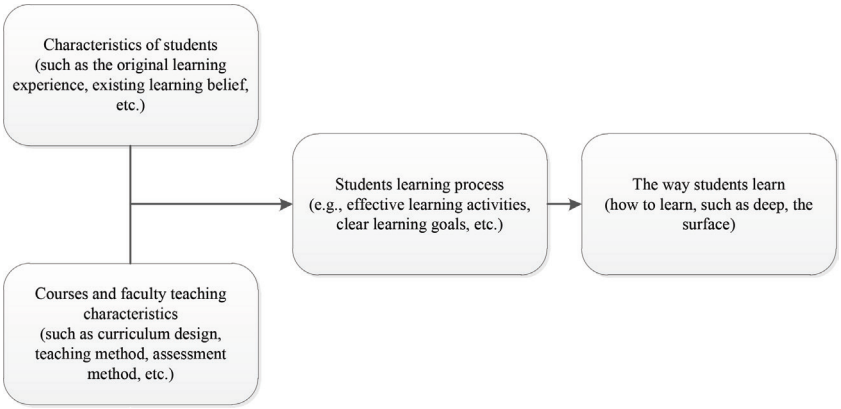

Figure 3 – Effective teaching analysis theoretical model

is because network space is weaving between real and virtual, the principle of network social intercourse established on it is also different from real society obviously. Therefore, college student management worker must combine the thought reality of college students, guide the students to understand the differences and similarities between virtual network and real society of college students, promote them change roles properly and return to real world from virtual world consciously.

5. Conclusions

The development and popularization of information network technology not only brings about new opportunities for colleges and universities to strengthen and improve college student management work, but also proposes some new challenges. At present, colleges and universities have become the main objects for domestic and foreign hostile forces to make ideological penetration and campus network has become the important position for ideological struggle. Therefore, colleges and universities have to take initiative to occupy the high point of network position, fully play the advantages of network college student management work and guide the healthy growth of college students.

For the features of network environment and combining the new situation appeared in college student management work in network era, college student manage work has to explore new ideas and adopt new countermeasures on the basis of inheriting the successful theoretical experience of traditional college student management work. College student management work can only increase own affinity, attraction, persuasion and charm under network environment by adapting to the operation features of network carrier, fully playing the benefit of network and trying to remove the shortage of network.

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Application Research on ELM-based English Writing Competence Evaluation Model in College English Teaching and Learning

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Abstract: To objectively and accurately conduct a comprehensive evaluation of English writing competence, analytic hierarchy process is adopted to construct the comprehensive evaluation index system and grading standards of English writing competence. Based on extreme learning machine (ELM) algorithm rationales, ELM English writing competence evaluation model is built to conduct the comprehensive evaluation over users' writing competence, and BPNN neural network model is also built for comparison. Results show that ELM English writing competence comprehensive evaluation model is consistent with the actual evaluation of teachers; the evaluation accuracy and generalization ability of this model are both superior to those of BPNN neural network evaluation model, so it is feasible and effective to apply it into writing competence evaluation. This paper applies English writing competence evaluation model into teaching and learning experiment to study its influence upon writing competence development of students. Experiment results show that ELM-based model evaluation system integrated into experiment teaching and learning can help students develop their writing competence and improve their independent learning capacity.

Keywords: evaluation model, extreme learning machine (ELM), English writing competence, English teaching and learning.

1. Introduction

English writing competence refers to the ability of students in utilizing various writing strategies and rhetorical devices to produce works of different styles based on acquired special knowledge and combining relevant English knowledge (Yan, 2014). Researches show that English writing competence is displayed as the ultimate ability of producing texts after writing environment cognition and thinking. English writing competence evaluation serves as a comprehensive evaluation over English writing level, which is guided by education evaluation theory and used to evaluate the overall English competence of students reflected by writing competence. Therefore, it is an important component of English education evaluation. It can detect not only the current English writing level of users, but also the expansibility contained in English writing competence.

To more scientifically measure the English writing competence of college students, it is necessary to build English writing competence based comprehensive evaluation model as soon as possible. It remains a problem to be urgently solved how to effectively improve English writing competence of college students and how to evaluate it. Zhang (2012) studied the dynamic evaluation system of college English writing teaching and learning. Luan (2012) analyzed the influence of online writing automatic evaluation system upon college students' English writing competence. Zhi (2014) conducted an experimental research on the influence of itemized writing evaluation upon non-English major college students' writing competence. Wu (2014) applied formative evaluation into high school English writing teaching and learning, and obtained certain effects. Zhang and Luan (2013) used online formative evaluation tool to study the influences of English writing competence upon vocational college students; Gao and Luan (2013) studied the influence of online writing automatic evaluation system Writing Road map 2.0 upon college students' writing quality. Tang and Wu (2012) studied the application of writing automatic evaluation system in college English teaching and learning. Yan (2014) built a college academic English writing competence evaluation system. Literature (LI, 2016; Wei, 2015; Guo, 2013; Zhang, 2016; Qiao, 2014) all studied the influence of online evaluation system upon English teaching and learning. Literature (Butler and Lee, 2010; Wang, 2011) studied the influences of individualized evaluation upon English learning. Literature (Wang and Xian, 2011) integrated writing automatic evaluation system into classroom teaching and learning. Literature (Stevenson, 2016) focused on the influences of automatic writing evaluation system WRM 2 upon Chinese college students' English writing. Most of the above researches are targeted at the influences of writing competence evaluation system upon English writing, teaching and learning. However, the current writing competence evaluation systems are normally based on SVM or BPNN algorithm, and traditional neural network mostly adopts gradient descent method to adjust weight, hence revealing the shortcomings of slow speed, poor generalization ability and tendency towards local minimum (Wang, 2014).

Huang et al., (2014), Huang et al., (2011) proposed the algorithm of extreme learning machine (ELM) in literature, and Deng (2009) modified it in literature, hence further improving the training speed and generalization ability of ELM. This paper proposes a kind of ELM-based English writing competence objective evaluation model. Before training, this model only needs to set the hidden node number of network, and the values of network input weight and hidden layer deviation can be assigned randomly without repeated iteration, which will produce the only optimal solution. This paper applies this model into teaching and learning experiment so as to study its influence upon the writing competence of students.

2. Rationale of ELM Algorithm

Different from traditional neural networks, the hidden layer of process neural network is consisted of operators that can complete temporal and spatial aggregation operation (Gonçalves et al, 2015; Quiñonez et al., 2015). In addition, input process and weight are the functions related with time, which can reflect the spatial aggregation function and temporal accumulation effect of time varying input signal, with the most representative one being single-hidden layer feedforward neural network (SLFN). As one new type of

SLFN, ELM algorithm randomly produces the connection weight between input layer and hidden layer as well as the neural threshold value of hidden layer. In process of training, no adjustment is needed, and what we need to do is to set the number of neurons in hidden layer. As a result, the only optimal solution will be obtained (Cui, 2013). The topological structure is as shown in Fig.1.

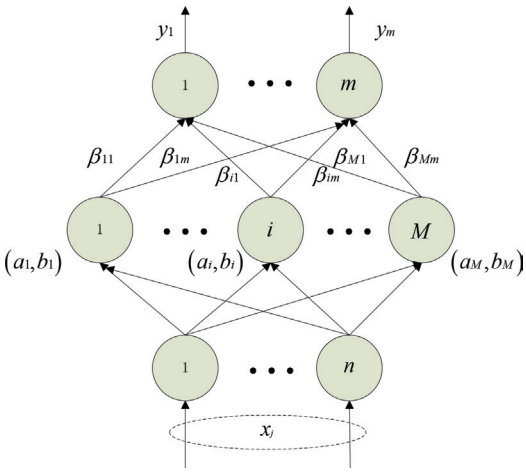

Figure 1 – SLFN structure

As shown in Fig.1, if there are N training samples (x_i,t_i), where $x_i=[x_{i1},x_{i2},\cdots,x_{in}]^T \in R^n$, $t_i=[t_{i1},t_{i2},\cdots,t_{im}]^T \in R^m$, then when there are M ($M \le N$) hidden nodes and activation function is $g(x)$, the single-hidden layer neural network model can be expressed as:

$$\sum_{i=1}^{M} \beta_i g(a_i \cdot x_j + b_i) = O_i, j = 1,\ldots,N \tag{1}$$

In formula (1): to connect the input weight of the ith node in hidden layer, $a_i=[a_{i1},a_{i2},\cdots,a_{in}]^T$; b_i is the deviation of the ith node in hidden layer; β_i is the output weight of the ith node in hidden layer, and $a_i \cdot x_j$ represents the inner product of a_i and x_j . Activation function $g(x)$ can be "Sigmoid", "Sine" or "RBF".

The learning goal of SLFN is to minimize the cost function $E(\omega)$, which represents the sum of squared errors between target output and expected output.

$$E(\omega) = \sum_{i=1}^{N} \left\| O_j - t_j \right\|^2 = 0 \tag{2}$$

Namely there are β_i , a_i , b_i ,

$$\sum_{i=1}^{M} \beta_i g(a_i \cdot x_j + b_i) = t_j, j = 1,\ldots,N \tag{3}$$

Formula (3) can be expressed through matrix:

$$H\beta = T \tag{4}$$

where,

$$H\left(a_1,\ldots,a_M,b_1,\ldots,b_M,x_1,\ldots,x_M\right)=\begin{bmatrix} g(a_1\cdot x_1+b_1) & \cdots & g(a_M\cdot x_1+b_M) \\ \vdots & \cdots & \vdots \\ g(a_1\cdot x_N+b_1) & \cdots & g(a_M\cdot x_1+b_M) \end{bmatrix}_{N\times M} \tag{5}$$

$$\beta=\begin{bmatrix} \beta_1^T \\ \vdots \\ \beta_M^T \end{bmatrix}_{M\times m} \quad and \quad T=\begin{bmatrix} t_1^T \\ \vdots \\ t_N^T \end{bmatrix}_{N\times m}$$

H is output matrix of hidden layer; β is output weight; and T is expected output.

Based on previous researches, Huang et al. proposed ELM algorithm for SLFN on strength of the following theorems, hence providing theoretical foundation for the application of ELM.

Theorem 1:

Assuming that there are N random and different samples $\left(x_i,t_i\right)$, where $x_i=\left[x_{i1},x_{i2},\cdots,x_{in}\right]^T\in R^n$, $t_i=\left[t_{i1},t_{i2},\cdots,t_{in}\right]^T\in R^m$,infinite and derivable activation function between N hidden layer nodes and any range $g:R\to R$, and value for SLFN within $a_i\in R^n$ and $b_i\in R$ are randomly assigned, the formed hidden layer matrix H is reversible, that is, there is an accurate solution to the equation set, and the cost function $E\left(W\right)=0$.

Theorem 2:

Assuming that there are random and different samples $\left(x_i,t_i\right)$, where random error $e>0$, and the infinite and derivable activation function within any range $g:R\to R$, there will always be one SLFN containing M ($M\le N$)hidden layer nodes, which will make error $E\left(W\right)\le e$ under random assignment of $a_i\in R^n$ and $b_i\in R$.

From theorem 1 and 2, it can be known that as long as there are enough number of nodes in hidden layer, SLFN can approach any continuous function under random assignment of input weight. Meanwhile, after confirming model training parameters, we can define a reversible hidden layer output matrix, so as to transform SLFN training process into the issue of computing least square solution for $H\beta=T$. When H^TH is non-singular matrix, the hidden layer output weight computation formula is:

$$\beta=\left(H^TH\right)^{-1}H^TT \tag{6}$$

Based on the above, the ELM algorithm can be understood as: given a training set $\left\{\left(x_i,t_i\right)\middle|x_i\in R^n,t_i\in R^m,i=1,\cdots N\right\}$, activation function $g\left(x\right)$ and hidden layer node number M .

1. randomly assign input weight a_i and threshold value b_i, both of which are within the range of [-1,1];

2. compute hidden layer output matrix H ;
3. compute β through formula (6).

3. Construction of Writing Competence Index System and Realization of Evaluation Model

3.1. Constructing Writing Competence Index

Considering that college student English writing competence comprehensive evaluation index system and grading standards are lacking, this paper, referring to relevant literature, starts from the realities of Chinese college student English learning, combines evaluation and practice requirement, and adopts analytic hierarchy process to construct a comprehensive evaluation index system and grading standards suitable for students. Ultimately, an evaluation index system was constructed that can reflect the English writing competence of college students. There are 10 indexes in total in this evaluation model, including vocabulary, grammar, writing style, content, structure, smoothness, fluency, accuracy, norm (suitable for the conventional expression of British and American people), and writing strategy. Evaluation process is as follows:

1. Evaluation table is made with 10 full scores for each index, with grading standards provided;
2. All teachers in the school of foreign languages are asked to score for the English level of the students in class A and class B (103 students in total) by natural teaching from non-English majors according to the evaluation table in the ways of interview and written examination, so as to obtain each teacher's original data of scoring for each index;
3. Pro-processing is conducted on the original data: scores for each index are averaged through removing the highest and lowest point, so as to obtain student English writing competence evaluation original data as shown in Table 1.

Sample number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
vocabulary	9.12	9.25	8.25	8.63	7.12	7.58	6.92	6.04	5.35	4.15
grammar	8.68	9.12	8.64	8.17	7.58	7.69	6.85	6.07	5.63	6.12
writing style	9.23	9.3	9.21	8.21	7.45	7.85	6.12	6.81	5.68	5.63
content	9.35	9.52	8.45	8.65	7.31	7.21	6.53	6.73	5.52	5.21
structure	9.25	9.01	9.31	8.54	7.15	7.15	6.85	6.45	6.23	5.92
smoothness	8.82	9.21	9.24	7.52	7.41	7.12	6.78	6.95	6.13	5.13
fluency	8.95	8.35	8.97	8.92	8.23	7.45	6.09	6.51	5.98	5.51
accuracy,	9.23	8.39	8.05	8.12	7.08	7.16	6.25	7.04	6.14	6.23
norm	8.98	8.35	8.23	8.12	8.14	7.58	7.12	6.92	7.01	6.21
writing strategy	8.95	8.55	8.52	8.43	8.53	8.21	7.45	8.45	6.23	6.52
Evaluation results	A	A	B	B	C	C	D	D	E	E

Table 1 – Partial data in training set

Evaluation results are divided into five levels of A-E, namely excellent, sound, medium, passable, and impassable. Set the overall evaluation score $9 \le S < 10$ be level A; $8 \le S < 9$ be level B; $7 \le S < 8$ be level C; $6 \le S < 7$ be level D; and $S < 6$ be level E.

3.2. Realizing Evaluation Model

3.2.1. Training Samples and Selection of Testing Samples

To build the model, the data of experiment class A and Bwere chosen for experiment as experiment data. The evaluation table of 50 students in Experiment class Awas used as training set, whilethe evaluation results of 20 students chosen from experiment class Bwereused as testing set. Given that the 10 indexes for training samples are digits within 0-10, there is no need for normalization.

3.2.2. Network Training and Performance Evaluation

ELM algorithm was adopted to conduct network training of 50 training samples and 20 testing samples. Two statistical indexes, namely coefficient of determination R^2 and RMSE (root-mean-square error), were chosen to evaluate the ELM model. When the statistical indexes of training samples and testing samples were close to one another, the model had a sound generalization ability and prediction accuracy. If the coefficient of determination R^2 is closer to 1 within the range, it indicates that the model has better performance; the smaller the RMSE and its value, the better the performance of the model. Computation formula for statistical indexes is as follows:

$$R^2 = \frac{\left(N\sum_{i=1}^{N} \widehat{y_i} y_i - \sum_{i=1}^{N} \widehat{y_i} \sum_{i=1}^{N} y_i \right)^2}{\left[N\sum_{i=1}^{N} \widehat{y_i}^2 - \left(\sum_{i=1}^{N} \widehat{y_i} \right)^2 \right] \left[\sum_{i=1}^{N} y_i^2 - \left(\sum_{i=1}^{N} y_i \right)^2 \right]} \tag{7}$$

$$\sigma_{RMSE} = \frac{1}{N} \sqrt{\sum_{i=1}^{N} \left(\frac{\widehat{yi} - yi}{yi} \right)^2} \tag{8}$$

Sigmoidal was chosen as activation function for cycling, with the coefficient of determination R^2 and 10RMSE corresponding to the number of neurons in different hidden layers. The obtained data was used for drawing the scatter diagram, with tendency fit line added as shown in Fig.2.

From Fig.2, it can be known that when the number of hidden layer neuron is 12, the determination coefficient is basically stable and reaches the maximal value; moreover the RMSE is small, and the network prediction accuracy at this moment is relatively high.

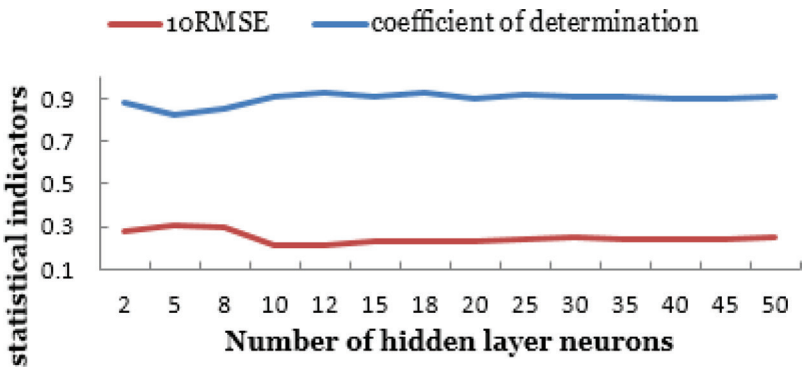

Figure 2 – Influence of hidden layer number upon ELM performance

3.2.3. Comparison of ELM Model and Other Model Accuracy

To compare and explain the efficiency of ELM evaluation model, this paper also builds BPNN evaluation model. The building process is as follows: the training samples and testing samples of ELM algorithm are used for BPNN, which adopts typical single-hidden layer structure; the input layer node number is the same with the feature vector dimension number of samples, namely 10; the output layer node number is the same with the classification result number, namely 5; the gradual growing method or gradual trimming method is used to determinate the final neuron number to be 15, that is, when hidden layer node number is 15 the network performance is optimal. Then the topological structure of BPNN is determined to be 10-15-5; the transfer function of hidden layer and output layer adopts logsig and purelin respectively; and training function adopts traindgx. The experiment results comparison is as shown in Table 2.

Evaluation model	**Sample**	R^2	σ_{RMSE}
ELM evaluation model	Training sample	0.9234	0.0223
	Testing sample	0.9356	0.0213
BPNN evaluation model	Training sample	0.9125	0.0236
	Testing sample	0.9176	0.0224

Table 2 – Experiment results comparison

From Table 2, it can be seen:

1. in terms of R^2, whether for training samples or testing samples, $R^2_{EML} > R^2_{BPNN}$.
2. in terms of σ_{RMSE}, whether for training samples or testing samples, σ_{RMSE} in ELM model is smaller than that in BPNN model.
3. through comparing model structure and parameters setting, ELM evaluation model enjoys big advantages, because its parameters setting is simple, so it will not get into local optimum.

It can be seen that the evaluation accuracy and generalization ability of ELM evaluation model are both superior to those of BPNN model, indicating that ELM can be used for English writing competence comprehensive evaluation. Therefore, this paper chooses ELM to build evaluation model to evaluate college student English writing competence.

4. System Framework of English Writing Competence Based Evaluation Model

The English writing competence evaluation model in part 2 is utilized to construct English writing competence evaluation system as shown in the following Fig3.

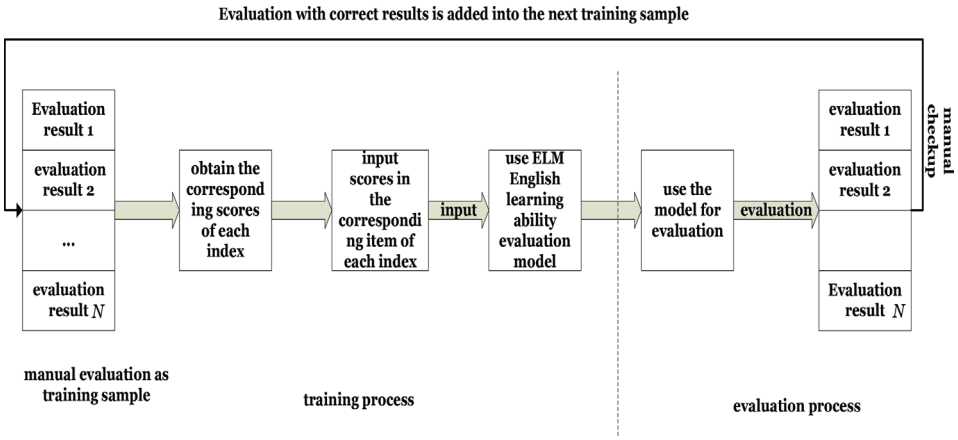

Figure 3 – System Framework of English Writing Competence Based Evaluation Model

Users can use the evaluation system to appraise their own English writing competence, during which process, they can firstly evaluate the scores for each index, input them into the corresponding index item and finally utilize ELM English writing competence evaluation model to get the final scores. Manual checkup module can be added into the system, and through this module the evaluation with correct results will be added into the next training practice, so as to improve the accuracy of the evaluation system.

5. Influence of English Writing Competence Evaluation System upon Student Writing Competence Development.

With deepened academic exchanges between institutions of higher education across the world, the ability of written expression and communication has become more and more important. Researches find out that the lowest scoring rate for students with different diploma in CET-4 and CET-6 lies in writing (Jin, 2011). At present, Chinese college English teaching and learning are faced with double pressures, that is, students outnumbering teachers and the urgent requirement to improve students' writing competence. Considering the English learning status of Chinese undergraduates and the evaluation system of schools and in order to facilitate the experiment, this paper reduces the indexes of ELM evaluation model from 12 to 6, only leaving content,

structure, voice, lexicon, fluency and norm (Tang and Wu, 2012). The system developed on the basis of ELM evaluation model scores for student composition from the aspect of each item and general performance. This paper will study the influence of ELM based writing competence evaluation system upon the development of student writing ability in English teaching and learning.

5.1. Research Object and Experiment Design

The object of this research is 120 students of non-English majors. Class A has 58 students and class B has 62 students. The two classes share the same English teacher and have similar English level (based on average performance for previous exams) for a period of 1 year.

Before experiment, students in the two classes participated in a standard writing level test, so as to know their real English level and compare with the scores after experiment. Class A uses ELM based English writing competence evaluation system to practice writing so as to improve their shortcomings, while the teaching in class B keeps normal as usual without adopting English writing competence evaluation system.

After the experiment, the students in two classes took part in an English writing level test. The selection of composition titles adopted AB cross-over sampling, so as to eliminate the interference of time and different titles and thus ensure the comparability of the average scores of two classes.

5.2. Experiment Results and Analysis

The test scores of two classes will be used to analyze the influence of ELM based evaluation system upon student writing competence as shown in Table 3 and 4.

Evaluation index	Test time	Number of students	Average score	Standard deviation	Average deviation
content	before	58	7.082	0.7105	-0.464
	after	58	7.546	0.7752	
structure	before	58	7.357	0.4503	-0.466
	after	58	7.823	0.6334	
voice	before	58	7.394	0.4885	-0.434
	after	58	7.828	0.6214	
lexicon	before	58	7.559	0.4381	-0.337
	after	58	7.896	0.7201	
fluency	before	58	7.357	0.4695	-0.455
	after	58	7.812	0.6245	
norm	before	58	7.392	0.4723	-0.480
	after	58	7.872	0.6596	
Total score	before	58	7.382	0.4789	-0.409
	after	58	7.791	0.6291	

Table 3 – Test score comparison of class A before and After experiment

Evaluation index	Test time	Number of students	Average score	Standard deviation	Average deviation
content	before	62	7.185	0.6115	-0.024
	after	62	7.161	0.6804	
structure	before	62	7.404	0.4551	-0.141
	after	62	7.540	0.5017	
voice	before	62	7.411	0.4476	-0.102
	after	62	7.513	0.5370	
lexicon	before	62	7.034	0.4258	-0.097
	after	62	7.131	0.5478	
voice	before	62	7.358	0.4213	-0.146
	after	62	7.504	0.5325	
norm	before	62	7.387	0.4438	-0.177
	after	62	7.564	0.5332	
Total score	before	62	7.272	0.4151	-0.129
	after	62	7.411	0.5063	

Table 4 – Score comparison of class B before and after experiment

Referring to Table 3 and 4 for vertical comparison, the progress amplitude of class A is 0.4, and class B is 0.1. Students in class A taking part in evaluation system showed a better performance than those in class B in terms of 6 dimensions. The above results show that the application of writing evaluation system in teaching and learning can uplift the writing competence of students.

5. Conclusions

This paper constructs an English writing competence comprehensive evaluation index system and grading standards consistent with the realities of China, and realizes the ELM-based evaluation system and traditional BPNN comparison model. Statistical indexes like coefficient and RMSE, are chosen to evaluate and compare the fitness accuracy and test accuracy of each evaluation model. Comparison results show that ELM evaluation model can be used for English writing competence evaluation. Based on ELM evaluation model, this paper constructs ELM evaluation system. Through teaching and learning experiment, ELM-based evaluation system is helpful for uplifting student English writing competence.

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The Design and Realization of a Campus Roaming System Based on Virtual Reality Technology

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Abstract: Virtual reality technology is a new and high technology which uses a computer's hardware and software to simulate the real world and generate a 3D virtual environment. This paper focuses on the design of virtual scenes for Langfang Teachers University to achieve roaming performance based on 3DS Max, a basic way to realize virtual campus.

Keywords: virtual reality technology, campus roaming, 3D Max

1. Introduction

Virtual Reality Technology (VR for short) is a new integrated technology developed at the end of 20th century. By simulating the real world, this technology can generate a lifelike virtual environment in which users can perform various interactions and have a variety of sensory experiences as if they were exposed to the real environment. Nowadays, virtual reality technology has been widely applied to many fields, such as medical equipment simulation, military combats simulation, 3D architecture simulation and 3D animation production. The campus roaming system can visualize the campus information on a computer and create life like virtual scenes of the campus by means of the virtual 3D building technology which combines 3D and 2D images, sounds, texts and other materials together. This system is a simulation system with an actual roaming function.

At present, many foreign countries are starting to try developing virtual reality systems. San Jose State University in the United States has established a virtual campus on the "Second Life", one of the world's most popular 3D virtual platforms (Wu, 2012). Other countries like the United Kingdom, Japan and Germany are also in the leading position for the study of virtual reality technology (Yan, 2013). A university in Germany has developed an urban simulation system based on GIS for the convenience of students to search information and conduct research. Japan established the world's first "virtual school" in December 2014 by combining its developed animation and advanced virtual reality technology (Hong, 2012).

Virtual reality technology has been listed as a national key research project in China (Liu, 2012). Tsinghua University, Xiamen University, Zhejiang University and many other key universities and their laboratories have implemented 3D virtual campus systems (Yu, 2016). Harbin Engineering University has implemented a roaming system which combines indoor and outdoor communities together and enables human-machine interaction in the Unix system (Zhang, 2012).

2. Virtual Reality Technology

2.1. The Definition of VR Technology

Virtual reality technology is a virtual simulation technology made up of many technologies such as computer simulation, 3D display technology, artificial intelligence, computer network technology and multimedia technology. Among these technologies, computer network technology and simulation technology lay a necessary foundation for realizing virtual reality. Virtual reality makes it possible that people perceive the entities from real scenes in a virtual environment and experience real-time interaction through languages, gestures and other natural communication ways and that experiencing effects are realistic and natural (Gao, 2013).

2.2. The Features of VR Technology

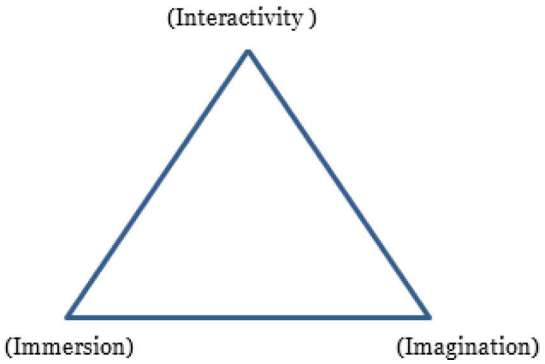

Figure 1 – Virtual Reality Technology Triangle

Virtual reality technology originated from the United States (Ma, 2014). In 1993, Philippe Coiffet and BurdeaG, scientists from the United States, published an article entitled Virtual Reality System and Applications in which they proposed a concept of “virtual reality technology triangle”. This triangle vividly illustrates three typical features of VR technology: immersion, interactivity and imagination as shown in the figure (Qiao, 2011):

- Immersion

Immersion refers to the realistic degree of a virtual environment in which users realize that they act as a protagonist. An ideal simulation environment should place users in an immersive environment in which they are unable to tell virtuality from the real world.

- Interactivity

Interactivity means that people can obtain natural, two-way interactions with the objects in a virtual world; in other words, it refers to the extent to which users can operate these objects within the simulation environment and to which users can naturally get feedback from the environment (Liu and Sourin, 2005).

For example, when opening a window, users can push the window directly by hand and then feel their hands touched by the window. Besides, they can control how wide the window should be opened and the window in sight can move immediately as the hand pushes the window.

- Imagination

Imagination means that users can imagine freely in a simulation environment and virtual reality technology can not only simulate real-world scenes but also simulate any imaginary scene.

Based on the above-mentioned features of virtual reality, we designed and developed a virtual campus roaming system.

3. The Design of a Virtual Campus Roaming System

3.1. Design Requirements

Virtual campus is a combination of geographic information technology, virtual reality technology, computer network technology and other high technologies, achieving the 3D digitization and virtualization of a real campus environment (Wang, 2010). In order to make users interact in real time with the scenes in a 3D simulation of a campus and obtain a full range of roaming experiences, a virtual campus should meet the following requirements:

- Sense of Reality. It must give users a sense of reality, which means that users are able to have a feeling that they are present at a “real world” and to immerse themselves in the virtual scenes when operating the system. The simulation should be lifelike.
- Automatic Roaming. Automatic roaming means that the virtual campus can automatically display various 3D scenes of the entire campus to users.
- Real-time Interactivity. More real-time interactive functions should be provided in order to make users better experience the reality of the virtual scenes.

3.2. The Flow Chart of a Virtual Campus Roaming System

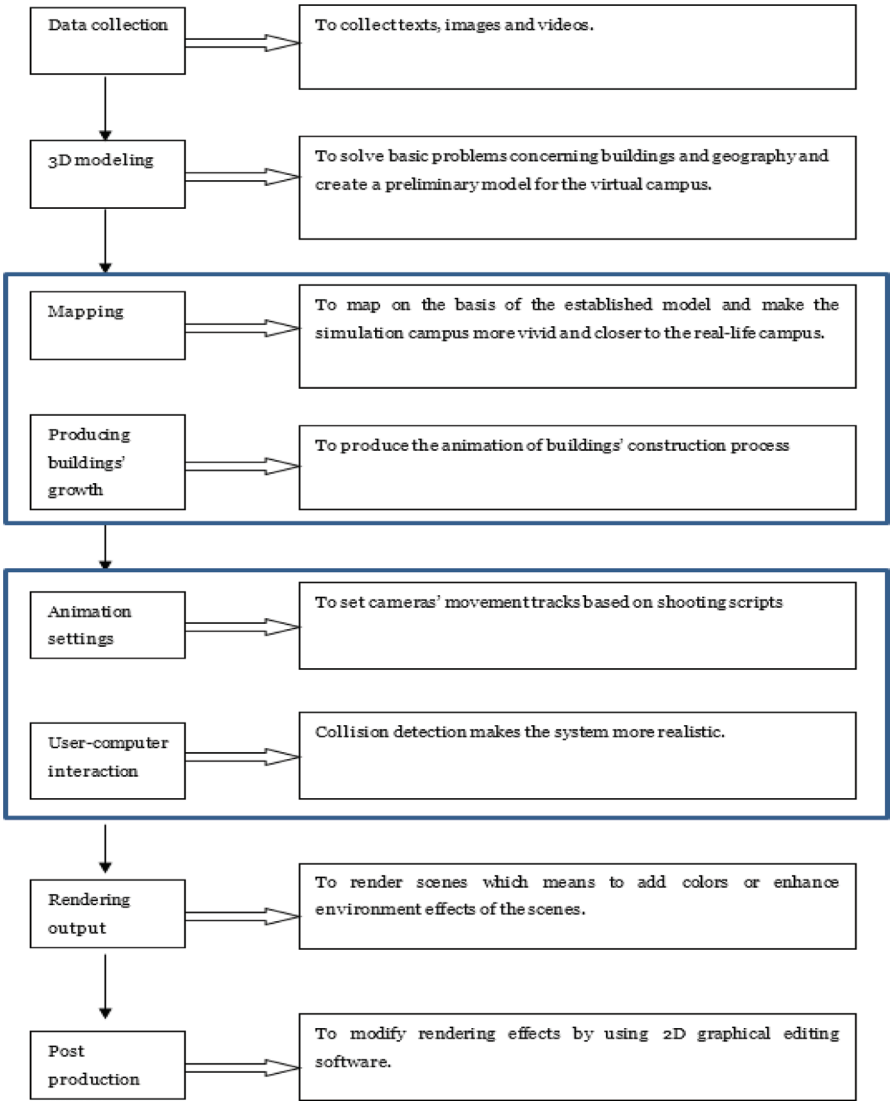

Figure 2 – The Flow Chart of a Virtual Campus Roaming System

4. The Realization of a Virtual Campus Roaming System

4.1. Development Tools

This roaming system mainly uses 3D Max software to set up 3D models of teaching buildings and save these models as . WRL files. We can obtain a complete and

coordinated virtual environment by reasonably arranging the locations and relations of these buildings in the simulation environment.

3D Max software, developed by Discreet, a subsidiary of the renowned Auto desk, is a software capable of making 3D scenes, whose functions include modeling, rendering, animation and others. 3D MAX, a visual and easy way of modeling, greatly simplifies and enriches the scene construction of virtual reality (Xue, 2013). This software has been widely used in film and video production, animation, industrial design, architecture design, assisted instruction and other fields.

4.2. The Realization of Virtual Campus Roaming Based on 3Dmax

- Collecting and Collating Data

First, we confirm the location of Langfang Teachers University based on real satellite images and identify the locations, specific materials and details of each building on the campus, as shown in Figure 3.

Second, we collect 3D images of the appearance of campus buildings. The photos taken and collected should show as many characteristics of the building as possible, such as the number of floors of the building and its typical appearance, as shown in Figure 4.

Figure 3 – The Satellite Image of the Campus

Figure 4 – The Exterior of a Building

Last but not least,we take photos of detailed features of buildings, such as doors, windows, pillars, etc.

- Modeling of Campus Buildings

We model the campus buildings based on the photos collected before. The modeling is mainly polygon modeling.

We start from the modeling of building structures. Take the University Auditorium for example. This building has only three storeys and its windows are obviously concave. Therefore, 2D lines are used to create the rectangles of appropriate size.Then we convert the rectangles into editable lines before editing spline lines and filling random

parameters in the contours and two 2D rectangular lines can be seen in front view. After that, we resize the small 2D rectangle to match with the actual size of the window based on the photos of the University Auditorium,as shown in Figure 4. Next, we select the small 2D rectangle and copy it to produce two 2D rectangles of the same size. The following step is to put three 2D rectangles at suitable positions and to use the extrusion tool in the Modifier Menu to get a fundamental structure of the building after obtaining satisfactory shapes. In the process of extrusion, we set suitable thickness parameters as shown in Figure 6. In order to facilitate later mappings, we name the fundamental structure “qiang1”. Since the fundamental structures within a building are similar, their names can be included in the same group, which will reduce modeling workload when instance copying is carried out.

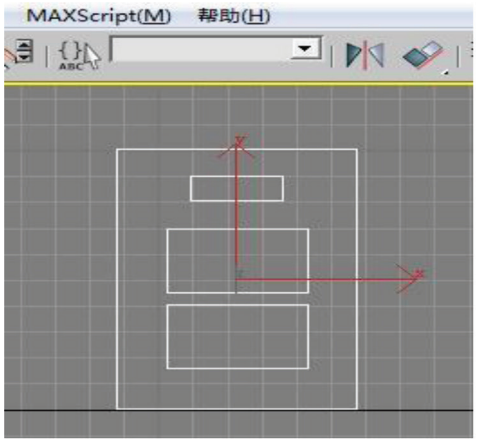

Figure 5 – 2D Rectangular Lines

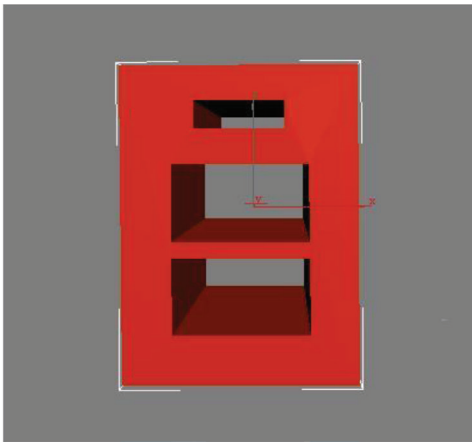

Figure 6 – The Fundamental Structure

The next part is the modeling of windows and accessories. We can use the doors and windows included in 3D MAX but their materials are not easy to change. Therefore, we usually design the doors and windows on our own. In addition, the self-designed doors and windows are more realistic and three-dimensional than the ones in 3D MAX. First, we make basic frameworks for windows based on their features. For example, since the shape of the University Auditorium windows is common square, 2D rectangular lines can be directly used to make the frameworks. Then, we create a rectangle of a suitable size and convert it into editable splines. After that, we select the splines and set their contours to 100mm and we get a 2D rectangle whose length and width is 200mm shorter than that of the original rectangle. The next step is to use the stretch tool in the Modifier Menu to create a double 3D effect and use it as a window frame under the name “chuangkuang0”. We can make additional windows and doors in the same way when necessary.

As for prominent pillars and window hoods in the walls of the University Auditorium, we create rectangular blocks of suitable sizes to act as wall pillars and window hoods respectively. Then, we use the alignment tool in the Tool Menu to align these blocks. After that, we select the objects we want to move and press Alt+a to execute the alignment tool,

as shown in Figure 7. Next, we select the objects we want to align and fill the required parameters in the choice box.

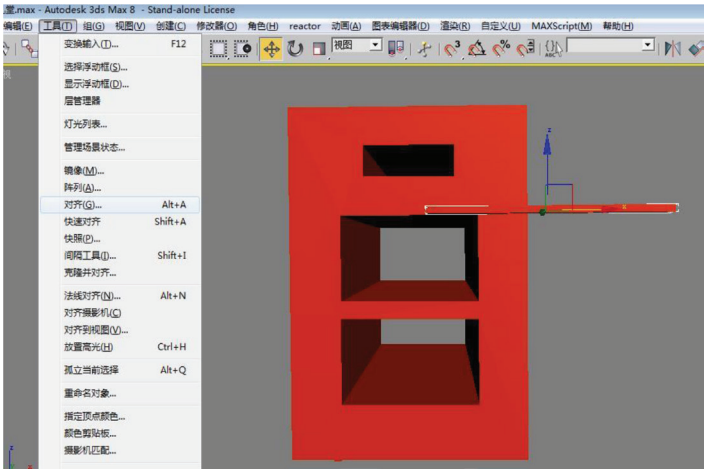

Figure 7 – Alignment Tools

There are plaster decorations on the windows of the campus buildings. Simulation of the plaster decorations cannot be achieved only by piling rectangular blocks and we need to adopt 2D lines. We use the “Detailed connection” tool to increase the number of points on a line when there are arc-shaped bulges in the middle of the line. Then, we select the points on the line and drag them to become an arch. The images shown in the figure are in the opposite direction compared with the images we made, so we use the mirror tool in the menu bar to carry out the instance copy. The next step is to copy the single window decoration, produce many same decorations and arrange them according to a certain order. Finally, we can obtain a set of regular plaster window decorations. Then, we combine all the sets into a group for follow-up production.

- Producing Mappings

① Collecting Mappings

Due to the fact that buildings in the real world have a variety of wall surfaces which may be frosted, coarse or made of bricks, Materials Editor in 3D MAX cannot meet the requirements to create desired effects. Therefore, we use mappings to achieve the wanted results. We use a digital camera to take photos of each teaching buildings on the campus to record the colors and texture of their walls and grass as well as the colors and patterns of their ground bricks. Then, we adjust these digital photos and make them as mapping materials. Sometimes we also search on the Internet for mapping materials when digital photos cannot have the desired effects.

② Identifying Building Materials

First, we select the object whose materials need to be identified in the scene.For example, we select a piece of grasslands and click the “UVW mapping” in the Modifier Menu. Then,

we set the size of the UVW mapping according to the size of the photo. If the size of the grass photo is 1000×1000, fill the same parameters in UVW settings. After that, we press the M button on the keyboard and Material Editor will pop up. Then, we select the material ball and click the Resource Explorer in the Tool Menu. The following step is to open the folder where mappings are supposed to be and select the mappings of the grassland. Then we drag the mappings onto the material ball and click the mapping on the Material Editor. After this, we drag the mappings of the grassland in the Resource Explorer onto the mapping type with the concave-convex feature.Finally,the mappings of the grassland will be lifelike.The mapping effect of the building is shown in Figure 8 below.

Figure 8 – Mapping Effect of the Building

- Producing Buildings'Growth Animation

Buildings' growth animation, using 3D virtual technology, is a dynamic construction process which shows objects grow out of nothing, grow from being a few to many and grow from being sparse to concentrated (Zhang, 2013). For example, from the stage of building its foundations to its completion. It is just like every day you take a photo of a building being built at a fixed place and in the end you make a film out of these photos according to the time order to show its construction process. The process of the film shows the evolution or construction process of the building.

Buildings' growth plug-in developed by the Spotlight Digital Technology, a scientific and technological company, is a very popular plug-in for producing scene growth animation. We run the script through MAXScript in the menu bar. The interface of this plug-in is shown in Figure 9.

There are many command options in the interface which can adjust the growth animation of a building. For instance, growth animation of a building which shows its construction process, movement and rotation can be produced through the following steps. First, we select all the polygons in the building, click the option of "create a group" and name the group "zhishanlou". Since the growth animation is about movement and rotation, the parameters of the plug-in is set as shown in Figure 10.

Then, we click on the "select a group" in the operation panel, select the "zhishanlou" group, check "movement" in the check box and select the "x axis". After that, we set the animation duration to 20, the interval to 5 and the distance to 1000. The next step is to

Figure 9 – The Interface of the Plug-in

Figure 10 – The Parameters in the Plug-in

check “rotation” in the box and select the “x axis”. After setting the animation duration to 20, the interval to 5 and the angle to 90, and clicking on the option “ create” in the panel, we finish producing the growth animation of a building. When we click on the perspective window and play it, we can see the growth animation.

- 3D Campus Animation and Interactivity Settings and Collision Detection

In a virtual scene, users use cameras to carry out real- time interaction with the objects in the scene. The video cameras used in 3D Max are more powerful than the ones used in our daily life. For example, 3D Max cameras can replace lenses in a very short time. Besides, the function of stepless zoom cannot be matched by any cameras in real life (Xu, 2012). By setting the camera tracks of 3D Max, we achieve animation effects. By moving along a track, rotating, changing focal length or changing visual angles, cameras can simulate the campus roaming animation. After setting the track, we click on the perspective window and play the animation.If the desired effects are not achieved, we can delete the previous camera tracks and set new ones.

In order to give users a lifelike roaming experience, the roaming system must be able to detect collisions and make immediate response when users run into a building, which will avoid "walking through walls" (Han, 2016). The particle collision detection included in 3D Max can easily carry out some basic detection.

- Outputting Animation Rendering

After the optimization of building structures, mappings and the whole scene, we can output rendering. At the stage of rendering, we need advanced settings which enable the output to have high-quality images.We can use 3ds Max renderer or other renderer plug-ins. The most frequently used renderers include: V-Ray, Brazil, Mental ray, etc. Please note that we should choose a correct rendering angle. This roaming system includes all the buildings on the campus and there are a large number of objects in 3D MAX. Therefore, it will take a long time to render.

- Post Production

In this stage, we import the finished animation to the Premiere, a software which is used to adjust image colors, connect multiple animations and add suitable transition effects. Then we add appropriate background music and subtitles to enrich the animation.

5. Summary

Virtual reality technology as a new information technology is being widely used by people. However, it is still in the process of development, which means that there are still many technological and application issues yet to be solved. This paper takes the 3D roaming animation of Langfang Teachers University for example and applies 3D MAX technology to the campus information development, hoping to provide users with a general knowledge of the campus landscaping and campus planning of the Langfang teachers University. In the follow-up studies, we will enrich the functions of the roaming system to make it more powerful and able to meet the needs of different users.

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Research on effect of social contact of computer network on interpersonal relationship of student and countermeasures

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Abstract: The undergraduate is one of main receivers and users of many kinds of social contact of computer network. At present, theoretical research concerned with network and interpersonal communication of undergraduate is mainly focused on feature of network society and effect of network on human life and research concerned with social contact of computer network and interpersonal relationship of undergraduate is relatively few. This paper tries to know and understand role and function of social contact of computer network in interpersonal relationship of undergraduate from the perspective of philosophy of science and technology. Take the undergraduate as object of study to investigate current usage situation of social contact of computer network of undergraduate through document literature collection, questionnaire survey and empirical analysis, analyze positive and negative effect of interpersonal relationship of undergraduate under effect of social contact of computer network, and put forward suggestion and strategy regarding to construction of harmonious interpersonal relationship of network of undergraduate.

Keywords: Network media, Political education, Acceptance effect of ideological.

1. Introduction

According to investigation report of China Internet Network Information Center (CNNIC) in January of 2012, as of December 2011, net citizen of which age group is between 20-29 years old in the group surfing the Internet within China has occupied 29.8% of total net citizen quantity, with the highest Internet penetration and usage rate among each age group, up to 72.9% (Martin and Dowson, 2009). Analyze from occupation perspective, student is the group with largest scale in net citizen, occupying 30.2%. Seen from educational level, Internet usage rate of group with junior college education background and education background higher than that reaches to 96.1% (Ma and Yuen, 2009). Above data reflects that Internet usage frequency of university students is the highest with the most people, and university students become one of main receivers and users of many kinds of social contact of computer network. Therefore, social contact of computer network will affect interpersonal relationship of undergraduate necessarily (Aidoo, 2012).

Seen from the doctrine of contradiction analysis method that everything has two aspects, on the one hand, social contact of computer network infinitely increases existence value of undergraduate, and it can relieve mental tension of daily learning of student, gush repression and dissatisfaction in the heart, and release studying burden and emotion pressure (Lai and Gwung, 2013). Social contact of computer network has many features, such as stealthiest, indirectness, over-timeliness, and convenience, providing a brand-new interpersonal association way and means for undergraduate, and providing an approach for expression of emotion and catharsis. On the other hand, when it is confirmed that social contact of computer network brings positive role to interpersonal relationship of undergraduate, we shall see its impact on healthy affective development and interpersonal relationship of undergraduate, and negative effects leading to appearance of a series of interpersonal obstacle problem of undergraduate (Ridwan et al., 2011). To reduce and avoid adverse effect of social contact communication of computer network on interpersonal relationship of undergraduate, and to reasonably use various social contacts of computer network to construct harmonious interpersonal relationship of undergraduate, it is necessary to strengthen research on social contact of computer network and its effect on interpersonal relationship of undergraduate.

This paper tries to know and understand role and function of social contact of computer network in interpersonal relationship of undergraduate from the perspective of philosophy of science and technology (Brok, 2012). Starting from feature, development and current usage situation of social contact of computer network, analyze formation and development tendency of social contact of computer network, explore science, technology and society factor of appearance of social contact of computer network and current usage situation of undergraduate, and describe favorable influence brought by social contact of computer network, and analyze adverse factor to interpersonal relationship of undergraduate under the effect of social contact of computer network, and put forward necessity to construct harmonious interpersonal relationship of undergraduate and give countermeasure and suggestion (Lynley and Avi, 2008).

2. Main features of interpersonal relationship of undergraduate under the effect of social contact of computer network

2.1. Openness and universality

Social contact of computer network provides an open platform for daily life communication of undergraduate. Everyone can take part in it and performs presentation (Lacy, 1978). Presentation content and way are various, being wide and open. Platform established through social contact tool closely connects ordinary people with surrounding people, which makes it possible that everyone can be known and attended by others, so as to improve the extensibility of network communication (Perry et al., 2009).

2.2. Equality and independence

In the process of using social contact of computer network to perform interpersonal communication, contact subject ignores grade, identity, status and gender difference,

which shows equality feature (Halawah, 2006). Usage of social contact tool is independent, and people can take themselves as center, showing themselves freely. The equality and independence can temporarily cover disadvantage and shortage of contact subject, so they can get rid of various contradictions easily occurring in real communication and status hierarchy difference, and pressure of public opinion and communication constraint can be decreased (Pacoe et al., 1976).

2.3. Over-timeliness and globalization

Social contact of computer network breaks time and space limitation restricting communication, and people can perform instant communication through social contact of computer network, which gets rid of limitation of necessary direct communication in real interpersonal relationship, and embodies advantage of over-timeliness (Sibel et al., 2010). At the same time, social contact of computer network breaks restrictions between territory and area of country, really realizing mutual communication within the global range, which embodies globalization feature.

3. Status analysis on the undergraduate using social contact of computer network

To better know and master usage condition of social contact of computer network of undergraduate, this paper mainly adopts empirical research method, and questionnaire survey is performed by taking sample from 7 colleges and universities chosen in Chengdu City. Total 1200 questionnaires are issued in the survey and 1128 copies are returned with 94.0% return rate, of which there are 1065 effective questionnaires with 94.4% effective rate. After questionnaires collected and returned are verified, digital coding will be performed and it will be recorded to computer. Adopt statistical software SPSS17.0 to perform statistical analysis (Tschannen et al., 2006). Through statistical analysis to effective questionnaires returned, basic usage condition of social contact of computer network of undergraduate is reflected in a degree.

3.1. Purpose of using social contact of computer network

Survey data shows that the purpose of choosing to use social contact of computer network by 79.8% undergraduate is to contact with friend and schoolmate conveniently, and 49.7% shows that they want to know more friends; 57.6% undergraduate regards social contact of computer network as an approach to gain information, and 14.5% thinks that using social contact of computer network is a symbol of fashion; 47.5% undergraduate shows that they can relax themselves and dispel pressure through social contact of computer network, and 21.3% thinks that using social contact of computer network can meet mentality requirement, and 45.3% undergraduate shows that reason of using social contact of computer network is just because of boredom and the purpose is to kill the time (Taub and Mcewen, 1992). Seen from above content, social contact of computer network is changing communication way of undergraduate indeed. (See Fig.1)

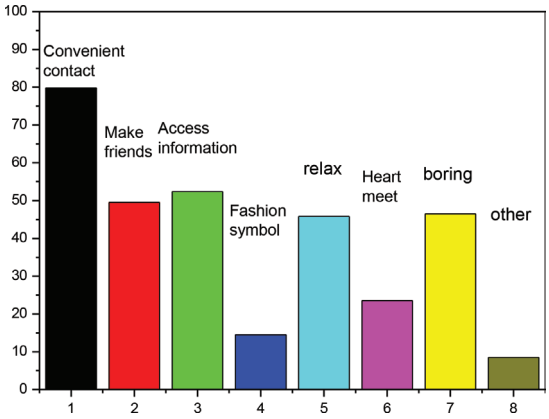

Figure 1 – The intended use of computer network

3.2. Usage frequency of social contact of computer network

In survey of usage frequency of social contact of computer network, there are 452 samples where social contact of computer network is used almost every day in 1065 effective samples, occupying 42.1% of total samples; quantity of sample where social contact of computer network is often used is 405, occupying 37.7% of total samples; proportion of sample where social contact of computer network is occasionally used is 16.6%; and proportion of sample where social contact of computer network is seldom or hardly used respectively is 2.9% and 0.7% (see Table 1). It is also reflected in survey concerned with dependence severity of social contact of computer network, and approximate 83% survey sample shows that dependence to social contact of computer network exists, of which proportion of sample with moderate or more dependence is about 36% (see Table 2).

Frequency	Frequency	Effective percentage	Cumulative percentage
Every day	452	42.5	42.5
Often	405	38.5	78.5
Once in a while	185	16.5	96.6
Very few	35	2.8	99.8
Almost no	8	0.8	100.0

Table 1 – Computer network use frequency table

Degree	Frequency	Effective percentage	Cumulative percentage
Severe	74	6.8	6.8
Moderate	315	28.5	35.6
Mild	545	46.5	85.6
No	185	17.6	100.0

Table 2 – Degree of dependence on computer network

3.3. Depth comparison between social networking and real interpersonal communication

Data shows that topic of communication among undergraduates is often about trivial matters in daily life, respectively occupying 68.7% and 56.5%; then it is communication concerned with learning, proportion of discussing concerned learning content in real communication exceeds 50%, and proportion of this aspect in network communication occupies about 33%; emotion topic also occupies important proportion in the two communication forms, respectively reaching to 49.4% and 31.9%; proportion of communication of game and other topics is nearly equal in social contact of computer network and real communication, occupying about 30% (see Fig.2), which reflects that learning, life and emotion problem are the most frequent topic discussed by undergraduate no matter in real interpersonal communication or in network interpersonal communication. Compared with society, campus life is relatively single, and thought is relatively simple.

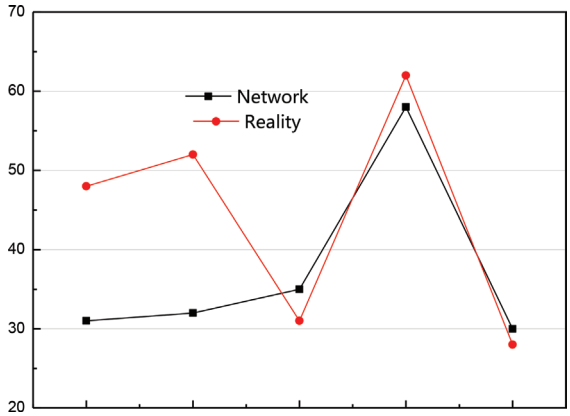

Figure 2 – Social networking and social reality

4. Empirical analysis of effect of social contact of computer network on interpersonal relationship of undergraduate

4.1. Positive effect of social contact of computer network on interpersonal relationship of undergraduate

The most prominent feature of social contact of computer network is its anonymity and equality feature. Everyone can get rid of external and realistic constraint, not signing name and not disclosing real identity, and contacting equally with communicate by choosing identity and way as they like, which brings no pressure and constraint to contact subject in the process of interpersonal communication. Communication process becomes relaxing. Information source share and emotion expression are more widely and sufficiently. Survey data shows that about 88% of respondents agree that sensual experience of network communication is richer; 88.4% of respondents agree that identity of network communication is more changeable and more concealed, which makes communication more open; about 89% of respondents agree that status of network

communication is more equal; 84.2% of respondents agree that it is easier to find the network group with which they would like to communicate in network (Fig.3-Fig.4).

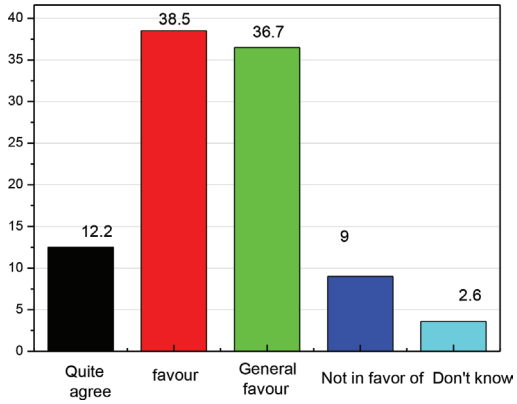

Figure 3 – Whether agree that social networking make communicate more open

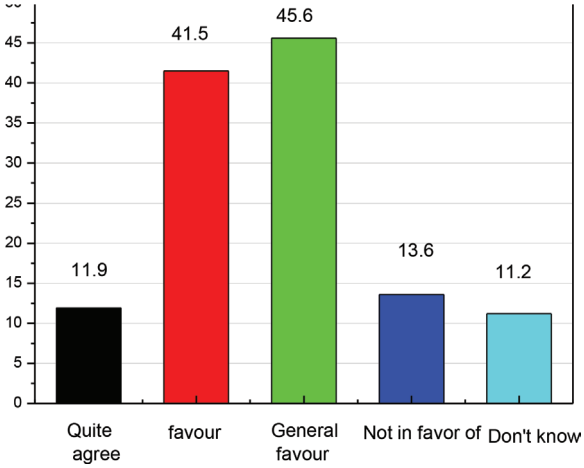

Figure 4 – Whether agree with social networking more equal

In the survey regarding to the topic "whether you agree with the opinion that talking true words with others in network has more sense of security and meets affective interaction requirement more", 78% undergraduate holds relatively agreed attitude (see Fig.5), and the data shows that social contact of computer network helps undergraduate to construct sincere and trusting interpersonal relationship. In real interpersonal communication, undergraduate group is different from student who lives a life with three points and one thread every day at stage of compulsory education, and they live and study in the relatively free environment, with more various and wider requirements in terms of layer and category of interpersonal communication. Therefore they have to face various people every day, which is decided by their interpersonal communication feature.

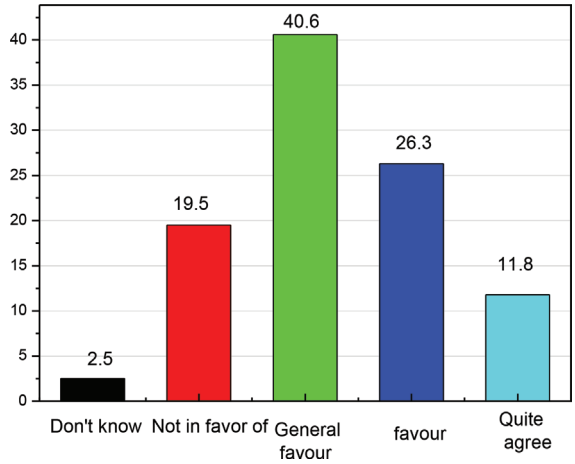

Figure 5 – Whether agree to talk more communication in the network

Social interaction becomes an interpersonal communication with relatively higher purity through social contact of computer network. Undergraduate can choose and change contact object according to his willingness, which changes past contact mode thoroughly, and extends contact space. With the help of social contact of computer network, undergraduate can express their thought incisively and vividly, which makes communication truer and more vivid and student who is relatively diffident and shy can communicate with others confidently. All of these help undergraduate to enlarge communicative language and interpersonal communication skill will be improved finally. Concerned survey data also verifies the viewpoint. In survey concerned with the topic "whether you agree with the opinion that social contact of computer network helps to improve language expression communication ability of undergraduate", about 80% undergraduate agrees with the opinion (see Fig.6).

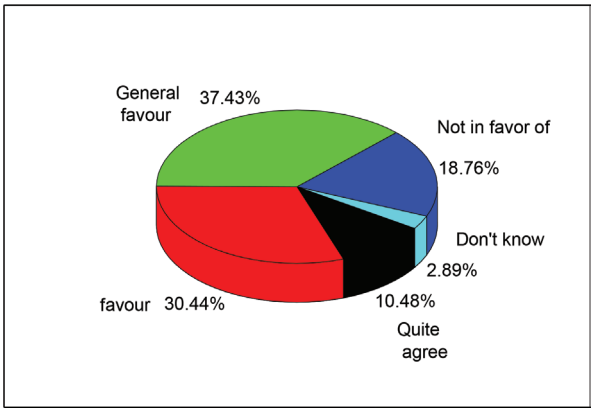

Figure 6 – Whether agree to network communication to improve college students' language competence

4.2. Negative effect of social contact of computer network on interpersonal relationship of undergraduate

On the one hand, over-frequent network communication will lead to decrease of real interpersonal communication time, decreasing and hampering communication time of face to face by undergraduate in a certain degree (see Fig.7). Communicate with others through network where emotional coloring is lacked in long time and lack face-to-face emotional experience, and if things go on like this, the undergraduate will lack patience to real interpersonal communication, which makes real interpersonal communication difficult. On the other hand, if the undergraduate performs over-frequent network communication, they will ignore construction of real interpersonal relationship, which will lead to reclusiveness and repression, and some even show anxiety, force, melancholy, low spirit, interest loss, energy shortage and decreasing self-assessment ability, and interpersonal communication ability will be weakened, making real interpersonal communication difficult.

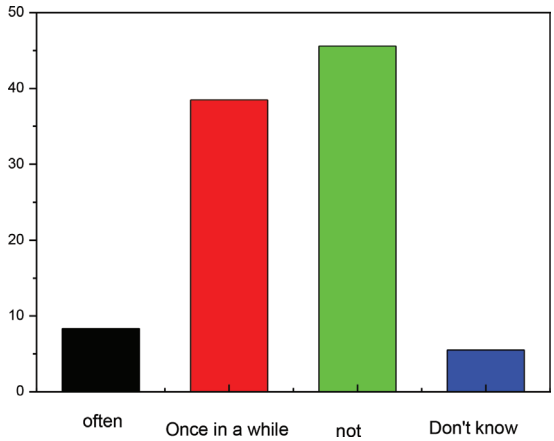

Figure 7 – Whether agree to network communication to reduce the time to meet people

5. Main strategies to scientifically and reasonably make use of social contact of computer network and construct harmonious interpersonal relationship of undergraduate

5.1. Prepare and normalize concerned laws of social contact order of network, and create harmonious social contact environment of network

Combination of self-discipline and heteronomy is the premise of interpersonal communication under network environment, and whether in realistic society and network society, good interpersonal relationship needs improved laws and regulations as guarantee. Legislation is one of main features of the contemporary age. Develop various social network activities within frame of laws, do well in the requirement that there are laws to abide by, laws already enacted must be enforced to the letter, and violators must be brought to justice in social network activities, and truly embody

authority effect of laws in social network, and all of these are of great importance in development of network society of our country. Therefore, only prompting network legislation and strengthening public opinion guidance can create harmonious social network environment, maintains normal interpersonal communication of network society, and promotes healthy development of social contact of computer network.

5.2. Strengthen public opinion guidance and create harmonious social network environment

As guidance of public opinion, media pays more attention to correct, comprehensive and objective report at the present when network society is rapidly developed. As for guidance of media and public opinion, following aspects shall be strengthened: the first aspect is to closely follow pace of times, correctly reflect objective reality and spread mainstream ideology and values; the second aspect is to care for reality and refuse the false, close to life and avoid fickleness, and close to the masses and put an end to the vulgar; the third aspect is to actively promote industry self-discipline, and advocate network civilization series activities. It is certainly not enough to rely on constraint of laws and guidance of media, we shall correctly guide undergraduate to consciously form moral restraint in the process of using social contact of computer network. The whole society shall try together to create healthy public opinion atmosphere and good social network environment for correct usage of social contact of computer network by the undergraduate.

5.3. Construct moral idea and specification having universal meaning for social network by undergraduate

As subject living in the society, the undergraduate needs to follow systematic criterion and mechanism. As criterion to adjust social relations, moral standard plays an irreplaceable social function, and acts as lubricant of interpersonal relationship in a certain degree. Just like basic moral standard in realistic society, network morality adjusts relationship among people and controls behavior of human. We shall insist on mutual assistance principle of morality and laws, pay attention to organic combination between morality influence and legal norm. It is certain that appropriateness shall be noted in legislation of network morality norm. Only when the optimum joint point and penetration of network morality and legal norm are found with hard work can laws and moral standard add radiance and beauty to each other and bring out the best in each other in the maintenance of network society order.

5.4. Cultivate network education management team, and correctly guide interpersonal communication of undergraduate

There shall be a professional network education management team to guide undergraduate to correctly use social contact of computer network. Colleges and universities shall take school (department) as unit, strengthening construction of network education management team, and correctly guiding interpersonal communication of undergraduate. The first is to establish network education management team of school with co-participation of professionals, logistical personnel, psychological guidance teacher, and instructor of class etc. The second is to set concerned learning course, such as network technology, and interpersonal communication etc., which teaches correct

and effective communication means and method to undergraduate. The third is to know the real usage situation of social contact of computer network of student within management range and master usage condition and universal rule.

6. Conclusion

Through research, it is found in this paper that social contact of computer network has positive effect on relieving interpersonal communication pressure of present undergraduate, realizing equal and free interpersonal communication and constructing wider interpersonal communication and improving communication ability. But at the same time, because of incorrect usage of social contact of computer network and other reasons, it has certain negative effect on realization of interpersonal communication and formation of love viewpoint of undergraduate. Therefore, it is important to strengthen government management and support power, actively promote the real-name system of social network, prepare and normalize concerned laws and regulations of social network order, and cultivate credit consciousness of undergraduate, and construct moral idea and specification having universal meaning for social network by undergraduate. Generation of social contact of computer network is the result of continuous evolution and innovation of science and technology of Internet, being extension to real interpersonal communication. Existence of social contact of computer network has many favorable factors for interpersonal relationship development of present undergraduate but its unfavorable development factor cannot be ignored. Therefore, researching effect of social contact of computer network on interpersonal relationship of undergraduate has important practical significance to guide undergraduate to correctly, reasonably and suitably use social contact of computer network, cultivate perfect personality of undergraduate and construct harmonious interpersonal relationship.

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Research on Problems Existed in Political education & ideological education in Colleges and Universities and Countermeasures Based on Computer Network

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Abstract: This paper has analyzed the main problems existed in current computer network ideological education and political education in colleges and universities, found out reasons for the problems and proposed specific countermeasures for current computer network political education & ideological education in colleges and universities through making investigation on current internet use situation of current college students, which is of great theoretical significance and realistic significance for further improving discipline construction of political education & ideological education , enriching and developing Marx's political education & ideological education , strengthening the pertinence and effectiveness of computer network political education & ideological education in colleges and universities as well as providing decision-making reference for the vast majority of workers for political education & ideological education in colleges and universities.

Keywords: political education & ideological education, computer network, colleges education.

1. Introduction

Computer network political education & ideological education in colleges and universities is the marriage between computer network and political education & ideological education, is the inevitable result of modern education technology development and is the innovation of political education & ideological education work under new trend. It is stressed in central file that it needs to "occupy the new position of network political education & ideological education actively", "strengthen the construction of campus network and make network become the main method of carrying forward the main melody and implementing political education & ideological education" (Journell, 2012). Therefore, the development trend of computer network technology, lifeline effect of political education & ideological education as well as the particularity of college students require us to regard the existing problems existed in current political education & ideological education in colleges and universities and its restriction factors in an open mind, fully play the computer network advantages and take active measures to improve

the pertinence and effectiveness of computer network political education & ideological education in colleges and universities (Zhang, 2015). Therefore, for college students with active thoughts, how to make full use of the flexible computer network education mode and increase the attraction and appeal of political education & ideological education work in colleges and universities is important subject that the vast majority of workers for political education & ideological education in colleges and universities to solve urgently.

2. Current situation of computer network political education & ideological education in colleges and universities

Computer network is playing a more and more important role in the study and life of contemporary college students, which is not only an important source and channel for college students to attain knowledge and information, but also becomes a main venue for them to express thought freely and make emotional communications gradually. We have become the country connecting international internet and opened up the new situation for political education & ideological education work in computer network era. In view of the development situation of recent decades, especially the computer network political education & ideological education work in colleges and universities, it mainly experienced three stages (Baumgartner & Morris, 2010). The first stage is from 1985 to 1995, which is passive adaption stage taking spontaneous exploration at grassroots level as feature, the second stage is from 1995 to 2005, which is active challenge stage taking the construction of various "red websites" as the feature and the third stage is from 2005 to 2015, which is conscious depth stage taking the development of integrated computer network community as the feature. In view of the situation of some colleges and universities at present, the pattern of computer network ideological education work has been formed basically, which can be summarized into three aspects generally: first is to base on spontaneously formed and spontaneously constructed two kinds of computer network positions, second is to coordinate two teams of ideological and political work and computer network technology, third is to implement into two tasks of construction and management (Lin et al., 2008). In view of the working conditions of each college and university, political education & ideological education network work mainly starts from following three aspects: first, set up theme website, transfer the main content of political education & ideological education to internet; second, open principle mail box and make the senior leaders of school understand the thought dynamic of students directly and even make direct dialogue with students; third, adopt information security technology, restrict the publish of bad information and prevent bad information entering into campus.

Till today, all our colleges and universities have established own local area network basically and college students can study, communicate and entertain online in library, open laboratory and even in dormitory (Zan and Aalberg, 2011). For the ideological and political work in colleges and universities, on one hand, the development of information computer network provides modern means for implementing the ideological and political work at school, expanding space and channel, on the other hand, brings about new tasks and new problems for ideological and political work at school (Errante, 2009). Zemin Jiang has pointed out in the national conference of ministers of propaganda

held in 2005 that "it needs to pay high attention to the propaganda of public opinion of internet, develop actively, make full application, strengthen management, drawn on the advantages and avoid disadvantages, strengthen the influence and fighting force of online propaganda continuously and make it become the new position for ideological and political work and new channel for external propaganda."

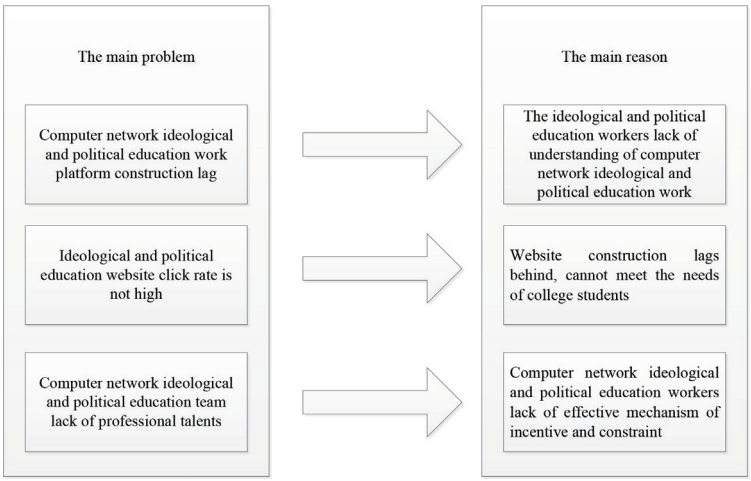

Figure 1 – Main problems of computer network in colleges and universities political education & ideological education and the reasons

In 2009, Ministry of Education has published "some suggestions on strengthening political education & ideological education of higher education and proceed computer network work", which plays a strong guidance and promotion role for our political education & ideological education in colleges and universities to make computer network work (Petersen and Aarøe, 2013). At present, a lot of colleges and universities have established own theme website, made some computer network management methods and implementation details and tried to use computer network to make political education & ideological education for students.

3. Main problems existed in computer network political education & ideological education in colleges and universities and the reasons

3.1. Main problems existed in computer network political education & ideological education in colleges and universities

1. Backwardness in the construction of computer network political education & ideological education work platform

   The website management for schools with theme website for political education & ideological education is very easy and they only need to publish the big national

events and related current policy online, while they do not care whether they are people clicking at all; nobody cares about whether this kind of network political education & ideological education method is effective.

2. Low click rate for political education & ideological education website

   At present, colleges and universities have made some explorations for computer network political education & ideological education work, but it is not satisfactory in general and some practical problems are difficult to solve. First, most of political education & ideological education websites are with problems of low click rate and low visit rate (Górecki, 2011). For some schools with over twenty thousand students, the daily visit of political education & ideological education website is less than 100; most of those visitors are only for checking materials for related research, there are few people click actively usually and the function of political education & ideological education website is difficult to play. Second, it is easy to open principle mailbox but difficult to manage well. Principles of colleges and universities are usually busy with office work and have to deal with a lot of things every day, so it is not realistic to ask the principle to check each mail in the mailbox (Zhang, 2015). Therefore, most of colleges and universities assign people to take care of the mailbox of principle and only the very important opinion confirmed by the person in charge will be reported to the principle. This kind of behavior is workable, but people think that there is no big difference between principle mailbox and the principle mailbox made of wood, the enthusiasm of college students of writing email to principle has been affected. Therefore, logically speaking, the "firewall" constructed by computer network information security technology can't fully prevent the entry of bad information, which has increase the difficulty for computer network political education & ideological education.

3. The computer network political education & ideological education team lacks professional talents

   At present, colleges and universities have taken some measures, for example, make computer network technology training for political education & ideological education workers or select outstanding personnel from teachers and cadres who master computer network technology to strengthen the instructor team, but this is only temporary measure. There are a lot of aspects need to study for how to ensure the stability and long term of team construction and cultivate professional talents understanding both computer network technology and solid political education & ideological education theory and practical experience (Williamson, 2008).

3.2. Reasons analysis

1. Political education & ideological education workers have inadequate understanding of computer network political education & ideological education work

Colleges and universities can't master the development features and law of development of computer network technology comprehensively and correctly while implementing computer network political education & ideological education among students, they do not have comprehensive and systematic scientific planning for the position, team, system, mechanism, working method and investment etc. of computer network political education & ideological education and they let each department "act of own free will", breaking up the education resource into parts. They do not make full and effective integration for computer network political education & ideological education resource and can't form into force. When construct campus network, the direction and thought are not clear and strength is not enough for how to make functional positioning for school network, implement creative computer network ideological and political work and play the important role of campus network in the growth of college students.

2. Backward website construction can't meet the requirements of college students

   Campus computer network construction is uneven and student visit rate is low, with shortages of inadequate content, slow update, dull form, boring language, weak interaction and poor production etc. According to one computer network investigation carried by Huazhong University of Science & Technology, 91% students believe that campus network "has few personalized service", 88% students believe that "webpage is not vivid", 72% students believe that "content update is slow", 85% students are reluctant to visit once they see the name of political education & ideological education etc. and 79% students think that it disconnects with classroom education. For the content of campus network in most of colleges and universities, it only pays attention to scores but not problems, big and empty with strong preaching; it does not know how to make effective instillation in guidance and puts more emphasis on the promotion of political theory knowledge, while there are less contents related to the professional study, psychological consultation, employment guidance, interest and hobbies as well as recreation and entertainment for college students (Siham et al., 2012). Even there are some columns, but the content is old and lack of systematic and scientific content; there are even less contents with deep thought and can touch the soul of students. After students checking some material on this kind of website, they are not interested in it and will leave at once as it can't arouse their ideological resonance.

3. Computer network political education & ideological education workers lack effective incentive and restraint mechanism

   The work effect of instructor in implementing student political education & ideological education is not included in annual assessment for evaluate and not connected with promotion; it lacks effective incentive and restraint mechanism for the backbone strength of instructors who implement student ideological and political work, which directly causes the weak enthusiasm of instructor for computer network political education & ideological education work and restrict the effectiveness of computer network political education & ideological education work.

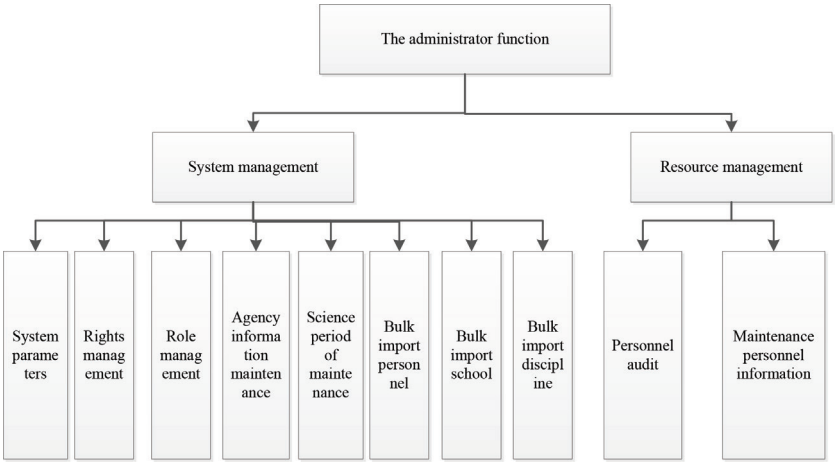

Figure 2 – system administrators to political education & ideological education

4. Research on the countermeasures for computer network political education & ideological education in colleges and universities

4.1. Strengthen the understanding and set up strategic consciousness for computer network political education & ideological education in colleges and universities

Realizing computer network for college student ideological and political work is ideological education adapting to the need of social development, is an effective method of strengthening the education for "online generation" and is the inevitable demand for the innovation and development of ideological and political work in new period, which is of great significance for helping college students to set up correct world outlook, outlook on life and values, confirming socialist path with Chinese characteristics under the leadership of Communist Party of China and realizing the common ideal and firm belief of the great rejuvenation of the Chinese nation(Fair et al., 2015). It is an urgent task in front of political education & ideological education workers during new period to adapt the new method of computer network communication and seize the commanding heights of online publicity education. Political education & ideological education workers in colleges and universities should strengthen the strategic consciousness of computer network political education & ideological education , strengthen sense of mission and sense of urgency, take the construction for the college student political education & ideological education theme website as the important project for school information construction and political education & ideological education work, change closed and static thinking into open and dynamic thinking, get rid of the stale and take in the fresh, committed to reform and make bold innovation. Colleges and universities need to use correct, positive and healthy thought, culture and information to occupy computer network position, prevent some people making use of computer network to spread

wrong thought and information and it needs to strengthen the leadership and guidance of computer network work for political education & ideological education and construct new platform for computer network political education & ideological education . It needs to include computer network work with political education & ideological education into the overall plan of campus computer network construction and also include computer network culture into the overall pattern of campus culture construction to make plan and deployment (Zápotočná, 2012). According to the features of computer network technology as well as the demand of ideological and political work for computer network work, establish corresponding leadership and management system. At the same time, organize scholars actively to implement ideological and political work and make research on computer network, clarify direction, clear up the thoughts, make deep research and comprehensive planning for position construction, team construction, system construction, operation mechanism, working method and expense investment of computer network ideological and political work and make overall deployment for well promoting computer network ideological and political work (Lancet, 1996).

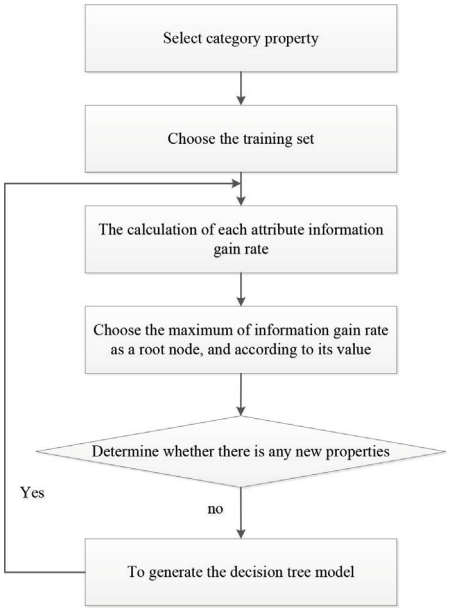

Figure 3 – The working process of the decision tree of ideological education computer system

4.2. Insist on educating people with service and strengthen the website construction for computer network political education & ideological education comprehensively

1. Set up campus network

   Set up website according to the needs of students in study, life and amusement etc, we will make whatever students need and upload the content that students want to hear, want to watch and want to make clear on website. Put emphasis

on constructing comprehensive student information service platform with wide content radiation, strong service and wide range of audience. It can be composed of seven service platforms, the first is learning service platform, providing reference material for political education & ideological education as well as professional theoretical study; the second is life service platform, providing logistics service information such as healthy life counseling material, work study, student loan and life management etc; the third is employment service platform, establishing employment information database and provide comprehensive employment service information; the fourth is psychological health service platform, providing mental health information and psychological counseling service etc. and helping students to solve the problems in study and life practically; The fifth is skills training service platform, provide systematic discipline knowledge through computer network teaching, supplement the shortages of classroom teaching with adoption of the rich network information and strong comprehensive strength and satisfy the demand of students for education and employment and improve the click rate of computer network. The sixth is activity service platform, which provides sites for class activities, community activities and social practice activities and enables students with a space for playing personalities and presenting themselves. The seventh is entertainment service platform, which sets up electronic forum, online communication, chatting room and student reunion etc, providing service for the communications between school leaders and students, between teachers and students and between students(Waddington, 2015). These seven service platforms can make interactions, involving various aspects for students, including thought, study, life, communication, friendship, love, morality, ideals, occupation and future etc.

2. Build up political education & ideological education theme website

   For the features that college students are eager to know new information and combining the hot topics of development of political situation, international situation change and graduation policy and so on that they care about, each college and university should strengthen the platform construction for computer network political education & ideological education and set up theme website for political education & ideological education (Zapata et al., 2014). Each school also needs to set up political education & ideological education theme website with school characteristics. Make organic combination of the variety of forms and interest of content with adoption of the material downloaded from public information website and internet, make promotion text with graphics and colors, accept the visit and browse of students or send to students in email, publicize current international and domestic current affairs, central policy, foreign affairs issue, national laws and school disciplines and advanced model etc and form good public opinion atmosphere and correct direction.

3. Build up “two courses” teaching website

   “Two Courses” is the main channel and main position to make systematic political education & ideological education for college students. Trying online

"two courses" teaching is to provide detailed contents and various reference materials of courses online and change the course content structure from linear design to network design. This design can present main knowledge and organic connection of courses clearly and provide a relatively complete and systematic knowledge framework for learners, which is not only good for teachers to update the course content, but also good for students to make independent and selective learning. At the same time, set up corresponding moral resource information database and upload books and related materials of leaders, so that the students can read and download at any time, expand and sublimate course content, which is good for student to make inquiry learning.

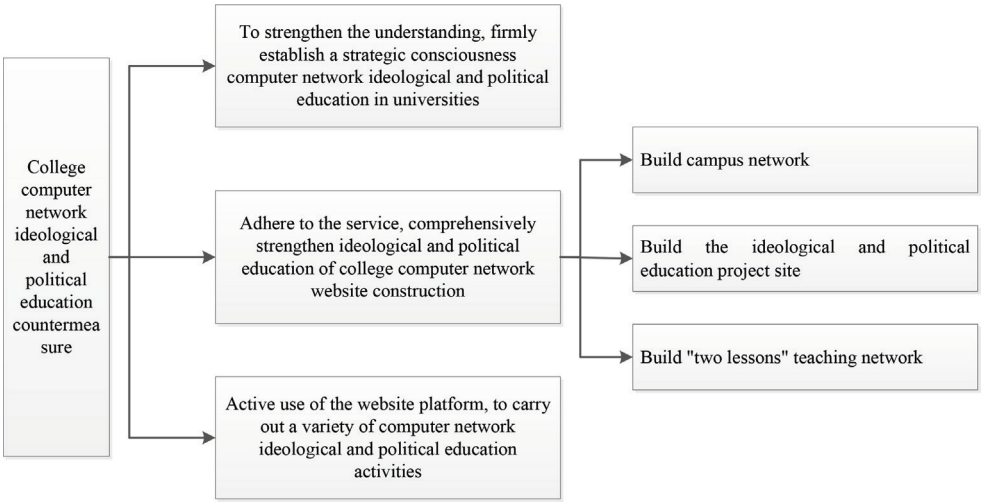

Figure 4 – College computer network political education & ideological education countermeasure

4.3. Make use of website platform actively and implement colorful computer network political education & ideological education activities

Forum is a site where students can express own opinions on national affairs and social hot spots. The perspectives, opinions and views in forum can reflect the ideological of students accurately and improve the pertinence of computer network political education & ideological education. Internet is "Information Ocean", how to find information closely related to the study and life of college students is the problem that the vast majority of political education & ideological education workers must face. For this, it can implement online investigation and understand the thought dynamic, psychological situation, behavioral features and moral conditions of college students with the highest efficiency, as is shown in Figure 4.

5. Conclusions

This paper has analyzed the main problems existed in current computer network political education & ideological education in colleges and universities and found out reasons for

the problems through making investigation on current internet use situation of current college students:

1. Political education & ideological education workers have inadequate understanding of computer network political education & ideological education work;
2. The website construction is backward and can't meet the demand of college students;
3. Computer network political education & ideological education workers lack effective incentive and restraint mechanism.

On this basis, specific countermeasures have been proposed for computer network political education & ideological education in colleges and universities:

1. Strengthen understanding and set up strategic consciousness of computer network political education & ideological education in colleges and universities
2. Insist on educating people with service and strengthen website construction for computer network political education & ideological education in colleges and universities comprehensively

This has provided decision-making reference for further improving discipline construction of political education & ideological education, enriching and developing Marx's political education & ideological education, strengthening the pertinence and effectiveness of computer network political education & ideological education in colleges and universities as well as the vast majority of workers for political education & ideological education in colleges and universities.

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Research on the Spatial Pattern Evolution of the Inclusive Development of Jiangxi Province's New Urbanization from the Ecological Environment Perspective—Spatial econometrics analysis based on provincial panel data

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Abstract: The core concepts of the new urbanization's inclusive development lie in the harmonious co-existence between humans and the environment. The environmental influences brought by the urbanization process have become increasingly severe. To research the new urbanization spatial pattern's evolving tendency in the ecological environment and analyze the influences of the ecological environment on the spatial environment, this paper especially sets up the comprehensive evaluation index system for the new urbanization's inclusive development in the ecological environment and adopts the entropy method to measure the inclusive development levels of eleven cities' new urbanization in Jiangxi between 2005 and 2014. It also carries out a deep analysis of the spatial pattern's evolution process. Meanwhile, this paper also selects Moran'sI index to carry out the spatial auto-correlation testing. It respectively selects influence factor variables from the economic, social, environment and social security levels. With the spatial econometric model, it analyzes the influence factors of the spatial pattern evolution. This paper has obtained such conclusions: The inclusive development of Jiangxi Province's new urbanization represents a high-level aggregated distribution, and there exists a tendency that high-level regions are spreading to low-level regions; besides, the spatial pattern of the new urbanization's inclusive development is greatly influenced by the ecological environment and the regions that have a good ecological environment also enjoy a high level of inclusive development.

Keywords: new urbanization; ecological environment; inclusive development; spatial pattern

1. Introduction

With the stable improvement of the national economy, Chinese urbanization has obtained huge achievements after years' development. In 2013, Chinese urbanization rate reached 53.7% and increased by 35.78% compared with that of 1978, with an annual increase of 1.02%. The urbanization's development is also the developmental process of constantly breaking the urban-rural dual structure, eliminating the urban-rural disparity and achieving the urban-rural integrated development. Chinese current urbanization level is in the phase of fast development. Both the urbanization scale or the urbanization speed have achieved a certain degree (He and Liang, 2015). However, many problems have also occurred in the process of fast promoting urbanization. Firstly, the population's large aggregation into the city causes the increase of load and pressure to cities, which are specifically represented in the lacking professional skills of populations who migrate from rural areas, the constraints in urban living space ad the imperfection of the medical industry, education and other living security systems. Secondly, the constant expansion of energy consumption and environmental pollution problems become increasingly prominent. The same as the modernization process of advanced countries, the Chinese urbanization also has the characteristics of high energy consumption and high discharge. The traditional urbanization development mode adopts the path of first pollution and then treatment, which also causes the severe resource and environmental pressure faced by China. In 2012, the Central Economic Working Conference pointed out: It is necessary to incorporate the ecological civilization concept and principle into the whole process of urbanization and follow the path of intensive, green and low-carbon new urbanization path (Ma, 2016; Puello, 2016).

According to the *National New Urbanized Planning 2014-2020* proposed by the government, Chinese urbanization needs to follow a new urbanization path that is oriented on people, have synchronized four modernization, optimized pattern, ecological civilization and cultural inheritance, as well as Chinese characteristics. This plan's accentuated priority has shifted from focusing on the city's own development to the urbanized direction that humans and the environment coexist harmoniously (The Chinese Central Government, 2014). The concept of the inclusive development derives from the inclusive development. It was first proposed by the Asian Development Bank in 2007 and was written into the 2020 Strategic Development Framework by international organizations, such as EU (Guan and Tong, 2015). The inclusive growth seeks the sustainable development and coordinated development of the economy, society and environment. Contrary to simply pursuing economic growth, the inclusive growth promotes the growth of equal opportunities. The basic meaning is the urbanization development should adapt to the ecological environment and promote the new urbanization's development based on the precondition of not damaging the ecological environment. However, faced with the left-behind problem that the ecological environment is destructed in the traditional urbanization's development model, it is necessary to follow the inclusive development path whose precondition is to protect the ecological environment. This is also the necessary path for the new urbanization's development.

With the constant promotion of the urbanization process, domestic and foreign scholars have currently carried researches on the spatial pattern evolution of urbanization. In the medium-to-late phase of the last century, Australian scholar Moran proposed the Moran

index and used it in the testing of spatial auto-correlation (Moran, 1948). Getis proposed the spatial auto-correlation index based on the spatial auto-correlation distance and further promoted the development of the partial space's auto-correlation (Grtis, 1992). Qin Jia analyzed the data of the sixth national population census's data and thought there were significant spatial differences in Chinese population urbanization levels, which represent the spatial pattern of "being low in the west and high in the east" (Qin and Li, 2013). Li Bo carried out a spatial auto-correlation difference analysis of 28 prefecture-level cities' urbanization in the central plain's economic districts, and revealed the spatial heterogeneity of the urbanization level (Li and Zhang, 2013). Hu Hao and Wei Houkai started from the overall situation and spatial pattern of the urbanization in western regions and adopted the qualitative analysis & quantitative analysis to carry out deep analysis of the urbanization development in western regions and problems existing in it (Hu and Wei, 2015).

In conclusion, domestic and foreign scholars have carried out researches on the urbanization's spatial pattern evolution. In the current big context of inclusive development, the new urbanization's spatial pattern should shift from traditional economic and social indexes to the ecological environmental index measurement. Therefore, this paper carries out researches on the new urbanization's spatial pattern of Jiangxi Province's inclusive development under the ecological environment on the basis of the new urbanization level comprehensive evaluation index system that includes inclusive developmental indexes. It also establishes the motivation factors of the spatial econometric model on the spatial pattern and provides a theoretical basis and practical guidance for the ecological environment's new urbanization path.

2. Research Methods and spatial econometric model

2.1. Entropy Method

The entropy method is an objective weighting method, which determines the index's weighted value according to the information value provided by various indexes' observed values. Supposing there are m plans to be evaluated and n evaluation indexes, which have formed the primitive index matrix $X=(x_{ij})_{m\times n}$. For a certain index x_j, the bigger the difference from the index value x_{ij}, the bigger the role played by this index in the comprehensive evaluation (Yang, 2015). The procedures of calculating index weighted values based on the entropy value method are as the follows:

Standardized processing of data

1. Positive index's standardized formula:

$$x'_{ij}=\frac{x_{ij}-\min\{x_j\}}{\max\{x_j\}-\min\{x_j\}},i=1,2,L,n,j=1,2,L,m \tag{1}$$

2. Negative index's standardized formula:

$$x'_{ij}=\frac{\max\{x_j\}-x_{ij}}{\max\{x_j\}-\min\{x_j\}},i=1,2,L,n,j=1,2,L,m \tag{2}$$

Calculate the proportion of the j index in the Year i to this index's values of past years

$$P_{ij} = \frac{X_{ij}}{\sum_{i=1}^{n} X_{ij}} (i = 1,2,L,n, j = 1,2,L,m) \tag{3}$$

Calculate the entropy value of the j index

$$e_j = -k \sum_{i=1}^{n} P_{ij} \ln(P_{ij}) \tag{4}$$

In the formula $k > 0$, and make $k = 1/\ln(m)$.
Calculate the variation coefficient of the j index

$$g_j = 1 - e_j \tag{5}$$

Calculate the weighted value of the j index

$$W_j = \frac{g_j}{\sum_{j=1}^{m} g_i} (j = 1,2,L,m) \tag{6}$$

Calculate the new urbanization level index of the year i

$$S_i = \sum_{j=1}^{m} W_j P_{ij} \tag{7}$$

2.2. Spatial auto-correlation testing

The traditional spatial data analysis method is set up based on the mutual independence of the observed values. Therefore, it is necessary to select the correct statistical amount to analyze the spatial auto-correlation according to the different types of the spatial data's observed values. According to the spatial patterns of 11 prefecture-level cities in Jiangxi, select the Moran'sI index that has the widest application. The calculation formula is as follows:

$$\text{Moran'sI} = \frac{\sum_{i=1}^{n} \sum_{j=m}^{n} w_{ij} (x_i - \overline{x})(x_j - \overline{x})}{S^2 \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}} \tag{8}$$

In the formulate, The index value's range is [-1,1]. When the value I is near 1, it means the similar observed values of similar regions tend to aggregate in space and represents positive spatial auto-correlation; when I is near -1, it means the observed values of

two similar regions are in scattered distribution and represent negative spatial auto-correlation; when I is equal to 0, the observed value is in an independent distribution.

2.3. Select the spatial econometric model

Considering that a certain region's urbanization level may be influenced by other regions in terms of the spatial position, this paper selects the SLM to discuss whether the explained variable in one region suffers the influences of the explained variables in surrounding region (Wang and Song, 2014).

$$Y_t = \pm + \acute{A}WY + {}^{2}X + \mu \tag{9}$$

When a certain region's explained variable is not only influenced by surrounding regions' explained variables and also suffer the influences of the explain variables in surrounding regions, namely the explain variable's lagged term is added on the basis of the spatial auto-regression model, which formes the SDM.

$$Y = \pm + \acute{A}WY + {}^{2}X + {}_{\grave{}}WX + \mu$$

In the formula, *WX* means the spatial lagged variable of the explain variable of the adjacent region; *è* is the explain variable's spatial lagged coefficient.

3. Analysis of the new urbanization spatial pattern evolution based on inclusive development

3.1. Set up the evaluation index system

This paper following the principle that the evaluation is scientific, comprehensive, comparable and the data is obtainable, this paper constructs the new urbanization level evaluation index system that is based on inclusion. as is shown in Table 1.

Calculate the new urbanization level index

Following the calculating procedures of the entropy value method, the new urbanization level indexes of 2005, 2008, 2011 and 2014 are respectively calculated (see Table 2). Through these indexes, this paper analyzes the new urbanization spatial pattern evolution of Jiangxi's inclusive development between 2005 and 2014.

Seen from Table 2, Jiangxi new urbanization development is not only represented in the improvement of the economic level, but also in the establishment and improvement of the urban ecological system. Jiangxi Province's urbanization spatial pattern, this paper inputs each city's new urbanization inclusive development level indexes and the whole province's average value into the database as attributive data. With the ArcGIS10.2 software, and respectively formulates the new urbanization inclusive developmental level's maps in 2005, 2008, 2011 and 2014(Figure 1).

Criterion Layer	Index Layer	Weighted Value
Economic Development	GDP per capita (yuan)	0.023
	Proportion of the tertiary industry to GDP (%)	0.036
	Financing expenditures per capita (Yuan)	0.017
	Fixed asset investment (Yuan)	0.012
	Land yield rate (%)	0.041
Social Development	Social insurance coverage (%)	0.022
	Urban registration unemployment (%)	0.045
	Living area per capita (m2)	0.031
	Book held by every one thousand people (copy)	0.012
	Hospital bed owned by every one thousand people (one)	0.014
	Road density (km/km2)	0.010
	Average education year (Year)	0.047
Placement of migrating population	Urbanized migration rate of migrating population (%)	0.055
	Urbanized employment rate of migrating population (%)	0.051
		0.054
	Proportion of migrating population's children absorbed by migrating population	0.043
	Coverage rates of elderly care, medical, unemployment and other socials securities (%)	0.059
Ecological environment	Greenland area constructed by every one thousand people (m2)	0.058
	Greenery coverage rate (%)	0.087
	Electricity consumed per unit of GDP (degree)	0.071
	Annual number of days with excellent air in the city (day)	0.071
	Discharge standard rate of industrial water(%)	0.052
	Industrial SO2 processing rate (%)	0.059

Table 1 – New urbanization level's comprehensive evaluation index system based on inclusive development 3.2. Empirical analysis of the spatial pattern evolution

Prefecture City	Y 2005	Y 2008	Y 2011	Y 2014
Nanchang	0.711	0.714	0.720	0.751
Jiujiang	0.609	0.631	0.657	0.683
Shangrao	0.524	0.547	0.590	0.601
Fuzhou	0.519	0.521	0.572	0.583
Yichun	0.403	0.447	0.496	0.589
Ji'an	0.579	0.589	0.591	0.621
Zhangzhou	0.615	0.623	0.675	0.746
Jingdezhen	0.487	0.495	0.524	0.613
Pingxiang	0.419	0.423	0.446	0.534
Xinyu	0.537	0.567	0.591	0.608
Yingtan	0.495	0.512	0.537	0.549

Table 2 – Inclusive developmental level indexes of 11 prefecture-level cities' new urbanization inclusive development under the ecological environment perspective

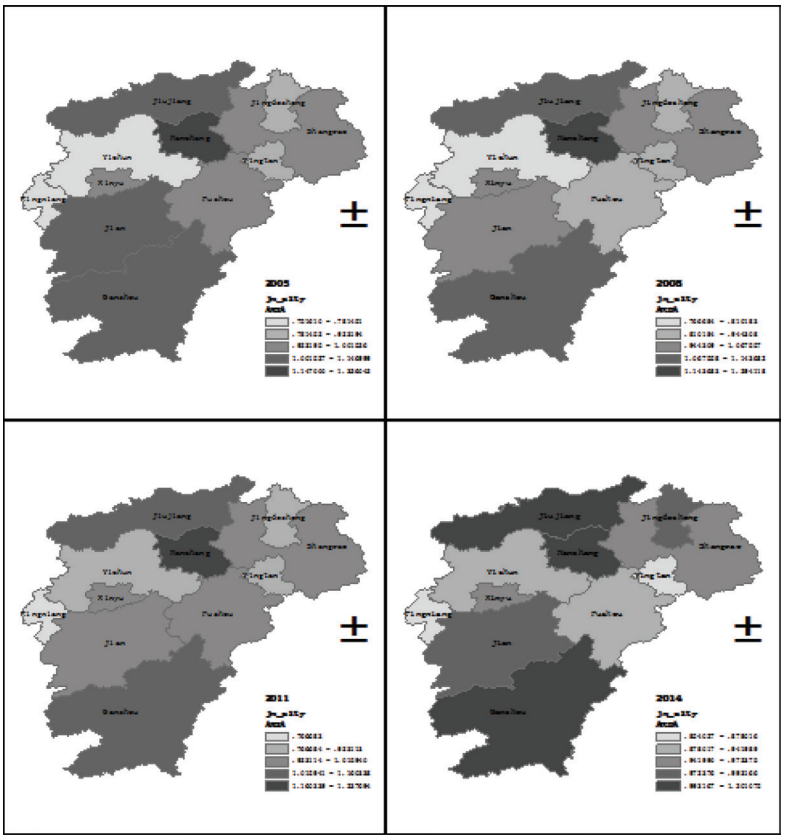

Figure 1 – New development level of the new urbanization of eleven prefecture-cities in Jiangxi Province in different months from the ecological environment perspective

Seen from Figure 1, the regions that had a high level of new urbanization's inclusive development in 2005 included Nanchang, Jiujiang, Ji'an and Zhangzhou cities; the prefecture-level cities that had a medium level included Fuzhou, Xinyu and Shangrao, while the prefecture cities that have lower levels included Jingdezhen, Yingtan, Yichun and Pinxiang. In 2014, the spatial pattern of Jiangxi's new urbanization inclusive development were polarized in the south and north: The northern region is the high-level district whose cores include Nanchang and Jiujiang cities; the southern region is the high-level district whose core is Zhangzhou. This is also benefited from the support of Nanchang-Jiuzhang integration, the invigorating of Zhangzhou, Nanzhou and Suzhou regions, as well as relevant policies. However, it can be seen that the new urbanization inclusive development levels of Pingxiang and Yingtan cities are low. Seen from the whole province, developmental differences still have the tendency of further expansion.

Analysis of the new urbanization's spatial pattern evolution under the constraints of ecological environment

To research what influences the environmental factors will exert on the new urbanization's indexes levels, it is necessary to analyze the changing situations of the economic urbanization, the social urbanization and population urbanization under the environmental constraints. By using the sample data collected in eleven prefecture cities in Jiangxi Province between 2005 and 2014, this paper uses the Formula 9's spatial auto-regression model to respectively measure the urbanization levels of economy, society and population. Meanwhile, it also analyzes the changing relations between these three and the environment. The simulated results are shown in Table 3.

Variable	Economic Urbanization			Social Urbanization			Population Urbanization		
	ρ	β	γ	ρ	β	γ	ρ	β	γ
Constant term	-6.432	5.594	0.396	-10.511	3.062	1.275	-9.379	4.291	2.871
X	-0.172	0.322	0.117	-0.792	0.479	0.092	-0.093	0.039	0.112
Y	-0.329	0.391	0.236	-0.192	0.127	0.128	-0.101	0.103	0.342
Z	-0.117	0.405	0.179	-0.134	0.229	0.053	-0.275	0.029	0.576
t	0.086	0.792	0.317	0.912	0.316	-5.692	0.117	2.231	-1.082

Table 3 – Results of urbanization's dimensional regression under environmental constraints

Seen from the analysis results of the spatial auto-regression model, the environment exerts influences on the economic urbanization, social urbanization and population urbanization. The changes of the ecological environmental factors will changes the urbanization situations of the above-mentioned three dimensions. Among them, the ecological environment factor exerts the biggest influences on the economic

urbanization. The decrease of the ecological environment quality will cause the potential of investing in this region. Besides, it requires more costs to implement the environmental governance. By calculating the changes of the 3-D urbanization between 2005 and 2014, this paper formulates Graph 2. Seen from the graph, the economic, social and population urbanization process under ecological environmental constraints will all slow down. The urbanization's overall efficiency has the tendency of decreasing, and the new urbanization's inclusive development suffers huge influences. After 2009, as the ecological environment improves, each dimension's urbanization level is also gradually improving and the inclusive development whose core concept is truly ecological environment starts to be formed.

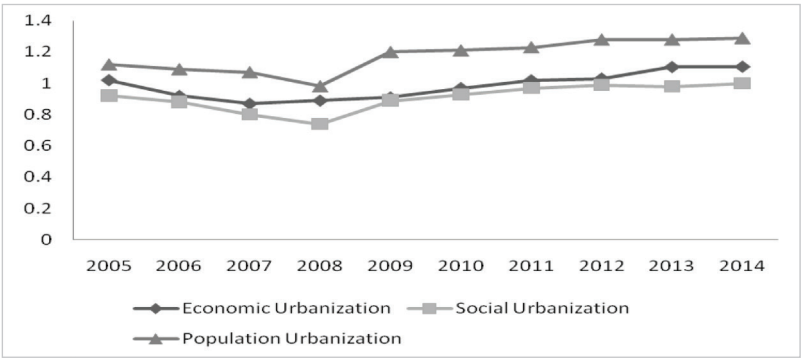

Figure 2 – Changes of each dimension's urbanization level under the environmental constraints

Generally, the spatial pattern evolution of Jiangxi Province's new urbanization inclusive developmental level between 2005 and 2014 are mainly represented in the following aspects: Firstly, In the process of urbanization development, from the early energy waste and sacrificing the environment to develop the economy to the current emphasizing protecting the ecological environment and developing the green economy, the new urbanization gradually achieves inclusive development. The overall spatial pattern's disparity distribution has also become prominent.

4. Analysis of factors influencing the spatial pattern evolution

4.1. Analysis of spatial auto-correlation

Use the Geoda software to carry out the significance testing of new urbanization's inclusive developmental levels of 11 prefecture-level cities in 2005, 2008, 2011 and 2014. The testing results are shown in Graph 3.

Seen from the Graph 3, the Moran's I index of the new urbanization's inclusive development levels of eleven prefecture-level cities in Jiangxi Province between 2005 and 2014 all had certain changes. However, their values were all over than 0.3 and had passed the significance test, which means the new urbanization's inclusive development level of each prefecture-level city is not disorderly distributed in space, but has significant spatial relevance.

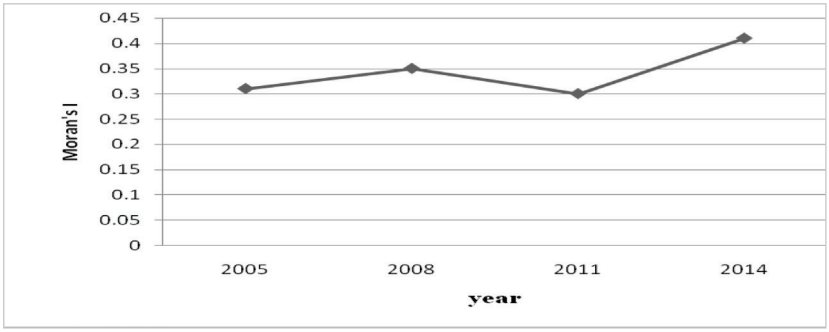

Figure 3 – Jiangxi Province, 11 prefecture-level cities in each of the new urbanization inclusive development level of Moran' sI

4.2. Construct the spatial econometric model

Based on the influence factors in the traditional urbanization's developmental process and combining the inclusive development connotations of the concept that humans and the environment should coexist together, it is necessary to analyze the factors influencing the new urbanization's inclusive developmental pattern evolution from four levels: Firstly, the economic level; here, the selected industrial developmental level K and asset element investing L are taken as the explanation variables in the economic level. secondly, the social level; when analyzing the new urbanization's inclusive development from the social level, the influence factors should contain two aspects: the government's governing capacity E and the infrastructure construction G; thirdly, the social security level. This is the most important level that represents the inclusive development. The new urbanization's inclusive development should establish a complete social security system. Here, the social security level F is selected as the explanation variable. Lastly, the environment level. Select the greening situation S and resource using amount W as the explanation variables in the environmental level. By far, the explanation variables of various levels have been selected, which can use the Cobb-Douglas production function to construct the influence analysis mode of the new urbanization inclusive development (Souza, 2015).

$$Y = AK^{\hat{a}_k} L^{\hat{a}_l} E^{\hat{a}_e} G^{\hat{a}_g} F^{\hat{a}_f} S^{\hat{a}_s} W^{\hat{a}_w} \tag{10}$$

In the formula, Y is the explained variable, namely the new urbanization's inclusive developmental level of eleven prefecture-cities in Jiangxi. A is the overall technology level of the production function. $\hat{a}$ is the parameter to be estimated. To make it convenient for calculation, take logarithms of the two ends of the formula (10), and the spatial econometric model is obtained, as is shown in Formula (11).

$$\begin{aligned} \ln Y_{it} = \pm_{it} + {}^{2}{}_{k} \ln K_{it} + {}^{2}{}_{l} \ln L_{it} + {}^{2}{}_{e} \ln E_{it} + {}^{2}{}_{g} \ln G_{it} + \\ {}^{2}{}_{f} \ln F_{it} + {}^{2}{}_{s} \ln S_{it} + {}^{2}{}_{w} \ln W_{it} + \mu_{it} \end{aligned}$$

In the formula, $å_{it}$ is the independent and the identically distributed random error term. i and t both meet the zero average and homoscedasticity $ó^2$.

4.3. Empirical Analysis

Data stability testing

This paper adopts the ADF unit root testing to carry out the stability testing of eleven explanation variables' time sequences. To improve the accuracy of testing results, this paper adopts the variables' logarithm means to carry out the test. The testing results are shown in Table 4:

Variable	Testing Means (C, F, T, K)	Testing value of 10%	ADF value	Conclusion
lnK	(1,0,1)	-2.801	-1.26	Stable
lnL	(1,0,1)	-3.674	-1.39	Stable
lnE	(1,0,1)	-2.096	-2.11	Stable
lnG	(1,0,1)	-4.573	-2.47	Stable
lnF	(1,0,1)	-4.462	-1.56	Stable
ln	(1,0,1)	-5.409	-2.58	Stable
ln*W*	(1,0,1)	-5.727	-3.65	Stable

Table 4 – Testing results of each variable's stability

Seen from the testing results: If the testing values of seven variables are all lower than the critical values when the significance level is 10%, accept the zero assumption.

Regression analysis

The spatial relevance testing has proved that 11 prefecture-cities in Jianxi Province have significant auto-correlation in the new urbanization inclusive's development, and there is a significant aggregating phenomenon in terms of the spatial distribution. To effectively evaluate the spatial pattern evolution's influence factors, first carry out a measurement analysis of the spatial panel data and use the influence factors of the new urbanization's inclusive development level between 2005 and 2014 to carry out the regression analysis, as is shown Table 5.

Seen from the results of the regression analysis, each variable index of the estimated results in the OLS model has passed the significance test. Seen from the estimated results, the urban security level has the biggest influences on the explained variable, while the influences of the social economic level and development level are smaller. The spatial pattern evolution analysis in the above paper has proved that the new urbanization inclusive development has spatial relevance. Therefore, the OLS estimation's results may be deviated or ineffective under the condition of neglecting spatial factors. Therefore, it is necessary to carry out the spatial auto-regression model and spatial Tobin model's

	Estimation Results I	Estimation Results II	Estimation Results III
Variable	OLS	SLM	SDM
K	0.0105*** (3.9124)	0.0061*** (3.4651)	0.0227*** (5.7822)
L	0.0513*** (21.7461)	0.0172*** (5.4954)	0.0073*** (7.1597)
E	0.0517*** (19.7435)	0.0517*** (17.4591)	0.0671*** (15.3108)
G	0.0598*** (11.7192)	0.0232** (3.0149)	0.0219*** (2.7843)
F	0.0094** (3.4729)	0.0216*** (4.7631)	0.0172*** (7.3492)
S	-0.0192*** (20.1375)	-0.0165*** (7.3429)	-0.0082*** (7.2052)
W	0.0617*** (20.5428)	0.0429*** (20.7934)	0.0506*** (21.2853)
$\rho(\lambda)$	-	0.5132*** (16.0342)	0.5531*** (16.4217)
R^2	0.8211	0.9317	0.9823
$\text{Log}-L$	7015.2	8152.7	8375.3

Table 5 – Regression analysis of the spatial econometric model

estimation. Seen from the final estimated results in the table, the spatial auto-correlation of two spatial econometric models are both positive values and have both passed the significance test, which also directly reflect a certain prefecture-city's new urbanization inclusive development is influenced by its surrounding local cities' development. It is necessary to analyze from the perspective of elements' changes. The spatial pattern evolution of the new urbanization inclusive development may be thought as the process in which elements aggregate and scatter. In this process, capital, population, resources and other elements constantly shift as the spatial pattern evolves.

Ecological environmental problems also become increasingly serious as the urbanization process is constantly promoted, which are also the results of the urbanization development's inadequate attention paid to environmental protection. Seen from the estimated results, the estimated parameters of the urban greening environment are both over 0.09 and have passed the significance testing, meaning the urban greening environment plays a positive promotion role to the new urbanization's inclusive development. In the developmental processes of eleven prefecture-level cities, Zhangzhou City values developing greening economy and the city's greening occupies a large proportion in the city's planning area, which greatly promotes the new urbanization's inclusive development to a large extent. However, the estimated parameters of the resource using amount both have negative values in two models, which means resource consumption has become the obstacle to urbanization's sustainable and healthy development.

5. Conclusions

Starting from the perspective of the ecological environment, this paper takes the inclusive development concept whose core is protecting ecological environment as its guide, sets up the comprehensive evaluation index system of the new urbanization's inclusive development level and observes the new urbanization inclusive development level's comprehensive index system and carries out a deep analysis of its spatial pattern evolution. It has obtained the following conclusions: ①The new urbanization inclusive development's spatial pattern represents the tendency of aggregation; the regions with high economic levels, complete fundamental facilities and urban environment have a higher level of inclusive development and have the tendency of spreading from the central region to surrounding regions. ②The new urbanization that is based on the inclusive development has significant spatial relevance and is mainly represented in the relative aggregation of high-level regions. Seen from the calculation of the spatial econometric model, the industrial developmental level, capital element inputs, governmental governance ability, infrastructure construction and good ecological environment positively promote the new urbanization inclusive development, while the using amount of resources hinder it.

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