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CONTENTS

Research On Optimization Of Controller And Communication Protocol For Network Control System

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Abstract: Networked Control System (NCS) refers to automatic control system based on network and results from combination of automatic control and communication technology. One basic problem of NCS study is that design controller of NCS according to characteristics of networked control; another basic problem of NCS study is that design network communication protocol which meets certain performance requirements. Starting from protocol design of industrial network, this article introduces design process and evaluation index of field bus protocol based on industrial serial communication, and introduces design process and evaluation index of industrial Ethernet communication protocol based on TCP/IP.
Keywords: Networked Control Systems, controller, communication protocol, optimization system

1. INTRODUCTION

With development of computer and network communication technology, and with increasing requirements of control and management, control system is rapidly developing from closed centralized system to open distributed system. Since the appearance of control system, problems of controlling information exchange and sharing have appeared. Due to technical limitations, control system adopts closed structure at early stage which is similar to early development of computer technology; in addition, networking development of control system has similar corresponding relationship with development process of computer network. In the development process of computer control system, appearance of control system with each structure always lags behind development of corresponding computer technology [1] . In fact, in most cases, since new technology appears in computer field, people begin to study how to apply this new technology to control field.

1.1 STATUS OF NETWORKED CONTROL SYSTEM

With 21st century coming, automation and industrial control technology requires deeper osmotic communication and network technology. On the one hand, modern factory is distributed in different space from intelligent equipment's sensor, controller and actuator, therefore communication between modern factory and intelligent equipment should be realized through data communication network, which is typical control system under network environment [2] (Figure 1). On the other hand, management and control of communication network require adoption of more control theories and strategies. Centralized control system and distributed control systems have some common disadvantages, namely, due to increasing field equipment, system wiring is very complex, cost will be significantly raised, anti-interference and flexibility are poor, and expansion is inconvenient. In order to fundamentally solve these problems, distributed control system must replace independent control system. Distributed control system transfers control function to site node and does not require central control unit for centralized control and operation. field bus control system and networked control system, the former can be regarded as primary stage of the latter [3].

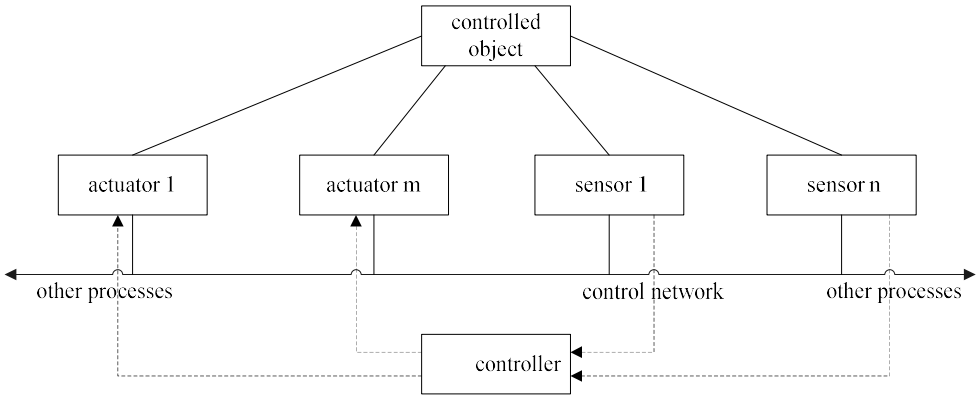

Figure 1 Typical Networked Control System and Information Flow

2. CONTROLLER DESIGN OF NETWORKED CONTROL SYSTEM

Controller design of networked control system is one of basic problems in studying networked control system. Unlike general automatic control system, controller design of networked control system is to study design of digital controller under network application environment. Controller design should consider influences of network on the system, especially influences unfavorable factors such as network-induced delay. It can be seen from networked control system shown in Figure 2, network-induced delay has negative effects on closed loop control system, so that control performance will be degraded and control system will be unstable. When designing control algorithm of controller, we often use methods of compensation and prediction to cope with delay link, network QoS changes and deterioration. In actual networked control system, communication delay has uncertainty, therefore general control algorithm will be difficult to obtain good control effect.

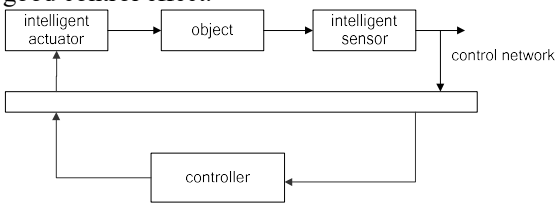

Figure 2 Diagram of Networked Control Systems

Modern control object and system become increasingly complex. Traditional control methods are established on accurate calculation and analysis on mathematical model of control object, so that traditional control methods are severely restricted, such as: traditional control usually considers control object and interference model known or available through identification, therefore traditional control is difficult to be applicable to uncertain systems; in traditional control theory, limited nonlinear control methods are hard to be applicable to highly nonlinear control object; traditional control methods are not adaptive to control of time-varying system; and traditional control methods are not adaptive to control of multivariable system. In production practice, target control is difficult to achieve in many complex production processes, while satisfactory control effect can be achieved through operations of skilled technicians or experts.

3. RESEARCH ON ETHERNET INDUSTRIAL COMMUNICATION PROTOCOL

Networked control system (NCS) has two kinds of analysis and design ideas. One idea refers to designing control algorithm of controller based on analyzing existing industrial network; another idea refers to designing and planning industrial network under the guidance of mature control theory so as to meet conditions of control algorithm. This chapter will focus on design of industrial Ethernet communication protocol with second idea. Ethernet can be based on TCP/IP model, and can also be based on OSI model. IT technology can be used for reference in industrial communication. Industrial Ethernet is the general term of industrial communication technology based on Ethernet. Although industrial communication can carry out work based on OSI model or other models, this paper only studies situations based on TCP (UDP) /IP model.

No matter established in which layer of TCP/IP, industrial Ethernet communication has process of encapsulation and decapsulation. Taking industrial Ethernet communication based on TCP as an example, datagram is encapsulated in TCP datagram, TCP datagram is encapsulated in IP datagram, and IP datagram is encapsulated in physical frame, as shown in Figure 3

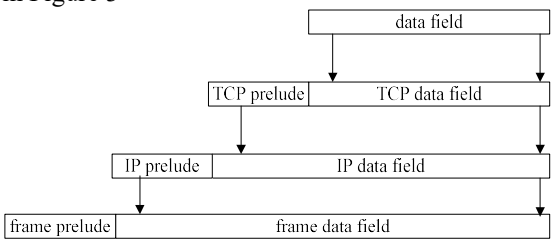

Figure 3 Encapsulation and Decapsulation of Protocol

With many performance evaluation indexes, network has its most important real-time performance. In addition, network has many other performances such as reliability, correctness and expansibility. Correctness of industrial Ethernet communication is guaranteed by verification, and industrial Ethernet communication will be discarded if not correct. Industrial Ethernet communication based on UDP or IP is non-connected protocol and is regarded as lack of reliability; in fact, industrial Ethernet controlling field can successfully complete non-connected connected data communication as long as there's no hardware error, and has better real-time than TCP. When UDP fails to communicate, TCP will also interrupt communication.

4. CONCLUSIONS

Combined with control technology and communication technology, networked control system is gradually becoming advanced technology in industrial control. Through industrial network and communication platform, control system can not only achieve real-time remote control but also realize fast and efficient sharing of information resource. Networked control system reduces the cost of system installation and maintenance, improves reliability, and enhances system's modularity, flexibility and expansibility. This article divides existing industrial network into two categories: certainty and uncertainty, respectively analyzes characteristics of two systems, and designs control algorithm; the second aspect is to introduce design process and evaluation index of field bus protocol based on industrial serial communication starting from protocol design of

industrial network, and this paper also introduces design process and evaluation index of industrial Ethernet communication protocol based on TCP/IP.

5. ACKNOWLEDGEMENTS

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A New Method for CMF Signal Processing Based on ANF and Cross Correlation Algorithm

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Abstract: A new method for CMF signal processing is proposed based on ANF and cross correlation algorithm in this paper. First, a modified adaptive lattice notch filter is introduced to filter the output signals of the CMF and calculate the frequency. Then, a new method based on multiple cross correlation algorithm is applied to calculate the phase difference between two enhanced signals. Simulation results show that the proposed method can track the change of frequency and phase difference continuously with higher accuracy of the CMF.
Keywords: Coriolis mass flowmeter (CMF), adaptive lattice notch filter, cross correlation, frequency tracking, phase difference calculation.

1. INTRODUCTION

Coriolis mass flowmeter is a kind of high precision mass flowmeter that can directly measure the mass flowrate. It has been widely used in many fields such as chemistry industry, petroleum, medicine and so on [1-2]. For CMF, the key points are exactly work out the frequency and phase difference. With the development of digital signal processing technology, many scientists make use of the digital signal processing methods to improve the accuracy of the traditional methods for the CMF [3].

However, due to the influence of external factors such as the variations of flowrate, density, fluid pulsation and magnetic field of the flow, the frequency, phase and amplitude of the actual CMF signals are time-varying, and the variations are generally stochastic and uncertainty. In order to achieve a high precision flow measurement and to improve its dynamic response speed of the mass flowrate, it is necessary to accurately track the variations of the frequency and phase difference in real time. The existing adaptive notch filter (ANF) frequency tracking methods cannot counterpoise the convergent rate and the tracking precision, and cannot track continuously as well [4-5]. For the phase difference calculation methods, the computational load is large for redundancy calculations, which decreases the accuracy and real time qualities, and all of these questions need to be resolved [6-7].

To improve the measurement accuracy of the CMF, a new method for CMF signal processing based on ANF and cross correlation algorithm is proposed in this paper. In Section 2, the principle of the proposed method is introduced, which includes modified adaptive lattice notch filter frequency tracking method and multiple cross correlation phase difference calculation algorithm. In Section 3, the proposed method is validated by simulations. Conclusions are drawn in the last Section 4.

2. PRINCIPLE OF THE PROPOSED METHOD

2.1 MODIFIED ADAPTIVE LATTICE NOTCH FILTER FREQUENCY TRACKING METHOD

Adaptive lattice notch filter is widely used for algorithm simplicity and higher accuracy in frequency tracking. However, it cannot keep tracking frequency precisely continuously, due to the inherent filter's structure which makes the non-quadratic error surface converge to a local minimum and leads to the algorithm ceases to adapt [2,8]. In order to resume the characteristic of the ANF and start to adapt, a certain threshold can be set when the convergence factor tends to 1. The modified adaptive lattice filter method can be summarized as following.

Step 1 Parameters initialization.

$\hat{k}_0(0)$, $\lambda(0)$, $\lambda_r, \lambda_\infty, \rho(0)$, ρ_r, ρ_∞, T_h, μ_h

Step 2 Track the frequency by LANF.

$$v(n) = y(n) - \hat{k}_0(n-1)\left[1+\rho(n)\right]v(n-1) - \rho(n)v(n-2)$$

$$C(n) = \lambda(n)C(n-1) + \left[1-\lambda(n)\right]v(n-1)[v(n)+v(n-2)]$$

$$D(n) = \lambda(n)D(n-1) + 2\left[1-\lambda(n)\right]v^2(n-1)$$

$$\hat{k}_0(n) = -C(n)/D(n)$$

$$\hat{k}_0(n) = \begin{cases} \hat{k}_0(n), & -1 \le \hat{k}_0(n) \le 1 \\ 1, & \hat{k}_0(n) > 1 \\ -1, & \hat{k}_0(n) < -1 \end{cases}$$

$$\hat{k}_0(n) = 0.5\hat{k}_0(n-1) + 0.5\hat{k}_0(n)$$

$$x(n) = v(n) + 2\hat{k}_0(n)v(n-1) + v(n-2)$$

$$e(n) = y(n) - x(n) - h(n-1)y(n)$$

$$h(n) = h(n-1) + \mu_h e(n)y(n)$$

$$\lambda(n) = \lambda_r\lambda(n-1) + (1-\lambda_r)\lambda_\infty$$

$$\rho(n) = \rho_r\rho(n-1) + (1-\rho_r)\rho_\infty$$

$$\hat{\omega}(n) = \arccos\left(-\hat{k}_0(n)\right)$$

Step 3 A certain threshold is used to resume the LANF search for the right frequency all the time.

if $h(t) < T_h$

$\lambda(n) = \lambda_0$, $\rho(n) = \rho_0$

else $\lambda(n) = \lambda(n)$, $\rho(n) = \rho(n)$

2.2 MULTIPLE CROSS CORRELATION PHASE DIFFERENCE CALCULATION METHOD

Two real-valued sinusoids $x(t)$ and $y(t)$ may be expressed as:

$$\begin{aligned} x(t) &= A\cos(\omega t + \theta_1) + N_1(t) \\ y(t) &= B\cos(\omega t + \theta_2) + N_2(t). \end{aligned} \tag{1}$$

where A and B are unknown amplitudes, ω is the unknown angular frequency, θ_1 and θ_2 are unknown initial phases, $N_1(t)$ and $N_2(t)$ are uncorrelated additive white Gaussian noise.

Then, the Hilbert transformation is conducted on the signals $x(n)$ and $y(n)$, which aims to make two signals have 90 degree phase shift as following.

$$\begin{aligned} x'(n) &= A\sin(\omega n + \theta_1) + N_1'(n) \\ y'(n) &= B\sin(\omega n + \theta_2) + N_2'(n). \end{aligned} \tag{2}$$

And then, multiple cross-correlations are computed between $x(n)$, $y(n)$, $x'(n)$ and $y'(n)$ respectively as following.

$$\begin{aligned} R_{xy}(0) &= \frac{1}{N}\sum_{n=0}^{N-1} x(n)y(n); R_{x'y'}(0) = \frac{1}{N}\sum_{n=0}^{N-1} x'(n)y'(n) \\ R_{xy'}(0) &= \frac{1}{N}\sum_{n=0}^{N-1} x(n)y'(n); R_{x'y}(0) = \frac{1}{N}\sum_{n=0}^{N-1} x'(n)y(n). \end{aligned} \tag{3}$$

In idealism condition, the noise signal is not correlated to vibration signal, and noise signal is not correlated to each other. So, (3) can be defined as following.

$$\begin{aligned} R_{xy}(0) &= \frac{AB}{2}\cos(\theta_2 - \theta_1) + \frac{AB}{2N}\sum_{n=0}^{N-1}\cos(2\omega n + \theta_1 + \theta_2) \\ R_{x'y'}(0) &= \frac{AB}{2}\cos(\theta_2 - \theta_1) - \frac{AB}{2N}\sum_{n=0}^{N-1}\cos(2\omega n + \theta_1 + \theta_2) \\ R_{xy'}(0) &= \frac{AB}{2}\sin(\theta_2 - \theta_1) + \frac{AB}{2N}\sum_{n=0}^{N-1}\sin(2\omega n + \theta_1 + \theta_2) \\ R_{x'y}(0) &= -\frac{AB}{2}\sin(\theta_2 - \theta_1) + \frac{AB}{2N}\sum_{n=0}^{N-1}\sin(2\omega n + \theta_1 + \theta_2). \end{aligned} \tag{4}$$

According to (4), we can obtain

$$\begin{aligned} R_{xy}(0) + R_{x'y'}(0) &= AB\cos(\theta_2 - \theta_1) \\ R_{xy'}(0) - R_{x'y}(0) &= AB\sin(\theta_2 - \theta_1). \end{aligned} \tag{5}$$

Utilize the properties of sine functions as following.

$$\tan(\theta_2 - \theta_1) = \frac{\sin(\theta_2 - \theta_1)}{\cos(\theta_2 - \theta_1)} = \frac{R_{xy'}(0) - R_{x'y}(0)}{R_{xy}(0) + R_{x'y'}(0)}. \tag{6}$$

Therefore, the phase difference $\Delta\theta$ can be obtained as

$$\Delta\theta = \theta_2 - \theta_1 = \arctan\frac{R_{xy'}(0) - R_{x'y}(0)}{R_{xy}(0) + R_{x'y'}(0)}. \tag{7}$$

From (7), we can see that it works even if the frequency is unknown, and it shows no bias, even if the number of signal periods is not an integer.

3. SIMULATION RESULTS

Assuming that the two signals are single-frequency real sine signals with white Gaussian noise. In simulations, the signal frequency equals 100Hz, the sampling frequency equals 2000Hz, the theoretic value of phase difference equals 6°, the number of sampled points equals 30000, and the SNR equals 21.4 dB. In order to explain the advantage of the proposed method, the comparisons between the frequency tracking method and phase difference calculation method are carried out respectively.

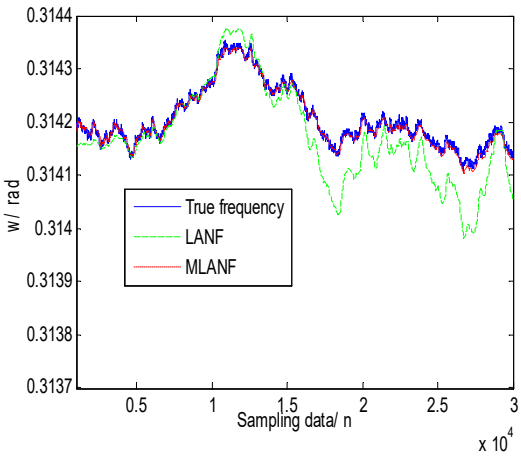

Figure 1 Estimated frequencies comparisons by the LANF and the MLANF

Estimated frequencies comparisons by adaptive lattice notch filter (LANF) and modified adaptive lattice notch filter (MLANF) are shown in Fig. 1. As shown in Fig. 1, the MLANF obtains a better performance, the LANF cannot track the frequency for a long time, but the MLANF can track it continuously. Besides, the MLANF can obtain a better convergent rate.

Phase differences are calculated by multiple cross correlation phase difference calculation algorithm and the sliding Goertzel algorithm (SGA) are shown in Fig. 2. To avoid the influence of convergence of the ANF, the enhanced signals after the 1000th point are intercepted when calculating the phase difference. As shown in Fig. 2, the algorithm based on SGA brings about remarkable deviations, whereas the multiple cross correlation algorithm is much more close to the theoretic values of time interval by comparison. The SGA algorithm lag behind the multiple cross correlation algorithm remarkably, the SGA algorithm brings about significant errors in phase difference measurements, because there is a compromise when deciding the width of rectangular windows and the width of overlap for the SGA, while the multiple cross correlation algorithm converges quickly, with high precision of phase difference. What's more, the multiple cross correlation algorithm can calculate the phase difference by a few sampled points, which obtains a better real time quality.

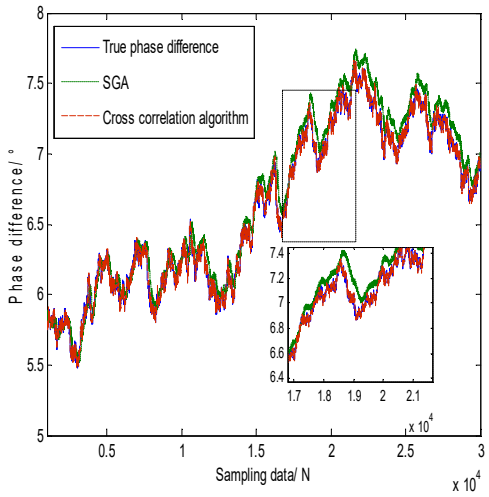

Figure 2 Estimated phase difference comparisons by SGA and cross correlation algorithm

4. CONCLUSIONS

Conclusions can be obtained from the simulation results as follows. Firstly, the modified adaptive lattice notch filter obtains higher tracking accuracy qualities. Secondly, the phase difference calculation algorithm based on cross correlation algorithm decreases the computational load and improves the accuracy of the measurement. Thirdly, simulation results show that the proposed method is effective.

5. ACKNOWLEDGMENT

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The Research on IOT Intelligent Community System

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Abstract: The project to design and implementation of district vehicle management, network access control system as an example, the completion of Things intelligent plot embedded system architecture based on. To speed up the intelligence community to provide theoretical and practical basis in the direction of the development of things.
Keywords: Intelligent Community; IOT; RFID

1. INTRODUCTION RELATED

The ARM technology and control principle of combining things, the use of advanced control technology Intelligent Community System controller multifaceted networking control. Easy to use Internet and wireless transmission technology. Complete embedded system architecture intelligent community.
The Internet of Things is a kind of network connecting any things to the internet by the radio frequency identification (RFID), infrared sensor, global positioning system, laser scanner and other information sensing device according to the agreed protocol, to make information exchange and communication to realize the intelligent identification, positioning, tracking, monitoring and management.

2. SYSTEM COMPONENTS

Contents of this project is to use the principle of ARM good network features and the ability to bind the distributed control is applied to generate a new control system based on embedded ARM Intelligent Community of the future. The Intelligent Community control development of new technologies and ideas.
The project mainly:
(1) part of the design and implementation of Things Intelligent Community perception. Perceived as part of the ARM chip CPU, control reader to read RFID tags on objects to achieve intelligent identification, positioning, tracking, monitoring and management (emphasis in design and implementation of district vehicle management system as an example).
By installing the RFID tag on the object is stored object-related information, the reader for a variety of data and information in real time to take down the object. Being part of a network-aware objects to collect information to complete the analysis of information and decision-making process, and achieve or accomplish a specific task of intelligent applications and services, in order to achieve things and things, recognition and perception of persons and things, to play smart effect.
After specifically EPC reader to read the data through the various gateways in the network layer to the application layer object information transmission, electronically coded according to application layer object object to retrieve or update information at the same time, to objects and tracking applications, things develop information systems on the PC, you can object integrated management in real time.
For example, in a cell-based RFID tag set per private car, in the district appropriate location to install the reader, the ARM chip as the CPU, unified identification, management of the district vehicle; passage in the garage, the ground channel, gate, fire exits, floor when crossing, sidewalk and other places to install the reader, found the vehicle parked in illegal parking spots, immediately report the management host and notify the owner, the owner did not take such measures within the specified time, the system starts an imaging apparatus such as exposure photographs.
(2) intelligent community network interconnection part of the design and realization of things. Mainly through the Intelligent Community of existing products and technology classification analysis, design of each intercommunication intelligent controller protocol and Internet protocol. To provide the necessary networking interface. Specifically, is the software and hardware connection, content and format of exchange of information, mutual control and linkage function between subsystems, each subsystem extension methods and so on. Thus enabling the respective separation equipment, functions and information is integrated into interrelated among the harmonization and coordination of the system, to achieve full sharing of resources and centralized, convenient management.
Establish network-based Internet communications management algorithm for multi-task embedded control systems ARM technology, the system has good parallel processing performance, the use of multi-tasking functionality timeshare priority to the thread as a unit in real-time engineering work strong mandate for mission-critical and real-time is not strong non-critical time-sharing parallel processing.
3, intelligent home design and implementation of the application layer things. The system uses high-performance computer cluster, using the cloud to complete the analysis of information processing and decision-making, as well as to achieve or accomplish a specific task of intelligent applications and services, in order to achieve things and things, recognition and perception of persons and things, to play smart effect.

3. THE SYSTEM INTENDS TO ADOPT TECHNOLOGY ROUTES

(1) the overall project planning, comprehensive design, including system design and system design principles.

(2) internetworking protocol analysis, ARM System Interface standard analysis and the development of networking communication protocols.

(3) the network management of Internet communication protocol algorithm and optimization studies, including the underlying structure of the process control algorithm design and high-level monitoring and management algorithm.

4, sub-module system hardware design and simulation function (cell vehicle management system hardware module design), including Protel DXP schematic circuit design, Protel DXP PCB design and circuit simulation.

(5) the Linux system software functional sub-module design, including the underlying process control level software design, high-level monitoring level software design, WEB database management system design.

The ARM based design of cigarette online detection machine is divided into hardware design and software design.

(6) ARM-based embedded control system testing. Including the hardware module testing and test each software module and communication module testing.

4. ACKNOWLEDGEMENTS

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Things Intelligent Community Intelligent Terminal Development

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Abstract: Through the automatic monitoring equipment, information resources and information services and their users and building the optimal combination, make a reasonable investment, environmental protection and energy conservation, the need for the information society and a safe, efficient, comfortable, convenient, and flexible architecture space. ARM technology is advanced in the field of intelligent control technology, and has been widely used in high-tech smart product development.
Keywords: Terminal; Intelligent; Community

1. INTRODUCTION

In recent years, things become a hot area of global concern, is considered after the Internet most significant scientific and technological innovation. The Internet of Things is a kind of network connecting any things to the internet by the radio frequency identification (RFID), infrared sensor, global positioning system, laser scanner and other information sensing device according to the agreed protocol, to make information exchange and communication to realize the intelligent identification, positioning, tracking, monitoring and management.

Intelligent building smart home control projects in the last two years, the rapid development of the Internet of Things for the development of intelligent home and introduced a new concept of development, intelligent home can be seen as an important application of the Internet of Things. Based on the Internet of Things smart home, showing the use of information sensing device (residential environment with a variety of items loosely coupled or tightly coupled) about the home life of the various subsystems together organically, and connect with the Internet, monitoring, management, information exchange and communication, to achieve intelligent home.

October 2010 ARM and INTEL have launched a multi-tasking on the smart home for embedded processor chip. On several Forum experts predict, based on the concept of things embedded in the smart home application of the benefits of the IT industry will be a major branch.

Powerful ARM technology capabilities, anti-interference ability. Provide good network connectivity, and support for distributed control. Distributed control system with its high reliability, convenient configuration software, rich control algorithm, open networking capabilities, the process has gradually become the mainstream of industrial automation control systems.

The project will ARM technology and control principle of combining things, the use of advanced control technology Intelligent Community System controller multifaceted networking control. Easy to use Internet and wireless transmission technology. Complete embedded system architecture intelligent community. Its flexible features high reliability, real-time, high security, low maintenance, and integrated management of shared tasks and information resources, fully embodies the intelligent home reasonable investment, safe, efficient, energy saving, environmental protection, comfort, convenient, flexible and sustainable development features. To accelerate the development of smart home has a big role. Smart home industry is the development of a more realistic breakthrough, the development of smart home industry is of great significance.

2. INTELLIGENT HOME DESIGN AND IMPLEMENTATION

The system uses high-performance computer cluster, using the cloud to complete the analysis of information processing and decision-making, as well as to achieve or accomplish a specific task of intelligent applications and services, in order to achieve things and things, recognition and perception of persons and things, to play smart effect.

3. THE SYSTEM INTENDS TO ADOPT TECHNOLOGY ROUTES:

(1) the overall project planning, comprehensive design, including system design and system design principles.

(2) internetworking protocol analysis, ARM System Interface standard analysis and the development of networking communication protocols.

(3)the network management of Internet communication protocol algorithm and optimization studies, including the underlying structure of the process control algorithm design and high-level monitoring and management algorithm.

(4)sub-module system hardware design and simulation function (cell vehicle management system hardware module design), including Protel DXP schematic circuit design, Protel DXP PCB design and circuit simulation.

(5) the Linux system software functional sub-module design, including the underlying process control level software design, high-level monitoring level software design, WEB database management system design.

The ARM based design of cigarette online detection machine is divided into hardware design and software

design.
(7) ARM-based embedded control system testing. Including the hardware module testing and test each software module and communication module testing.
The key technology projects:
1 the development and analysis of ARM technology-based embedded WEB control system communication management protocol.
2 research, networking communications management protocol optimization algorithm.
3 stability and maintainability Embedded WEB database management.
4 RFID tags Things stability Stability access technology, transmission communication network and each sub-module in real time.
5 wireless network security information, using encryption algorithm to encrypt data and commands.

4. ACKNOWLEDGEMENTS
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The Training of University Librarians Search Quotient Ability Based on the Network Big Data Background

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Abstract: Training search quotient is a long and complex process that requires constant search practice. As modern university librarians, they need to formalize the trend of the times, master a variety of retrieval techniques to cultivate their own search quotient, take full resource advantages of University Librarians, improve the utilization of information resources and provide readers with deep level and personalized service. Improving librarians search quotient is not only the requirement of the times, but also it is the demand to develop university libraries and librarians themselves.
Keywords: big data, search quotient, Librarian, University Library

1. INTRODUCTION

With the coming of the information age, knowledge updating growing day by day, we learn far less than the total of human knowledge. As a result of limited brain capacity and infinite knowledge, the speed of learning has been overtaken by the speed of updating knowledge which became a challenge to human learning. So humans had to use a tool to acquire knowledge. The Internet has become the largest repository of the information age and the search engine has become the most effective tool to gain knowledge for human. Therefore, it is crucial to have the ability of using the search tool to search useful information in Internet knowledge base whether in institutions or in business, information searching professionals are needed. However, universities are to cultivate high-search quotient professionals and supportive library resources is a powerful way to train for them. Therefore, personnel training librarians must first improve their own search quotient level in order to undertake the burden of cultivating students search quotient ability.

2.THE BASIC THEORY OF SEARCH QUOTIENT

Search Quotient which means search intelligence, the ability of people to use tools to acquire new knowledge.“Search quotient - The third kind of human ability” wrote by ChenPei who first put forward the concept of search quotient in 2006. It refers to human searching ability which is different from thinking ability of IQ and emotional competence of EQ. So search quotient belongs to the third kind of human ability. The essential feature of the search quotient is to search. If there is no search, and the search quotient will never exist. It’s also another major characteristic why the search quotient is different from IQ and EQ.
Search quotient expression:
SQ = K / T (C),
K = knowledge (knowledge acquisition);
T = time (time taken);
C = search quotient index (average ability to obtain the knowledge society) [1].
In this theory of search quotient, it mainly emphasized to get the ratio of knowledge and time which solved the efficiency problem of IQ and EQ. In the era of information explosion, the efficiency is an important factor in determining success, so we can understand why few people to become leading figures in various industries. In the commercial competition, it calls "fast fish eat slow fish" During the march of the war, "soldiers rapidly" also can get the victory. All winners are derived from an "efficiency", but, ultimately IQ and EQ also played a significant role in success. Therefore, IQ, EQ, and search quotient are a complementary relationship to decide success or failure in life: success = IQ + EQ + search quotient. Wherein the IQ and EQ are both raised by foreigners, but the search quotient is found and raised by Chinese. Besides it is constantly researched to develop and complete. From using the paper books to retrieval and seek the traditional paper-based information resource documents in library to use search engines to search on the Internet digital information resource documents in modern hybrid library. Search intelligence is inseparable [2] .Therefore, Librarians search quotient capability has become an important part of modern librarians to research.

3. NECESSITY OF IMPROVING LIBRARIANS “SEARCH QUOTIENT”

3.1 improving librarians “search quotient” is the need of the times

In the past, Confucianism, Taoism and some other poets always think that there are not more books to read, to the modern, book information and network information are year after year soar to all of the information what is impossible for human to understand. With the countless flood of information, the only thing we can do is to make good use of the Internet to improve their own awareness of searching and make full use of the search tools to find the search channels to enhance search capability to find the information we need when we need. So we can cope

with the impact of information flood. In the Internet era, we have no choice, we have to improve the search quotient to ride those waves in the sea of information. Therefore, Improving Librarians "search quotient" is the need of the times.

3.2 improve librarians “search quotient” is to adapt to the developmental need of libraries

In the Network information age, librarians played a role in reader information service as an information organizer and an information navigator. It is the highway bridge to connect to the reader and the information which is the soul of the whole consultation activities. Not only the librarian does to assist the reader to take advantage of the museum electronic resources, but also it’s the responsibility for him to guide the reader in the vast network information resources to search, analyze, screen and refine the accurate information. Therefore, information retrieval is a necessary basic skill for a librarian to provide services. Not only can search quotient enhance the ability of gaining needed information, but also it will improve the sensitivity of the information, information analysis and mining discrimination ability to a librarian[3]. Nowadays the development of characteristic information resource database has become an important part of library information service in major university libraries which requires librarians have the ability of developing, integrating and using resources, Thus it can be seen that if university librarians don’t have superb information retrieval skills and a high sense of information, it is impossible to carry out in-depth information services. Therefore, the training of search quotient is the most urgent task of university librarians[4].

3.3 improving the “search quotient” is the need of their own development

The function of library have some changes in information age, besides it needs to provide the paper-based information services to readers and provide a series of electronic resources services. It put forward new requirements for university librarians, not only do they need to acquire knowledge of library and information aspects but also they have to gain some knowledge of computer applications. For university librarians, the objects they served are vast students and teachers, these readers often study or research deeper program. The need of information also will be more professional which requires librarians need to have extensive knowledge, profound information search capabilities and skilled digital information processing capacity in order to provide satisfactory services to schools researchers. If librarians can’t master superb network information research skill and service capability, how could he develop in the library industry, it is always a letter library book? It seems impractical. As a librarian of the information era, he should comply with the development of times and improve his level of search quotient in order to develop better and provide better information services to readers.

4. BASIC WAYS OF TRAINING LIBRARIANS “SEARCH QUOTIENT”

4.1. mastering information retrieval technology

Information retrieval refers to organize Information in a certain way which is the process and technology to find Information according to the needs of Information users.http://baike.baidu.com/subview/5578913/5619394.htm

Information retrieval technology is commonly used by Boolean search, which includes three Boolean operators, logic "and" logic "or" logic "not", skilled use of the three operators, it can improve the retrieval efficiency in the process of retrieving, librarians meet with many readers to provide information retrieval services, so they have to get skilled search technology to improve service quality and service efficiency, Boolean operators is one of the technology which librarians must master.

4.1.1.logical "and"

It is represented by "and" or "*" It means “intersect” relationship and is used for narrowing the search range.

Logical equations :(A and B) or (A * B)

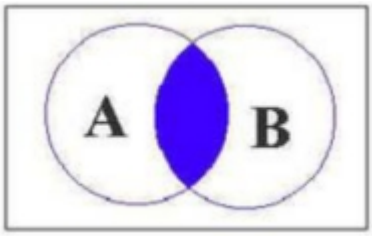

Figure 1 A and B

Fig.1 meaning representative: retrieve records contained both term A and term B in the collection of information retrieval to be considered to hit literature. Logic "and" can improve the precision in the process search.

4.1.2.logical "or"

It is represented by "OR" or "+” It means "intersect" relationship, to expand your search.

Logical equations: (A or B) or (A + B)

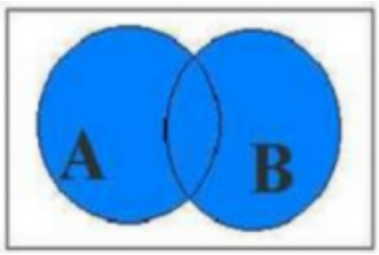

Figure 2 A or B

Fig.2 meaning is: Where to retrieve records containing the search term in the search term A or B, or both A and B contain the search terms, and both hit literature. Logic "or" can improve recall in the search

process.

4.1.3.logical "not"

It is represented by "NOT" or "-" It means "exclude" relationship, to narrow the search range.

Logical equations: (A not B) or (A - B)

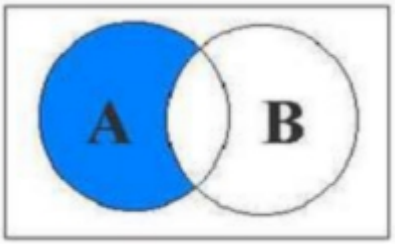

Figure 3 A not B

Fig.3 meaning is: Search for records containing the search terms A, but don't include the literature search term B, is considered hits literature. Logical "not" can improve the precision in the search process.

4.2 improving information application and evaluation ability of librarians

Evaluation capability information is not a single process or the final stage, but throughout the whole process of information retrieval. Evaluation information is to evaluate information quality of the entire search process, according to the current stage of search efficiency, deciding whether to transform search methods and strategies and play a diagnosis, screening and culling role.

In ancient times, information is scanty. Nowadays information overload in Internet era, facing huge network repository, librarians become the best assistant to help readers to gain accurate information. This requires that librarians have the ability of recognizing information true or false and analyzing information quality from the mass of information. The value of their information is relevant to its present, mobility and authority. Information evaluation process is essentially a judge process of discarding the dross and selecting the essential [5].

4.3. improving librarians information retrieval recall and precision

Information retrieval skills criteria are mainly based on "recall" and "precision", also known as "full-rate check" and "check precision", its essence is "full" and "accuracy." Librarians work in the Network Information Service, they must improve information retrieval standards to ensure the accuracy of the information which provided to the reader.

4.3.1.Recall Ratio, it is a measure of a retrieval system detected an indicator of the degree of success of the literature from the literature collection, namely the detection of the relevant literature and retrieval system, the ratio of the amount of the literature of the total.

Generally expressed as: recall = (related to the amount of information retrieved relevant information / system) x100%.

Improve the recall rate method, as follows:

Table 1. Improve recall ratio

No.	Main method	Instructions
1	Logical or retrieval method	Search query using the "+" or "or" to broaden your search
2	Multi-Engine retrieval method	Different search engines have different collection scope and criteria
3	Conversion lexical retrieval	Synonyms, thesaurus, related words, singular and plural forms and abbreviations
4	Multi Search Approach Method	Search Approach retrieval system, such as: title, category, author, etc.
5	Truncation symbol retrieval method	Truncation symbol "?"(0-1 characters), truncation symbol " * "(multiple characters)
6	Reducing restrictions law	Relax or remove restrictions

4.3.2.Precision Ratio: an indicator to measure the signal to noise ratio of a retrieval system, the percentage of relevant the literature that is detected and the detection of the all literature [6].http://baike.baidu.com/subview/258907/258907.htm

Generally expressed as:

Precision = (retrieved related information / information retrieved total) × 100%.http://baike.baidu.com/subview/721936/721936.htm

Improve the precision of the method, the following table:

Table 2. Improve precision ratio

No.	Main method	Instructions
1	Secondary retrieval method	Then search engines use outside the box "and then retrieve the results"
2	Symbol Search Method	Search query using the book title " or double quotes "

3	Advanced Search	Use the advanced search in search engine
4	Location word retrieval method	Use site (site, domain name), filetype (file type) and other location terms
5	Logic Non-retrieval method	Search query using the "-" or "not" to exclude irrelevant search terms
6	Logic and retrieval method	Search query using the "*" or "and" take the intersection of two search condition

Network information age, training librarians search quotient, not only need they to master information retrieval technology, but also they have a higher evaluation capacity for information. Recall and precision control are better. They also need to summarize some experience more in the search process; in the lightning updating speed of information, they have to keep tight with the pace of information change and understand the characteristics of information sources so that they will not waste time in the search process; it is more important that librarians should be interested in search interest can help to achieve a more refined and more accurate search. In short, in order to improve Librarians search quotient, they need to train more and more which is decided by many time and practical factors.

5. ACKNOWLEDGEMENTS

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The Development and Research on Testing System for College Entrance Examination of High Level Athletes

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Abstract : With the demand and help of the computer technology and the softwares of visual foxpro, microsoft access and spaa, I designed the automatic evaluation software for the recruit selection test of the high level athletes in Shandong Jiaotong University by myself so that it solved the difficulties which have been long time exsiting in the recruit selection test. The outcome are as follows: this testing system has the charicteristic of stability, easy operation. data processing fast and reliable, high accuracy rate. It greatly saves the human resource and improved the working efficiency.
Key words: high level athletes test; automatic system; development.

1. INTRODUCTION

In the process of recruiting high level athletes in universities of Shandong Province for so many years, they pay special attention to the excellent sports talent selection and training. According to related regulations of the "Shandong province high level sports excellent athletes test content standards and methods " which is issued by the department of education, and by experts to discuss certain proof and many times, our school has did the testing and selection which have make a outstanding achievement. However in the process of selecting high level sports talent ,as there are too many sinoprobe and standards in the sports testing. Make arrangement of complex time-consuming work personnel tired; Test scores statistics result conversion evaluation link trival, reduce the working efficiency and accuracy of evaluation. It has a importantly realistic significance to develop a operating system which can convert data processing and arrangement performance comprehensive evaluation. On the basis of original data entry with the help of computer technology and the function of the data bank.

2. THE FRAMEWORK OF THE SYSTEM DESIGN

Selecting the talent is the first stage of train a excellent athlete, it has a direct influence for a ahtlete to improvr their competing ability. It is easy to organize the selection in small group,while it will be rather complexed to select in large group.This oprating system is designed for the massive selection of the back-up sports talents.The test objectives are mainly high school graduating students of the year. According to the" test content standards and methods " they need to have four physical attribute tests(100m race, 800m race, standing long jump, throw in the shot-put) and sinoprobe.When making comprehensive assements, the achievement of the four physical attribute tests will occupy 30percent, and the sinoprobe will occupy 70 percent. The testing process are as follows(Picture 1) the system designs 6 modules as needed.Each module will operate internally and automatically. Each module is relatively independent. They can finish their own functions and also connect with each other, and finish the whole selection test coordinately.

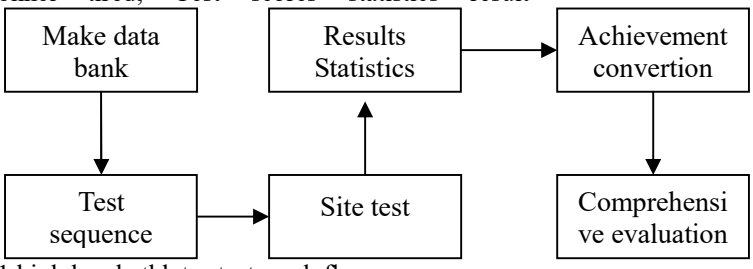

Fig1 high level athletes test work flow

3. MODULE DESIGN AND FUNCTION

3.1 establishment of the databank

Establishing the data bank is the basis of the different part of this system to make the automatication.According to the requirement of the test, except for the charicteristics of easy operation and convinience ,it should have a powerful calculating and making statistics function.So on the basis of visual foxpro,it is designed a data bank of the high level athletes including admission ticket number, name. Gender, age , achievement of the four physical attribute tests. Achievement of the sinoprobe total score.The related F can form a data bank which can be easily managed.

3.2 Test sequence

The work of the test sequence is to organnize all the

index on the spot,juet as to hold a big event.It can be divided into several groups by the gender,sinoprobe,quantity in advance,and then have the test in the fixed time spot.

Every year there are more than 300 students getting into the test in Shandong Jiaotong University, Before artificial layout workload is very big, took a large number of labor and time.After this system is designed,it can be done by the computer to classify the datas aumatically and and print out have autotype function of all test scores record sheets which are used for the refrees to fill in the achivement and then input the achievement to convert. This system can also add before the test adjustment test object, used for temporary registration examinee's test layout.

3.3 Results Statistics

This work is to fill all the original achievements in the result stastistic sheets. Before artificial to undertake searching fill in summary, due to the examinee number and test project is too much, the difficulty is bigger,the speed is slow, statistical error ration is also higher .After using this system, the problems above can be easily solved.IT can call the original achievements which have been input into it from the subdatabase as needed , then make a results statistics and output the sheet of the results statistics. And it can also make a motivate analysis to the achievements which can help the coaches and leaders make a credible decision.

3.4 The convertion from achievements to score

The convertion from the the sports achievements to the final score is the key point, and it is also the difficult point of the design of the operating system.In so many years,the recruitment of the high level sports athlete isdone by man with converting the score one by on according to the table of comparisons . This way of converting will have such problem: The table of comparisons is mostly adjusted from the 2002 model.there are great changes in the physical attributes and sinoprobe to the tesees. Some of the standards can not evaluate the crowd now.It should resample and make a new standard. The achievements and the scores are matched in different section, it is discontinuous, which is in the same period the athletic performance in the same score does not have a progressive scoring characteristics, and greatly reduces the accuracy and rationality of the evaluation. The score table searched artificially for the conversion of scoring has a big workload, a slow trival and it is easy to go wrong.

3.5 Comprehensive Assessment

According to the percentage of each testing standards snd its score after quantification from the “ Shandong province high level sports excellent athletes test content standards and methods ”. we can have a correctly comprehensive evaluation to the testee and make the rank which is convinient to select the back-ups. This module can classify all kinds of achievements,sheet of scores and total sheet quickly and conviniently.,meeting the needs of selecting talents.

4. APPLICATION EFFECTS

After the design of this operating system.with the original signing-up condition and the record of the testing achievements of the 2004,we take the process of the selection of the sports high level athletes as an simulation operation and make it adjusted and perfected according to the problems exsiting.In 2005, using this system to deal with the test of the recruitment of the high level sports athletes ,this operating system has a high level automatication ,stabality,convinience of operating after comparing with the work done before.Especially in the improving the working efficiency, it is dramatically outstanding. It saved 50 percent of the human resource compared with the artificial test as before.

5. APPLICATION PROSPECTS

Each department’s function in the system is relatively independent, which is in a dynamic management state. The framework of the system is multilevel open, but because of the default parameters of different or further development, it can achieve the new designed function. The operating system can be applied to the sports in many fields, such as all kinds of sports test selection sports ,teaching management work in physical training.

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Application of Generalized Predictive PID Control in Sewage Treatment pH Neutralization Process

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Abstract: Aiming at pH value object in sewage treatment of the characteristics of strong nonlinear, strong coupling and interference, in this paper, a Generalized Predictive Control (GPC) with PID structure method is applied to acid and alkali neutralization in the process of sewage treatment phase pH control. The method based on Generalized Predictive control and traditional PID control structure similar, by setting the Generalized Predictive control performance index function of weighted sequence control Q_j *(z - 1)* the configuration of the structure are derived with PID algorithm of Generalized Predictive Control law. So with the help of the Generalized Predictive Control algorithm parameters recursive relationship chains, rolling optimization of PID parameters, thus realizing Generalized Predictive PID Control. The simulation results show that compared with the traditional PID control for Generalized Predictive PID Control and Generalized Predictive Control has better adaptability and control precision.

Keywords: Sewage treatment; pH; GPC;PID control;

1. INTRODUCTION

With the rapid development of our country's economy and society, water pollution has become an environmental problem that our country has to face. In recent years, water pollution has seriously restricted the sustainable development of economy and the normal production and life of people in some areas, therefore, it is urgent to develop the sewage treatment industry. PH neutralization process is an important part of sewage treatment. At present, most of the domestic and foreign chemical methods are used for sewage treatment. By detecting sewage pH value, Control input neutralizing acidic or alkaline agents, to the sewage discharge standard. However, due to the high nonlinearity of the pH control process, it is difficult to establish the mathematical model of the identification process. Combined with the advantages of traditional PID control and generalized predictive control, the generalized predictive algorithm of non stationary system is added to the traditional PID control, which can achieve the purpose of real-time control of pH value in sewage treatment.

2. MECHANISM OF PH NEUTRALIZATION PROCESS

In the process of sewage treatment, continuous stirred tank reactor system of chemical equilibrium and mass conservation law based on the (Continuously Stirred Tank Reactor) model can accurately reflect the dynamic changes of pH neutralization process. In this paper, the mechanism of pH neutralization process is analyzed by means of this model, and the structure of this model is shown in Figure 1.

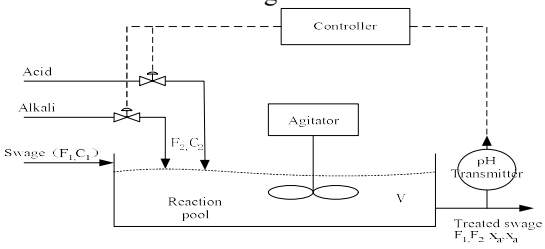

Fig 1 Mechanism of pH neutralization process

Continuous stirred tank reactor system to be treated sewage through the entrance into the neutralization tank, PH value of sewage measured at the discharge port of the sewage. By adding alkaline or acid neutralizing solution in the reaction tank, the neutralization reaction with acid or alkaline sewage can reach the control target of pH value of 7.

3 DESIGN OF A GENERALIZED PREDICTIVE CONTROLLER WITH PID STRUCTURE

3.1Generalized Predictive Control model

Generalized predictive control (GPC) as a new type of remote predictive control method,Integrating the advantages of a variety of algorithms,By using online identification is a kind of model parameters and developed on the basis of the principle of an adaptive model predictive control algorithm.The block diagram of the control system is shown in Figure 2.

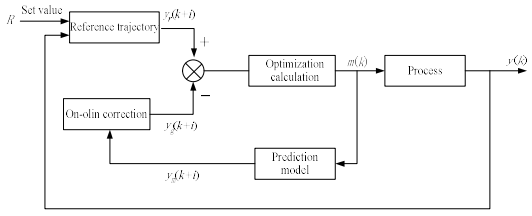

Fig 2 Generalized Predictive Control system block diagram

Using the integral controlled autoregressive moving

average (CARIMA) model

$$A(z^{-1})y(t)=B(z^{-1})u(t-1)+\omega(t)/\Delta \quad (1)$$

mong them,$A(z^{-1})$、$B(z^{-1})$is a polynomial of the backward shift operator z^{-1}

$$A(z^{-1})=1+a_1z^{-1}+\cdots+a_nz^{-n}$$

$$B(z^{-1})=b_0+b_1z^{-1}+\cdots+b_mz^{-m}$$

u(t)、*y(t) and ω(t)* said the object input value, output value and white noise respectively，Δ=1-z^{-1}said the difference operator. At the same time, consider the following type speed PID control structure.

$$u(t)=\frac{K_I}{1-z^{-1}}e(t)-\left[K_P+(1-z^{-1})K_D\right]y(t) \quad (2)$$

On the type of, $e(t)=y_r(t)-y(t)$，$y_r(t)$is the output of the set value,K_P for the scaling factor,K_I for the integral factor,K_D for the differential factor.The design task is PID generalized predictive performance index generalized predictive control method using decision based on the formula (2) in K_P,K_I,K_D.

The performance index function of the generalized predictive:

$$J=E\{\sum_{j=1}^{N}[y(t+j)-y_r(t)]^2+\sum_{j=1}^{N}Q_j(z^{-1})[\Delta u(t+j-1)]^2\} \quad (3)$$

On the type of,$y(t+j)$is the output of the controlled object.In order to obtain the optimal predictive value of output $y(t+j)$ after step j, N is predictive time domain,$Q_j(z^{-1})$meet the following conditions:

$$Q_1(z^{-1})=q_0^1+q_1^1z^{-1}+\cdots+q_l^1z^{-l}$$

$$Q_j(z^{-1})=q_0^j \qquad (j=2,3,\cdots,N)$$

Using Diophantine equation:

$$\begin{aligned}1&=E_j(z^{-1})A(z^{-1})\Delta+z^{-j}F_j(z^{-1})\\ E_j(z^{-1})B(z^{-1})&=G_j(z^{-1})+z^{-j}H_j(z^{-1})\end{aligned} \quad (4)$$

Among them, $j=1,2,\cdots N_1$ and E_j，F_j，G_j，H_j for the polynomial on the q^{-1},Order $j-1,n_a,j-1,n_b-1$ respectively.

By formula (1), (3) and (4) available:

$$\begin{aligned}y(t+j)&=G_j\Delta u(t+j-1)\\ &+F_jy(t)+H_j\Delta u(t-1)+E_j\omega(t+j)\end{aligned} \quad (5)$$

Ignore the time t after the white noise $E_j\omega(t+j)$,The $t+j$ time $y(t+j)$ of the optimal predictive value of the vector form can be written as

$$y=Gu+Fy(t)+H\Delta u(t-1)+E \quad (6)$$

Among,

$$y^{\mathrm{T}}=[y(t+1),\cdots,y(t+N_1)]$$

$$u^{\mathrm{T}}=[\Delta u(t),\cdots,\Delta u(t+N_u-1)]$$

$$F^{\mathrm{T}}=[F_1,\cdots,F_{N_1}]$$

$$H^{\mathrm{T}}=[H_1,\cdots,H_{N_1}]$$

$$E^{\mathrm{T}}=[E_1w(t+1),\cdots,E_{N_1}w(t+N_1)]$$

$$G=\begin{bmatrix} g_0 & & & 0\\ g_1 & g_0 & & \\ \vdots & & & \\ g_{N_u-1} & g_{N_u-2} & \cdots & g_0\\ \vdots & & & \\ g_{N_1-1} & g_{N_1-2} & \cdots & g_{N_1-N_u}\end{bmatrix}$$

Define $y_r^{\mathrm{T}}=[y_r(t+1),\cdots,y_r(t+N_1)]$，

According to the above definition formula (3) can be written:

$$J=E[(y-y_r)^{\mathrm{T}}(y-y_r)+u^{\mathrm{T}}Qu] \quad (7)$$

Among them, Q is N* N matrix:

$$Q=\mathrm{diag}\{Q(z^{-1})\}=Q_0+Q_1z^{-1}+\cdots+Q_lz^{-l}$$

and

$$Q_0=\mathrm{diag}\{q_0^1,\cdots,q_0^N\}\ Q_i=\mathrm{diag}\{q_i^1,0,\cdots,0\}\ i=1,2,\cdots,l$$

The formula (6) into (7), *J* is vector minimum control law can be written as:

$$u=(G^{\mathrm{T}}G+Q_0)^{-1}G^{\mathrm{T}}[y_r-Fy(t)-H\Delta u(t-1)+\sum_{i=1}^{l}Q_iz^iu] \quad (8)$$

According to the rolling optimization and feedback correction principle of the generalized predictive control algorithm,Formula (8) can be converted to the following formula (9):

$$\begin{aligned}u(t)=u(t-1)&+\sum_{j=1}^{N}p_jy_r(t)-\sum_{j=1}^{N}p_jF_j(z^{-1})y(t)\\ &-\sum_{j=1}^{N}p_jH_j(z^{-1})\Delta u(t-1)+p_1\sum_{i=1}^{l}q_i^1\Delta u(t-i)\end{aligned} \quad (9)$$

And (2) can be expressed as

$$u(t)=u(t-1)+K_Iy_r(t)-L(z^{-1})y(t) \quad (10)$$

Among this ,

$$\begin{aligned}L(z^{-1})&=(1-z^{-1})K_P+K_I+(1-z^{-1})^2\\ K_D&=K_P+K_I+K_D-(K_P+2K_D)z^{-1}+K_Dz^{-2}\end{aligned} \quad (11)$$

Comparison (9), (10), visible, if the order (9) the right end of the and the last two,

$$\sum_{j=1}^{N}p_jH_j(z^{-1})\Delta u(t-1)=p_1\sum_{i=1}^{l}q_i^1\Delta u(t-i) \quad (12)$$

So,

$$K_I=\sum_{j=1}^{N}p_j\ L(z^{-1})=\sum_{j=1}^{N}p_jF_j(z^{-1})=\sum_{j=1}^{N}p_j(f_0^j+f_1^jz^{-1}+f_2^jz^{-2}) \quad (13)$$

And then $l=N$, the formula (12) on both sides of the expansion and so that the corresponding coefficient of equal, it can be drawn

$$q_i^1=\frac{1}{p_1}\sum_{j=1}^{N}p_jh_{i-1}^j \qquad i=1,2,\cdots,l$$

By (11), (13) two type available

$$\begin{aligned}&K_P+K_I+K_D-(K_P+2K_D)z^{-1}+K_Dz^{-2}\\ &=\sum_{j=1}^{N}p_j(f_0^j+f_1^jz^{-1}+f_2^jz^{-2})\end{aligned} \quad (14)$$

$$K_P = -\sum_{j=1}^{N} p_j\left(f_1^j + 2f_2^j\right) \quad K_I = \sum_{j=1}^{N} p_j \quad K_D = \sum_{j=1}^{N} p_j f_2^j$$

$$u(t) = u(t-1) - \sum_{j=1}^{N} p_j\left(f_1^j + 2f_2^j\right)\left[y(t-1) - y(t)\right]$$

$$+\sum_{j=1}^{N} p_j\left[y_r(t) - y(t)\right] + \sum_{j=1}^{N} p_j f_2^j\left[2y(t-1) - y(t-2) - y(t)\right]$$

$$= u(t-1) - K_P\left[y(t-1) - y(t)\right]$$

$$+K_I\left[y_r(t) - y(t)\right] + K_D\left[2y(t-1) - y(t-2) - y(t)\right]$$

The block diagram of the generalized predictive control system with PID is shown in the following figure.

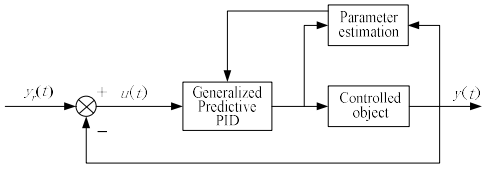

Fig 3 Generalized Predictive PID Control system block diagram

3. The simulation results

In the experiment, according to the pH value control requirements of the sewage plant, the control target pH setting value is set to 7,In the case of pH value of sewage, the conventional PID controller and the generalized predictive PID control system are compared.According to the control system response curve, the PID parameter tuning controller based on generalized predictive control is better to solve the nonlinear control problem of pH neutralization process.Compared with the traditional PID control, the overshoot is reduced, the response speed is accelerated, and the steady state performance is improved, and the control effect is good.

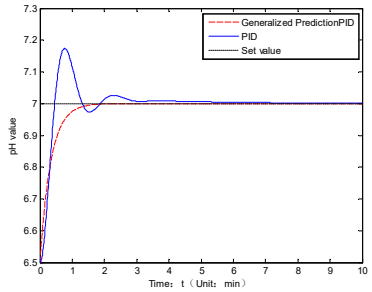

Fig 4 PID and Generalized Predictive PID response curve contrast figure

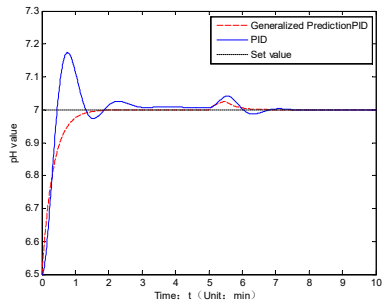

Fig 5 PID and Generalized Predictive PID response curve contrast figure after adding disturbance

Aiming at the large disturbance of the pH value of sewage,In sixth minutes adds a big disturbance, as shown in figure, the response curve shows that the generalized predictive PID has better anti-interference ability.

5. CONCLUSION

The experimental results show that the generalized predictive PID has good control effect in solving the control problems of large time delay, nonlinear, strong interference and so on.Although the application of the traditional PID control is simple, but in some special engineering practice, the control effect is not very good to achieve the predetermined control requirements,Therefore, it is better to apply the idea of generalized predictive value to the industrial process control system, which can better meet the control requirements of pH value of pH in sewage treatment system.

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Comparison of Several Histogram Equalization Methods

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Abstract: For the image under different lighting conditions, several classic image enhancement histogram equalization methods are introduced. By comparing the experiment, the treatment effect of these methods are analyzed; the scope and the advantages and disadvantages of these methods are indicated.

Keywords: Light environment Histogram equalization Image Enhancement

1. INTRODUCTION

Image enhancement is an essential step in image processing. histogram equalization as a classic, simple and effective image enhancement method is widely used inImage preprocessing.

The histogram is displayed for each gray level probability plot ratio of the number of total pixels of the image. when it is in uniform distribution, the image of the information entropy, and more information contained in the image, and then this image seems clearer. [1-3]。The histogram equalization method mainly includes the global histogram equalization and the local histogram equalization [4].Because the global histogram equalization is to make the entire image with a mapping transformation， contrast stretching is suppressed in some regions and Some details can not be effectively enhanced by Histogram equalization [5]；

Local histogram equalization,which is widely used, have been proposed to compensate for this deficiency. Local histogram equalization is divided into sub-blocks do not overlap, overlapping sub-block, sub-block section of overlap[6-8].

2. ALGORITHM INTRODUCTION

2.1 Global histogram equalization method

2.1.1 Algorithm principle

The basic idea of global histogram equalization algorithm is to make some mapping transformation to the pixel intensity in the original image, so that the gray probability density of the processed image is evenly distributed and Image contrast is improved by expanding the dynamic range of the image.

It is used to determine the value of its output gradation corresponding to the gradation according to the probability distribution of the input image and determine the cumulative distribution function is the key of the method.

In successive images, for example, provided the cumulative transfer function is:

$$s = T(r) = \int_0^r p_f(v)dv \tag{1}$$

In the formula (1), v is the variable of integration。 $T(r)$ satisfied: $0 \le r \le 1$, $T(r)$ single-valued and monotonically increasing in the range [0,1].

The r derivative of formula (1):

$$\frac{ds}{dr} = p_f(r) \tag{2}$$

The formula (2) into (1), we get:

$$p_s(s) = [p_f(r) \bullet \frac{dr}{ds}]_{r=T^{-1}(s)}$$

$$= \left[p_f(r) \bullet \frac{1}{\frac{ds}{dr}} \right]_{r=T^{-1}(s)} = [p_f(r) \bullet \frac{1}{p_f(r)}] = 1 \tag{3}$$

the formula (3) shows that the probability density transformed in its domain of definition is homogeneously distributed.

After the continuous image of discrete formula, you can get a digital image correlation expression:

Probability distribution is:

$$p_f(r) = \frac{n_k}{n} \quad k = 0,1,2,...,L-1 \tag{4}$$

Cumulative distribution function is:

$$s_k = T(r_k) = \sum_{j=0}^{k} \frac{n_j}{n} = \sum_{j=0}^{k} p_f(r_j) \; k = 0,1,2,...,L-1 \tag{5}$$

In formula (4),(5)， k is the gray level of Image pixels; L =256, is the total number of gray levels; n_k represents the number of gray levels of first-class k , n is the total pixels of the image。

2.2 Local histogram equalization method

2.2.1 Non-overlapping sub-block method

the image is divided into a series of non overlapping sub blocks by Non-overlapping sub-block method, and then the histogram equalization is performed separately for each sub block. This can effectively enhance the image of the local contrast and some details, but the output image will have a significant block effect.

2.2.2 Sub block overlap method

Firstly， a rectangular sub-block in the upper left corner of the image is defined in Sub block overlap method, Pixel sub-blocks of the center are equalized using histogram information of sub-block. Then the center of sub-blocks from a pixel to another pixel, until all of the pixels in image is completely processed.

This method can adequately strengthened local details of the image, and the complete elimination of the sub-block effects. However, since the total number of sub-blocks balance equal to the total pixels of the image, so the algorithm running time is very long. For large-size images, this shortcoming will be reflected in very obvious.

2.2.3 Sub block partial overlapping method

The main difference between the overlapping method and the sub block is that all the pixels in the rectangular block should be balanced. Then repeat the above process with a certain step size, until all the pixels in the image are processed. For a number of balanced pixels, the average value is calculated as the gray value of the pixel.Compared with the sub block does not overlap, the block effect can be reduced; Compared with the Sub block non overlapping method，program running time is greatly reduced.

3. EXPERIMENTAL RESULT

In this paper, the original size of the 3 images are 640×480 and the image format is JPG, carrying out the experiment in 2010a Matlab environment.

3.1 Global histogram equalization experiment

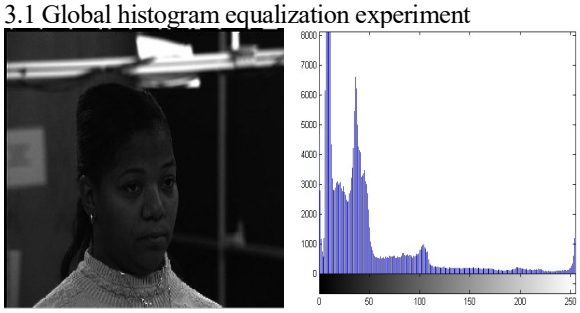


Figure 1 The original image one and its histogram

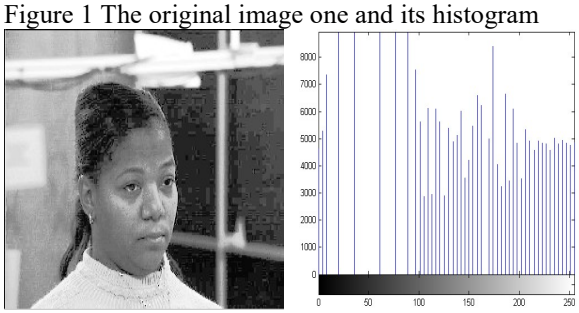


Figure 2 Result of image one by histogram equalization algorithm and its histogram

We can see from Fig. 1: The original image is dark overall and pixels in the histogram are mainly concentrated in the low gray area, the image pixels on a high gray level and rarely distributed evenly.

Fig. 2 shows that: brightness and contrast are improved greatly,And the whole face is showing out of the dark background. However, the visual effect is not satisfactory due to the presence of significant noise figure and over enhancement. The histogram of the image in the low gray level region is missing some gray level, while in the high gray level, the pixel is greatly increased after transformation.

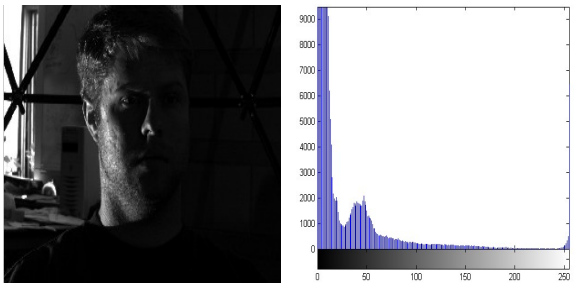


Figure 3 The original image two and its histogram

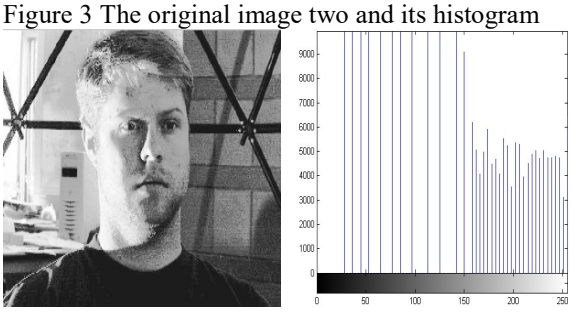


Figure 4 Result of image two by histogram equalization algorithm and its histogram

We can see from Fig. 3: The light of right area of the original image 2 is insufficient and the local contrast is poor.The right side of the face submerged in the dark background, making it difficult to see the whole face. According to the histogram, most of the pixels are located in the low gray scale, and missing some of the high gray level .

We can see from Fig. 4: The overall brightness of the processed image is improved. The right area of the face are improved obviously, and the details of the face and the dark area are enhanced, and the visual effect of the original image is improved.

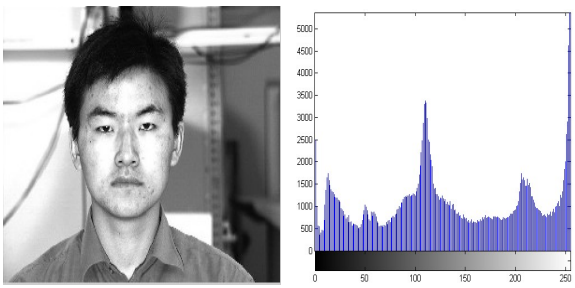


Figure 5 The original image three and its histogram

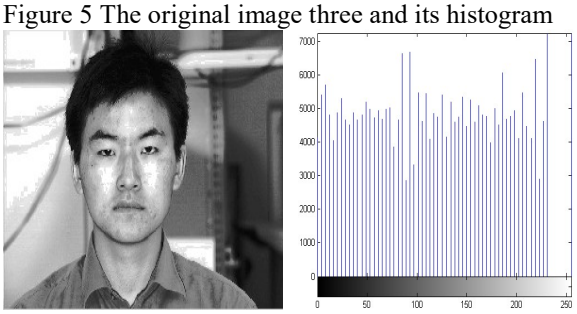


Figure 6 Result of image three by histogram equalization algorithm and its histogram

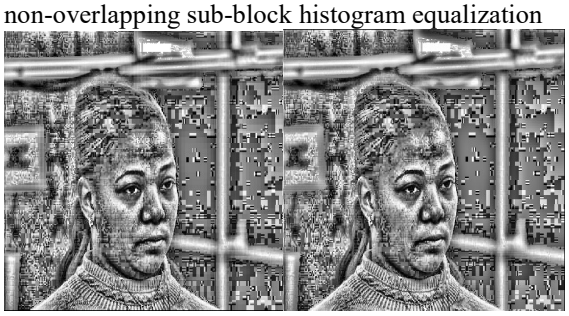
We can see from Fig. 5:The overall brightness of the original image 3 is high. High light phenomenon appeared in the cheeks, forehead of people and the upper left corner of the imge, and some part of the local

information of the face is lost.

We can see from Fig. 6: High light phenomenon of cheeks and forehead was suppressed on a certain extent after experiments and the effect is improved integrally.

3.2 Local histogram equalization experiment

Figure 7 The original image one and result by non-overlapping sub-block histogram equalization



a) Sub-block size is 40×30 and Step is 10×8 b) Sub-block size is 40×30 and Step is 4×3

c) Sub-block size is 160×120 and Step is 40×30 d) Sub-block size is 160×120 and Step is 16×12

Figure 8 Result of image one by partially overlapped sub-block histogram equalization

a) Sub-block size is 201 × 201 b) Sub-block size is 401×401

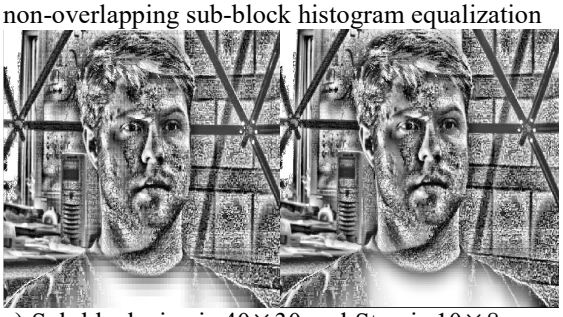
Figure 9 Result of image one by overlapped sub-block histogram equalization

We can see from Fig. 7: The local contrast and the brightness of the face is increased, the details of the left side face is effective to enhance by sub-blocks do not overlap algorithm; But the image is seriously blocking phenomenon, luminance of each sub-block difference between each other. And there are more noise figure, the entire image looks unnatural.

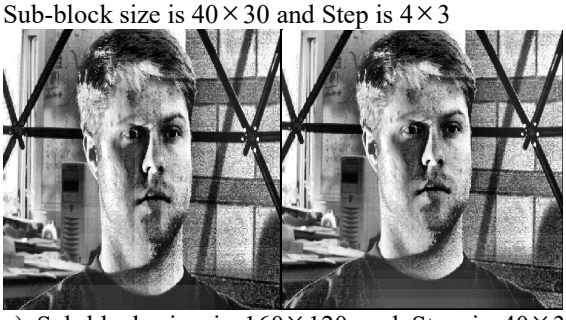
We can see from Fig. 8: When the sub block partial overlapping algorithm is used, the smaller the size of the image with the same sub block size is better; If constant step size and the proportion of the sub block, the smaller the sub block, the block effect is more significant, and the image effect is worse;The block effect basically eliminated when the block size is 160×120 and step is 16×12.

We can see from Fig. 9:The block effect can be eliminated and the equilibrium results of each sub block are consistent with sub block overlapping algorithm in the condition of sub block scale is201 × 201 or 401×401; The images are accompanied by more noise; In comparison, the image effect is better when the sub block size is 401×401.Compared with the former two methods, image in the experiment of sub block overlapping best in improving face brightness and contrast and noise is less, no massive phenomenon, highlighting the facial details, with more natural visual effect.

Figure 10 The original image two and result by non-overlapping sub-block histogram equalization



a) Sub-block size is 40×30 and Step is 10×8 b) Sub-block size is 40×30 and Step is 4×3



c) Sub-block size is 160×120 and Step is 40×30 d) Sub-block size is 160×120 and Step is 16×12

Figure 11 Result of image two by partially overlapped sub-block histogram equalization

a) Sub-block size is 201 × 201 b) Sub-block size is 401×401

Figure 12 Result of image two by overlapped sub-block histogram equalization

We can see from Fig. 10: There is block effect phenomenon using the sub block non overlapping algorithm on image 2.Compared with the image 1, the equalization effect of each sub block is better, without obvious noise.The right part of face is highlighted from the dark areas of the original,and the details of the local contrast was improved obviously.

We can see from Fig. 11:Under the condition of block size is 30×40, the image detailwas enhanced, but there is obvious block phenomenon on the face, and a part of the diagram was enhanced excessively.Under the condition of block size is 160×120, the details and the local contrast is fully enhanced, and the block effect is eliminated and the image level is strong when the step size is 16×12.

We can see from Fig. 12: The sub block overlap algorithm improves the visual quality of the image and completely eliminates the block effect. The enhancement effect is better when the sub block size is 401×401 in contrast.

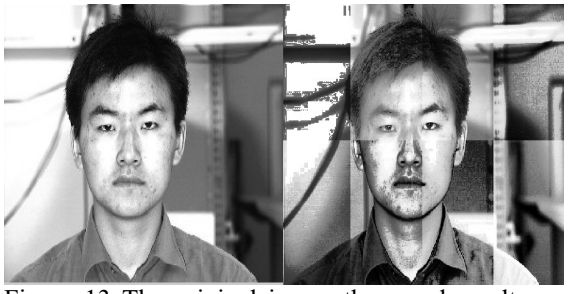
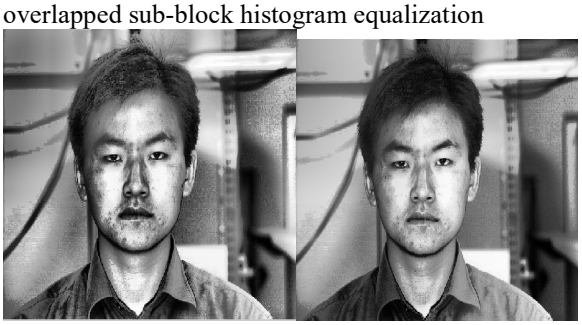


Figure 13 The original image three and result by non-overlapping sub-block histogram equalization

a) Sub-block size is 40×30 and Step is 10×8 b) Sub-block size is 40×30 and Step is 4×3

c) Sub-block size is 160×120 and Step is 40×30 d) Sub-block size is 160×120 and Step is 16×12

Figure 14 Result of image three by partially overlapped sub-block histogram equalization



a) Sub-block size is 201×201

b) Sub-block size is 401×401

Figure 15 Result of image three by overlapped sub-block histogram equalization

We can see from Fig. 13 to Fig. 15： For image three, the results by the three methods are not ideal, and the face of the phenomenon of high light always exists. At the same time, the sub block does not overlap with the sub block overlap algorithm.

4. CONCLUSION

The global histogram equalization method is simple and efficient, and its effect is better for the dark image. The global histogram equalization method can effectively improve the brightness and the contrast of the whole image, and not be applied to enhance the image of light and even high light.

Three local histogram equalization methods can effectively enhance the local details in the image and enhance the local contrast, but the image processing may appear over enhancement and noise phenomenon.In contrast, the overall visual effect of the sub block overlapping algorithm is the best, which can completely avoid the phenomenon of blocking;There is significant block effect of sub block non overlapping algorithm due to sharply difference of histogram equalization function of each sub-block.

5. ACKNOWLEDGEMENTS

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Error Analysis of the On-Line Measurement System for the Precision Grinding of Mid-Large-Aperture Aspheric Surface

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Abstract: In this study, the mathematical model of each axis of the aspheric grinding machine had been proposed by analyzing the machining principle of the envelope method for the mid-large-aperture optical axial symmetry aspheric surface. The optical aspheric surface precision grinding machine tool had been developed and the on-line measurement system had been designed by using the digital inductance micrometer. Did the on-line measurement on the machined optical aspheric surface and analyzed and modified the coordinate non coincidence error during the measuring process. A grinding experiment and on-line measurement of a 330×330mm square optical aspheric surface had been done on the developed grinding machine. The surface precision value PV of the aspheric surface is less than 3μm. The surface accuracy is satisfied with the on-line measurement requirement of the large quantities aspheric machining.
Keywords: Axial symmetry mid-large-aperture optical aspheric surface; Precision grinding; On-line measurement system

1. INTRODUCTION

In recent years, the development of high precision optical instrument towards to the direction of high precision, high image quality, small volume and light weight with the development of aerospace, laser technology and detection technology.[1] Due to its excellent optical properties, the optical aspheric surface element has gradually become the main imaging element of high precision optical instruments. The surface accuracy requirement of optical aspheric surface element is high. But the traditional methods of grinding and polishing the aspheric surface has the disadvantages of low processing efficiency, high cost and not suitable for mass production. [2]In order to improve the machining efficiency and precision of the optical aspheric surface element a series of research has been done by the experts both here and abroad.

America is the first country to research on the automatic machining of the aspheric surface, the Polariod company produced the world's first aspheric mirror in 1940. In the 1980s, Changchun institute of optics, fine mechanics and physics introduced the MSG-250CNC ultra precision diamond turning machine that is producted by the Pneumo Rank company in order to produce the aspheric surface in the field of aerospace. Based on that, the first CCOS optical aspheric numerically controlled machining center FSGJ-I had been developed in China. By using the machining center, the surface accuracy of the aspheric mirror can reach λ/50(12.656 nm), and the surface roughness value Ra can reach less than 3nm.

2. THE GRINDING PRINCIPLE AND EQUIPMENTS OF OPTICAL ASPHERIC ELEMENT

2.1 the envelope grinding theory for aspheric surface

When the generation line rotates about its rotational axis, the surface of revolution will form. This is the structural feature of the axial symmetry aspheric surface. The aspheric surface meridional transversal is the rotational generation, the mathematical expression of the curvilinear equation is:[3]

$$Z(x)=\frac{cx^2}{1+\sqrt{l-c^2(k+1)x^2}}+dx^4+fx^6+gx^8+\cdots \quad (1)$$

Where c=$1/R_0$ is the surface vertex curvature, R_0 is the surface vertex curvature radius, k is the quadric surface eccentricity function, z is the rotational axis of the axial symmetry aspheric surface, d *and* f are the higher term coefficientof the equation.

The envelope grinding theory for aspheric surface was shown in the Fig. 1. In grinding processing, along the aspheric surface optical element meridian, the X、Y、C axis achieved interpolation motion. It ensured that grinding point was always tangent to the aspheric optical element surface. Through the work piece rotary motion, wheel feed movement and rotational motion of wheel spindle turntable, the aspheric optical could be grinded out. According to the envelope grinding theory, the equations of motion of each axis are:

$$\begin{aligned} X &= x_i - R_w \times Sin\left(\arctan(f'(x_i))\right) \\ Z &= f(x_i) + R_w \times Cos\left(\arctan(f'(x_i))\right) \\ C &= \arctan(f'(x_i)) \end{aligned} \quad (2)$$

Where X, Z, C are the control center coordinates of the machine tool, x_i is the interpolate point x position of the axial symmetry aspheric surface generation, $f(x_i)$ is the axial symmetry aspheric surface generation function and R_w is the plat wheel radius.

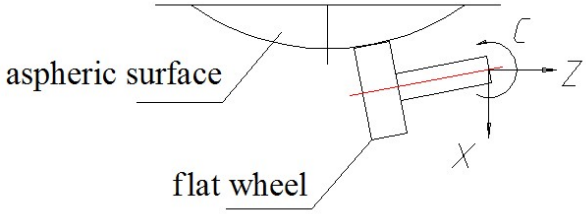


Figure 1 The theory of the plat wheel grinding the aspheric surface

2.2 the on-line measurement equipment

The role of the aspheric surface on-line measurement are providing data for error compensation machining, evaluating the surface quality of the machined workpiece and providing the original data for the subsequent polishing stage.[4] In the process of aspheric surface machining, the on-line measurement accuracy is directly related to the quality of the machined surface. So, in this paper, a kind of inductive on-line contact measurement system had been developed aimed at the designed aspheric surface precision grinding machine, as shown in Fig. 2. The on-line measurement system is consisted by the following parts: ultra precision CNC grinding machine, servo system, numerical control system (CNC), DGS-6G inductance micrometer with the resolution of 0.09um, sensor interface circuit, sensor measurement and control module, wireless data transmission module, industrial control computer, on-line measurement software and error compensation software. The differential transformer type inductance displacement sensor is arranged on the grinding wheel spindle and it can move along with the machine tool. The on-line measurement software and the error compensation software are running on the industrial control computer system. And the industrial control computer is connected with the numerical control system through the local area network. During the detection process, the workpiece kept the clamping and locating state in the machining process, and the axis of the sensor air flotation measuring head and the workpiece spindle are always keeping in the same line. In this way, the device can ensure the localization relation of the workpiece and tool during the machining process, and avoid the location error during the dismantlement.

Figure 2 Aspheric precision grinding machine

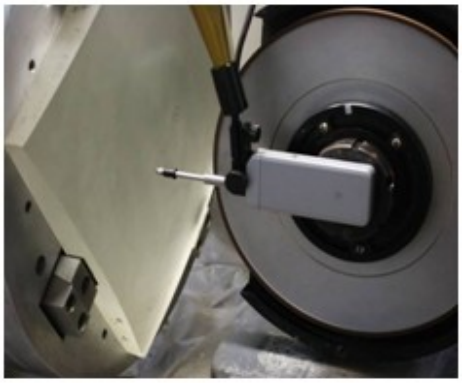
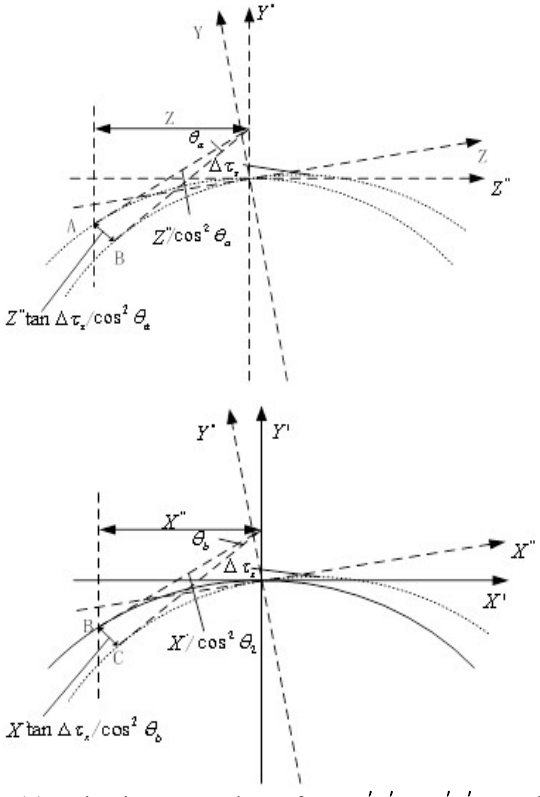


Figure 3 Ultra precision aspheric grinding machine

3. ERROR ANALYSIS AND REVISION

The on-line measurement adopted the rectangular coordinate system. Because the rod is not vertical and the measuring jip has dip angle, the measuring coordinate system does not coincide with the workpiece coordinate system and lead to error. [5,6] Set the XYZ coordinate system for the measuring coordinate system and the *X′Z′Y′* coordinate system for the workpiece coordinate system. The *X″Y″Z″* coordinate system is the transition coordinate system that is get by rotating the measuring coordinate XYZ around the X axis, as shown in Fig. 4(a) and (b). Because the non coincidence error of the coordinate measuring coordinate system and the measured workpiece ideal coordinate in the direction of X axis and Z axis. The dip angle error is generated and has an influence on the measurement of workpiece surface.



(a)Projection graph of $Y''Z''$ plane

(b) Projection graph of $X''Y''$ plane

Figure 4. The influence of the angle error of coordinate system on the measurement accuracy

Set the coordinate of point A under the XYZ coordinate system for(*X,Y,Z*). The corresponding point of point B under the transition coordinate system is the coordinate of point B under the measuring coordinate system, and set the coordinate of point B for(*X''Y''Z''*). The corresponding point of point C under the workpiece coordinate system is the coordinate of point C under the transition coordinate system, and set the coordinate of point C for(*X'Y'Z'*). So the coordinates of point A and point B are satisfied with the following relationship:

$$\begin{cases} Z'' = Z - (\dfrac{Z}{\cos(\theta_\alpha + \Delta_{\tau_z})} - \dfrac{Z}{\cos\theta_\alpha}) \cdot \cos\theta_\alpha \\ X'' = X \\ Y'' = Y - (\dfrac{Z''}{\cos(\theta_\alpha + \Delta_{\tau_z})} - \dfrac{Z''}{\cos\theta_\alpha}) \sin\theta_\alpha \end{cases} \tag{3}$$

The coordinates of point B and point C are satisfied with the following relationship:

$$\begin{cases} X'' = X - (\dfrac{Z''}{\cos(\theta_\alpha + \Delta_{\tau_Z})} - \dfrac{Z''}{\cos\theta_\alpha}) \cdot \cos\theta_\alpha \\ Z' = Z'' \\ Y' = Y'' - (\dfrac{Z''}{\cos(\theta_\alpha + \Delta_{\tau_Z})} - \dfrac{Z''}{\cos\theta_\alpha}) \cdot \sin\theta_\alpha \end{cases} \tag{4}$$

In this way, the coordinate of point B and θ_a can be calculated through the coordinate of point A under the measuring coordinate system and the coordinate of point C and θ_b can be calculated through the coordinate of point B. The vertical distance between point B and point C is the error generated by the dip angle $\triangle_{\tau X}$. The formula of the error is :

$$E_{\Delta\tau_X}(\theta_b) = \frac{X' \cdot \tan\Delta\tau_x}{\cos^2\theta_b} \tag{5}$$

The vertical distance between point A and point B is the error generated by the dip angle $\triangle_{\tau Z}$. The formula of the error is :

$$E_{\Delta\tau_Z}(\theta_a) = \frac{Z'' \cdot \tan\Delta\tau_z}{\cos^2\theta_a} \tag{6}$$

The total surface error is:

$$E_{\Delta\tau}(\theta) = E_{\Delta\tau_x}(\theta_a) + E_{\Delta\tau_z}(\theta_b) = \frac{Z'' \cdot \tan\Delta\tau_z}{\cos^2\theta_a} + \frac{X' \cdot \tan\Delta\tau_x}{\cos^2\theta_b} \tag{7}$$

In order to modify the surface measurement error, $\triangle_{\tau X}$ and $\triangle_{\tau Z}$ are got by separating the coordinate system dip angle error that is shown in Fig. 4. The coordinate change formula is :

$$\begin{bmatrix} X' \\ Y' \\ Z' \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\Delta\tau_x & \sin\Delta\tau_x \\ 0 & -\sin\Delta\tau_x & \cos\Delta\tau_x \end{bmatrix} = \begin{bmatrix} \cos\Delta\tau_z & 0 & \sin\Delta\tau_z \\ 0 & 1 & 0 \\ -\sin\Delta\tau_z & 0 & \cos\Delta\tau_z \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} \tag{8}$$

Where the coordinate(*X*、*Z*、*Y*) is the coordinate under the measuring coordinate system, and the coordinate(*X'*、*Z'*、*Y'*)is the coordinate under the workpiece coordinate system.

4. THE SURFACE MEASUREMENT EXPERIMENT OF MACHINED SURFACE

In this study, a grinding experiment of 330×330mm square aspheric surface element had been done on the developed mid-large-aperture optical aspheric surface precision numerical control grinding machine. Choose the 250Dx175Hx5Xx25T-SD80# plat wheel and linear interpolation method to do the grinding experiment. The on-line measurement of the machined aspheric had been done by using the developed on-line measurement system, as shown in Fig. 5. Fig. 6 shows the measured surface error curve, and the surface error value PV is less than 3μm.

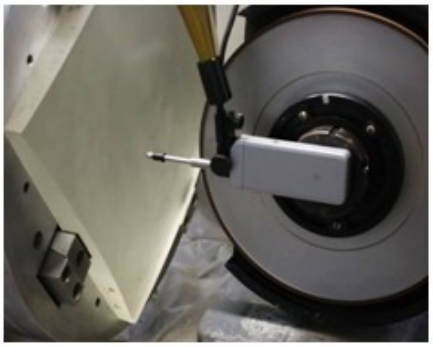


Figure 5 The hardware of on-line

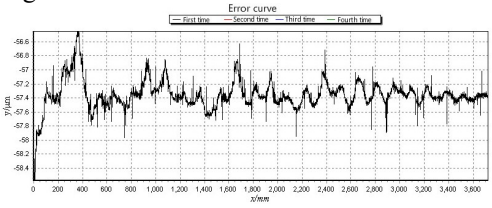


Figure 6 Surface detection result of aspheric measurement system experiment surface machining

5. CONCLUSION

In this study, the mathematical model of each axis of the aspheric grinding machine had been proposed by analyszing the principle of the envelope method for the mid-large-aperture optical aspheric surface. High precision optical aspheric surface grinding machine tool and on-line surface measurement system had been developed, and the grinding and detection experiment had also been done on the equipment. The experiment results are shown as follow:

(1)The aspheric surface on-line measurement system that is aimed at the aspheric surface grinding machining had been designed based on the contact measuring method. The detection accuracy is 0.01um.

(2)The coordinate non coincidence error had been analyzed according to the aspheric surface on-line measurement system. The correction method had been proposed and the on-line measurement data had been modified by using the method.

(3) The grinding experiment and on-line measurement of 330×330mm square aspheric surface element had been done on the developed optical aspheric surface on-line measurement system. The surface accuracy valve PV of the aspheric surface is less than 3μm.

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Fresh Agricultural E-Commerce Product Routing Problem Is Considering Equally Desire of Customer

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Abstract: Aiming at fresh agricultural e-commerce product routing problem under uncertain environment, considering the characteristic of the bounded rational of customer decision, fresh agricultural e-commerce product routing optimization model was established based on Cumulative Prospect Theory (CPT). According to the characteristics of fresh agricultural e-commerce supplier for fresh features, using minimum cargo damage costs, transportation costs and the penalty costs as objective, the agents point demand, goods loading and times window of logistic services to customer requirements as constraints. An improved Particle Swarm Optimization algorithm was respectively used to solve the model. Quoted the corresponding reference examples and make a comparison with others algorithms models. Simulation and test results showed that, the model based on CPT meted customer requirements for time window more accurately and helped to improve customer satisfaction, to provide theoretical support for the fresh E-commerce suppliers to optimize the distribution path.

Keywords: CPT; Vehicle routing problem; Fresh e-commerce; Time windows; An improved Particle Swarm Optimization

1. INTRODUCTION

The circulation of fresh agricultural products in China has the following characteristics: [1]1) high circulation cost; 2) disadvantage circulating pattern; 3) circulation is in chaos; 4) wholesale occupies an important position; 5) the fairs is the main place for consumers to obtain fresh agricultural products; 6) individual farmers are the main powers in the circulation of fresh agricultural products. There are three main modes of fresh agricultural products logistics distribution: [2]1) self-distribution mode; 2) 3PL distribution mode; 3) O2O distribution models.

Domestic fresh e-commerce was began in 2005, the foundation of Yi Guo net, the 2012 known as the first year of e-commerce [4] because the events of Chu Cheng to Beijing and cortical litchi wars.[3] Fresh electricity market potential is huge, broad prospects for development, but the profit situation is far from the expected assumption, is only 1%.[5] Throughout the several effects of fresh business profit factors , there are two reasons occupies the first place, one is the lag in the development of China's cold chain logistics, it is not up to the requirements of the development of fresh electricity suppliers; the second is all sorts of uncertain factors leading to the high cost of fresh business distribution.

Vehicle Routing Problem (VRP) is an important constituent modern logistical system. Proposed by Dantzig et al. [6]Say simply, is optimize the path of freight-receiving points (or freight-delivery points), improve vehicles 'efficiency, under the corresponding constraints, to achieve the corresponding purpose (the shortest distance, least funds, little time consuming, etc.).[7]Vehicle Routing Problem with Time Windows (VRPTW), is on the basis of VRP and the customers are limited by the time window of the visit. Including soft time window and hard time window. In this paper, the vehicle routing optimization model with soft time window is established. Soft time window is mainly to emphasize the customer in the distribution of service time to arrange more in line with their own schedule.

Until now, the research for vehicle routing problem most using ant colony algorithm, [8] genetic algorithm, [9] and particle swarm algorithm [10] and other heuristic algorithms, and has some achievements. While fresh e-commerce distribution and traditional distribution are different, fresh food has the characteristics of high cost and high losses, more attention to the timeliness of distribution than traditional distribution, [11] compared with the traditional distribution of the path optimization research fresh e-commerce suppliers distribution path optimization is still in its initial stage. Linde based on the e-commerce. Convenience stores distribution and urban goods distribution in the field of ‘last mile’ distribution involves the elements and activities, gives a clear definition of “last mile "logistics. [12]Gevaers et al pointed out that the road congestion, delivery failure and the non-optimal loading rate will increase the cost and reduce efficiency of the last mile distribution, [13]Gong Shu Sheng, and Liang Huai Lan et al [14] were studied on cold-chain logistics network of fresh food. Wang Hong Ling et al [15] fresh agricultural products in transit time is the shortest, the minimum distribution cost as the optimization objective to study the distribution path of agricultural products.

However, most frequently used path optimization method under the assumption of investor are totally

rational people, standard of choosing the path which effects or reliability of distribution, while ignoring the impact of weather, road conditions, human factors and other uncertainties, resulting in a certain deviation of the results of the distribution scheme.

Distribution path optimization largely depends on the transportation system, while it is a typical uncertain system that easily affected by two aspects of supply and demand.[16]With the development of behavioral science and psychology, under uncertainty conditions, people's decision making behavior appeared with rational characteristics, easily affected by personal preference and attitude towards risk. Kahneman et al offers prospect theory (PT) [18] and cumulative prospect theory (CPT) [19] based on the bounded rationality hypothesis of Simon et al. [17] A more accurate description of people's actual decision-making process. At present, there are scarce literature on the path optimization based on cumulative prospect theory, Xu Hong Li et al [20] analysis and empirical on the behavior rules of route selection based on prospect theory. But the model assumes that the traveler can fully master the road network conditions, which is not accord with the fact; Ren Liang et al [21]establishing a fourth party logistics routing problem considering tardiness aversion behavior of customer based on cumulative prospect theory. Model does not take the strict requirements of customers on time into account. Based on the existing literate, especially for the customer's finer details requests for time windows, established a model through flexible adjustment penalty coefficient to meet the requirements of different customers for time windows and save business distribution costs.

2. PROBLEM DESCRIPTION

Fresh electricity suppliers' distribution issue can be described as, customer placing orders after the website or mobile app, merchants planning of vehicle routing, regardless of whether it is a business on their own distribution or through third party distribution, are the first to the corresponding agents (or proprietary point, smaller pickup centers),and then according to the customer's address for refining and distribution, this research is based on the study of the path optimization problem of city distribution center to each agent point. Compared with classical VRP problem [22] to add the constraint conditions are as follows: 1) increases the cargo damage cost for the characteristics of perishable fresh food; 2) increases the penalty cost for the temporal characteristics of e-commerce's distribution; 3) application cumulative prospect theory to assign unit penalty coefficient; 4) the load of each truck is the same, keep the speed constant, The delivery time is only related to the distribution distance. The objective is to minimize the total cost.

Model parameters and variables are described as follows:

(1)Parameters

c_{ij} is the transportation cost through i to j; l number of vehicles in the distribution center; b_k express the load of each vehicle; w_i represents the demand for each agent point; cs the cargo damage cost; α unit time damage coefficient; p the prices in the catalog; L_{vi} client allow service start time; U_{vi} client allow service latency time; $[e_i, l_i]$ the time window for each proxy endpoint i; c_{ei}, c_{li} express unit penalty coefficient; t_{0l} express vehicle l departure time; t_{il} represents the time that the vehicle l reaches the proxy point i; t_{ij} driving tine from agent point i to j; s_{ei} represents the service start time of the agency point i; s_{li} time for service termination; s_i said the vehicle the service time needed to complete the task $T_{\max}$ show the maximum waiting time; Q_i show the punishment cost, the definition is as follows:

$$Q_i = \begin{cases} \infty, & s_{ei} \le L_{vi} \\ c_{ei}(e_i - s_{ei}), & L_{vi} \le s_{ei} < s_{ei} \\ 0, & e_i \le s_{ei} \le l_i \\ c_{li}(s_{ei} - l_i), & l_i < s_{ei} \le U_{vi} \\ \infty, & U_{vi} \le s_{ei} \end{cases} \quad (1)$$

(2) Variables

The distribution model is abstracted as a multiple graph $R(V,E)$.Among them $V(|V|=n)$ stand for the distribution center and various agencies, in which the distribution center is numbered 0, $1,2,\ldots,n$ stand for agencies, E represents a collection of selectable distribution lines. Both distribution tasks and center are represented by point $i(i=0,1,2\ldots n)$.

Define variables as follows:

$$x_{ijl} = \begin{cases} 1 & \text{the car l from point i to j} \\ 0 & \text{other else} \end{cases}$$

$$y_{li} = \begin{cases} 1 & \text{agent point i tasks completed by the car l} \\ 0 & \text{other else} \end{cases} \quad (2)$$

Most electricity logistics transportation with the characteristics of small batch, multi-batch, mass clients and allocation difficult, its transportation time is very difficult to precise positioning, generally described in discrete time. So, set the total delivery time t_{ijl} for a time period of discrete type random variable, obey the n points evenly distributed, and are independent of each other.

G said a pathway from the starting point to the destination node, is the optimized distribution line, $t(G)$ is the transit time of G, k stand for the number of agents in the G contained $(k \in n)$.

$$t(G)=\sum_{i}\sum_{j}\sum_{l}t_{ijl}x_{ijl}+(k-1)s_i \tag{3}$$

The problem to be solved in this paper is as follows: in the final refinement of the distribution stage of the distribution time is uncertain, provide a set of distribution solutions for ecommerce merchants about the transport task from the corresponding pickup centers to the customer, the scheme is required to meet the certain constraints: transportation time and Load weight. Customers have specific requirements for time windows, and expect to be served in a certain period of time.

3. DECISION SCHEMES BASED ON CPT

From vehicle routing problem with soft time windows (VRPSTW) knowing When the distribution time between L_{vi}, e_i and l_i, U_{vi}, is required to give customers a certain compensation, however, the requirement of penalty coefficient is relatively fuzzy, this paper introduces CPT determine the unit penalty coefficient by comparing the prospect value of transportation time on the distribution route, to fine tune the distribution line. And the product of the value function and the decision weight function can be expressed by the prospect value. That is:

$$c_{ei}=c_{li}=kc_0 \tag{4}$$

Where c_0 is fixed penalty factor determined by merchant, k as constant, to represent the urgency of the customer's request for time windows.

2.1 Cost functions

The determination of cost function is closely related to the selection of reference point, this paper assumes that the customer's expectations of distribution time, the reference point for the t_0. For each alternative G, when $t(G)>t_0$, the arrival time later than the customer expected time, performance as a loss; when $t(G)<t_0$, the arrival time earlier than the customer expected time, performance at a profit. The cost function can be expressed as:

$$v[t(R)]=\begin{cases}[t_0-t(G)]^{\alpha}, & t(G)\le t_0\\ -\lambda[t(G)-t_0]^{\beta}, & t(G)>t_0\end{cases} \tag{5}$$

On type $0<\alpha$，$\beta\le 1$ were characterized the concave and convex degree of cost function gains and losses, that reflects the customer's sensitivity to gains and losses; $\lambda\ge 1$, sensitivity coefficient for the loss of relative gain, λ is more averse to loss of customers, namely the time required more demanding.

2.2 Decision-making weight

When customers make decisions in uncertain situations, the corresponding conclusions are drawn through the chances. And after the processing of subjective factors, will often give the subjective probability $\omega(p)$ which deviation from the objective probability p, according to the cumulative prospect theory, small probability events will generally be overestimated, and the probability of events tend to be underestimated.

Therefore, $t(G)$ can be expressed as chances $(p_{-m},\ldots,p_i,\ldots,p_n)$ in reasonable ranges $(t_{-m},\ldots,t_i,\ldots,t_n)$, and in descending order, when $-m\le i\le 0, t_i\ge t_0; 0\le i\le n$, $t_i\le t_0$.

$$\begin{aligned}&\pi_n^{+}(G)=\omega^{+}(p_n),\quad \pi_i^{-}(G)=\omega^{-}(p_{-m})\\ &\pi_i^{+}(G)=\omega^{+}(p_i+\ldots+p_n)-\omega^{+}(p_{i+1}+\ldots+p_n)\qquad 0\le i\le n\text{-}1\\ &\pi_i^{-}(G)=\omega^{-}(p_{-m}+\ldots+p_i)-\omega^{+}(p_{-m}+\ldots+p_{i-1})\quad 1\text{-}m\le i\le 0\end{aligned} \tag{6}$$

$$\omega^{+}(p)=\frac{p^{\gamma}}{(p^{\gamma}+(1-p^{\gamma}))^{1/\gamma}} \tag{7}$$

$$\omega^{-}(p)=\frac{p^{\delta}}{(p^{\delta}+(1-p^{\delta}))^{1/\delta}} \tag{8}$$

On type $\omega^{+}(p)$, $\omega^{-}(p)$ to decision-making weight for gains and losses, respectively. γ, δ are model parameters, Kahneman after test calibration γ=0.61，δ=0.69.

2.3 Cumulative prospect theory

On the basis of cost value and decision-making weight, with CPT, the prospective value of a path G can be represented as:

$$V(G)=\sum_{i=0}^{n}\pi_i^{+}(G)v(t_i)+\sum_{i=-m}^{0}\pi_i^{-}(G)v(t_i) \tag{9}$$

4. MATHEMATICAL MODEL

Under uncertainty, fresh agricultural e-commerce product routing problem model considering equally desire of customer as follows:

$$\min z=\sum_{i}\sum_{j}\sum_{l}c_{ij}x_{ijl}+\sum_{i}Q+\sum_{i}\sum_{j}\sum_{l}\alpha px_{ijl}(t_{jl}-t_{il})$$

$$\begin{aligned}
s.t.\quad & C1 && \sum_{i}w_iy_{li}\le b_l && \forall l\\
& C2 && \sum_{l}y_{li}=1 && i=1,2\ldots,n\\
& C3 && \sum_{i}x_{ijl}=y_{lj} && j=0,1,2\ldots,n\quad \forall l\\
& C4 && \sum_{j}x_{ijl}=y_{li} && i=0,1,2\ldots,n\quad \forall l\\
& C5 && X=(x_{ijl})\in S && S\subseteq n\\
& C6 && s_{li}=s_{ci}+s_i && i,j=0,1,2\ldots,n\quad \forall l\\
& C7 && s_{cj}-(s_{ci}+s_i+t_{ij})\le t_{max}\\
& C8 && s_{li}+t_{ij}\le s_{cj} && i,j=0,1,2\ldots,n\quad \forall l\\
& C9 && L_{vi}\le s_{ci}\le U_{vi} && i=0,1,2\ldots,n\quad \forall l\\
& C10 && x_{ijl},y_{li}=\{0,1\} && i,j=0,1,2\ldots,n\quad \forall l
\end{aligned} \tag{10}$$

In the problem of system optimization design (type 10), the objective function, indicate that lowest cost includes transportation cost, penalty cost and cost of damage; constraint $C1$ starting from model transport reliability, the total amount of cargo loaded by the vehicle l is not greater than the limited capacity of the vehicle; constraint $C2$ starting from model transport efficiency, so as to ensure that each agent point only by a car distribution and all the agents are getting distribution; constraint $C3, C4, C5$ can be guaranteed to complete a circuit, namely each delivery vehicle from the distribution center, and then back to the distribution center; constraint $C6$, $C7$ starting from model time efficiency, are the end time for service and the maximum waiting time for quantitative description; constrain $C8$ the condition of the existence of two adjacent tasks on a line; constrain $C9$ is the restriction of time windows; constrain $C10$ in order to provide a 0-1 planning problem. Penalty factor of penalty function is determined by the formula (9) and (4).

Proved by many studies, VRPSTW problem belongs to the basic traveling salesman problem (TSP), while the traveling salesman problem belongs to NP problem. The model constructed in this paper is based on the VRSTW problem. So this model can also be attributed to the TSP problem. It is difficult to obtain the optimal solution for this kind of problem by using the traditional method, and some optimization criteria are introduced to increase the difficulty of the problem. People try to use a variety of heuristic algorithms to solve and lots of achievements have been obtained. Particle swarm optimization algorithm with its simple, fast convergence and good characteristics of the continuous problem, to solve the problem brings a lot of convenience.

Due to the best location of PSO in the history of the particle and the neighborhood or the best location of the population aggregation, the formation of the rapid convergence of the particle population effect, easy to fall into the local extreme, premature convergence or stagnation phenomenon.[23] In order to overcome the defects, several of the most representative PSO deformation: Linear decrement PSO algorithm (LDPSO), [24]PSO algorithm with compression factor (CPSO) [25] and PSO algorithm for multi ring topology (MTPSO). [26]This article unifies the related documents, the basic particle swarm optimization algorithm is improved in two aspects of learning factor and inertia weight, and the convergence speed of the algorithm is improved.

4. ALGORITHM DESIGN

4.1 Particles swarm optimization

Particle Swarm Optimization (PSO), is proposed for the first time in 1995 by Kennedy and Eberhart through the study on the behavior of birds flying .[27] Have the advantage of small number individuals, simple calculation and so on, all kinds of multidimensional continuous space optimization problems have achieved very good results. [28-29]PSO algorithm research can be roughly divided into five parts: [30-31] algorithm itself, topology, parameter selection and other evolutionary technique integration and application. In this paper, PSO is applied to the optimization of the vehicle distribution path of fresh electricity suppliers, and has achieved the desired results.

Particle swarm optimization algorithm simulates the foraging behavior of birds, fish, bees and other animal groups, through the individual mutual cooperation to achieve the optimal goal. Each individual is abstracted as no mass and volume of particles, and extended to n-dimensional space. All particles have a fitness is determined by the function of the optimization, PSO algorithm first to initialize some particles, particle flying in solution space, flight directions are affected by the current flight speed, the optimal location of the particle's own history, the optimal location of the population in the history of the three .[32]

The mathematical representation of the PSO algorithm is: the position and velocity of the i particle suppose D dimensional search space $X^i = \left(x_{i1}, x_{i2}, \ldots, x_{id} \right)$ and $V^i = \left(v_{i1}, v_{i2}, \ldots, v_{id} \right)$, particle in each iteration by tracking $pbest$, $P^i = \left(p_{i1}, p_{i2}, \ldots, p_{id} \right)$ and $gbest$, P_g with formula (11) and (12) to update the position and velocity, until the end of the iteration.

$$V_{ij}\left(t+1\right) = wv_{ij}\left(t\right) + c_1 r_1 \left[p_{ij} - x_{ij}\left(t\right) \right] + c_2 r_2 \left[p_{i_j} - x_{ij}\left(t\right) \right]$$

$$X_{ij}\left(t+1\right) = x_{ij}\left(t\right) + v_{ij}\left(t+1\right), j = 1,2,..,d \quad (12)$$

In the above equation, c_1 , c_2 for learning factors range from 0-4, usually $c_1 = c_2 = 2$; r_1、r_2 for the uniform distribution of random numbers among o and 1; ω as inertia weight, SHI etc. [33] the experimental results show that If the acceleration coefficient keeps constant decreases linearly ω with the iteration of the algorithm, will significantly improve the convergence performance of the algorithm.

4.2 Improved PSO

Two learning factors in the optimization process with time in $\left[c_{min}, c_{max} \right]$ between the changes, be called synchronous change learning factor, this makes the particle has great self-learning ability and less social learning ability in the optimization stage, to strengthen the global search ability; in the late optimization has great social learning ability and less

self-learning ability, is conducive to the convergence to the global optimal solution. The formula for learning factor in t iteration is:

$$c_1 = c_2 = c_{\max} - \frac{c_{\max} - c_{\min}}{t_{\max}} \times t \qquad (13)$$

In the standard PSO algorithm, the ω is set to the random number which is subject to some random distribution, to a certain extent, it can overcome the deficiency of linear decline of ω from two aspects.

Firstly, close to the optimum point in the prophase of evolution, random ω may produce relatively valid values, to accelerate the algorithm convergence speed. In addition, if the algorithm can't find the optimum point in the prophase, ω linear decrease, makes the algorithm convergence is not the method proposed, while ω random can overcome this limitation.

The formula for ω is:

$$\begin{cases} \omega = \mu + \sigma * N(0,1) \\ \mu = \mu_{\min} + (\mu_{\max} - \mu_{\min}) * rand(0,1) \end{cases} \qquad (14)$$

4.3 Improved algorithm is realizing steps

The basic steps of the synchronous learning factor random weight particle swarm optimization algorithm are as follows:

I Read customer information, set particle swarm optimization parameter size, M maximum number of iterations, N number of particles, D number of independent variables, $c_{\max}$, $c_{\min}$ the maximum and minimum of learning factor, $\mu_{\max}$, $\mu_{\min}$ the maximum and minimum values of the average value of the random weight, random weight variance;

II Initialize particle swarm optimization E_0, population generation $g = 0$ .Random initialization of the location $x(i, j)$ and speed $v(i, j)$ of each particle in the population;

III According to the fitness function to evaluate the fitness of each particle i, the position of each particle and the adaptive value are stored in the local optimal solution(*pbest*)of each particle, all *pbest* the location of the optimal individual and the fitness value of the optimal solution are stored in the global optimal solution (*gbest*);

IV The velocity and displacement of the particles are updated by the formula (11) (12), (13) update the learning factor, (14) update the weight;

V For each particle, compared with the best position, and if it is better, it will be used as the current optimal value, compared all current *pbest* and *gbest* , update *gbest* ;

VI If the stop condition is satisfied, search abandoned, result in output, otherwise, return to III to continue searching.

Then the time complexity of the algorithm is analyzed, improved particle swarm optimization algorithm to solve feasible solution time consuming $O(N)$, local optimization and global optimization stage time consuming is also $O(N)$. Meanwhile, the algorithm needs to be carried out M times, the maximum number of iterations of the algorithm. So that, the time complexity of the algorithm is $O(N \times D + 2M \times N) = O(M \times N)$, polynomial time algorithm.

5. EXAMPLE ANALYSIS

5.1 Comparative analysis of algorithms

In order to verify the effectiveness of the proposed algorithm, the methods of traditional particle swarm optimization algorithm (PSO), Particle swarm optimization algorithm based on the synchronous change of learning factors (LnCPSO) and the algorithm were used respectively on the following three typical benchmark functions (as shown in Table 1) to determine minimum value. The experimental setup parameters are as follows, the particle swarm size of the three algorithms is 100, the maximum iteration number is 1000; in basic particle swarm optimization algorithm $c_1 = c_2 = 2$, $\omega = 0.5$; in LnCPSO $c_{\max} = 2.1$, $c_{\min} = 0.8$, $\omega = 0.9$; In this paper, we study the same learning factor and LnCPSO algorithm in the algorithm, $\mu_{\max} = 1.9$, $\mu_{\min} = 0.8$, variance is 0.2. Aiming at the different dimensions of each test function, run $T = 40$ times. Figure 1~3 is the optimal fitness function evolution curve of 3 functions run stand-alone 40 times.

Simulation results and comparison of statistical data of three algorithms are shown in Table 2.

Table1. Benchmark functions used to test and their parameters

Function name	Formula	Dimension	Search scope	Optimal value
f_1	$f_1(x) = \sum_{i=1}^{n} x_i^2$	30	$[-100,100]$	0
f_2	$f_2(x) = \sum_{i=1}^{n} [x_i^2 - 10\cos(2\pi x_i) + 10]$	5	$[-5,5]$	0
f_3	$f_3(x) = \sum_{i=1}^{n-1} 100\left(x_n^2 - x_{n-1}\right)^2 + \left(1 - x_n\right)^2]$	2	$[-5,5]$	0

Table2. Comparison of optimization results of three Benchmark functions

Function name	Optimal value	PSO			LnCPSO			Improved PSO		
		Best	Worst	Mean	Best	Worst	Mean	Best	Worst	Mean
f_1	0	0	-73.400	-9.462	0	-46.115	-5.152	0	0	0
f_2	0	0	-0.984	-0.973	0	-0.224	-0.225	0	-0.011	-0.010
f_3	0	0	-3.8204	-0.092	0	-1.4742	-0.036	0	-0.0578	-0.001

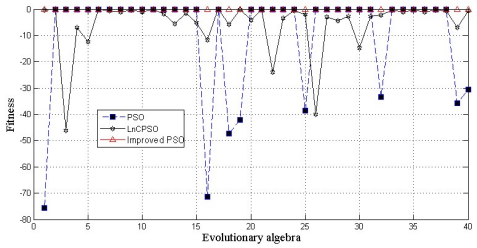

Figure 1 The fitness function evolution curve of function f_1

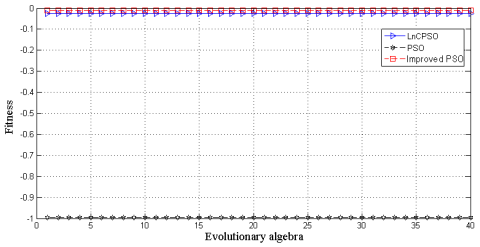

Figure 2 The fitness function evolution curve of function f_2

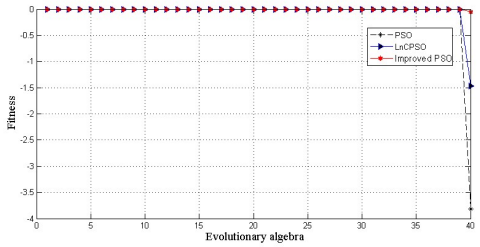

Figure 3 The fitness function evolution curve of function f_3

Can be seen from Tab. 2, the algorithm the test results of 3 basic test functions are better than the other two algorithms, 2 orders of magnitude higher than the PSO and LnCPSO algorithms on both the average and the worst value, the results show that the algorithm has better stability and optimization effect; Fig. 1~3 in the horizontal axis for the independent operation of the number of vertical coordinates for the value of the degree. From the graph, we can see that the algorithm converges to the optimal value faster than the other two algorithms, and the final optimization results are better than the other two algorithms.

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5.2 Case analysis

Due to the development of fresh electricity suppliers in the initial stage of exploration, studies on the fresh electricity suppliers and distribution path optimization research and case are less, this article adopts the case of literature [34], according to the characteristics of the model and corresponding conditions are increased. The model is verified by the matlab2012a operating environment. The problem has 10 transport the mesh point, distribution center and the distance of the network, as well as the demand of the network, time window and the network stay time, as showed in Tab. 3, Tab. 4.

Known speed 30km/h, the load weight of each vehicle is 10t, the average transportation cost is 1 yuan / (km / t). Group size is set to 50, learning factors maximum value and minimum value are set to 2.1 , 0.8; the maximum value of the average value of the random inertia weight is 0.8, the minimum is 0.5, and the variance is 0.2. $T_{\max} = 40$ $c_0 = 20$, $Q_{\max} = 1000$, $\alpha = \beta = 0.88$, $\lambda = 2.25$; iteration number 200 times, as to this issue, particle swarm optimization , improved genetic algorithm and traditional particle swarm optimization algorithm are used to optimize the distance, the comparison of the optimal solutions of the two algorithms is shown in Table5 and table 6.

Table3. The distance among distribution as agent points

	0	1	2	3	4	5	6	7	8	9	10
0	0	15	15	8	6	9	5	4	6	11	8
1	15	0	5	6	10	7	7	5	4	7	6
2	15	5	0	12	9	13	8	9	4	12	3
3	8	6	12	0	7	6	14	3	11	7	6
4	10	8	9	7	0	7	5	6	3	5	9
5	9	7	13	6	7	0	8	9	12	6	13
6	5	7	8	14	5	8	0	12	8	5	10
7	4	5	9	3	6	9	12	0	4	5	8
8	6	4	4	11	3	12	8	4	0	3	9
9	5	11	12	7	5	6	5	5	3	0	6
10	8	6	3	6	9	13	10	8	9	6	0

Table4. The demands and time windows of agent points and vehicle retention time

i	1	2	3	4	5	6	7	8	9	10
wi	2	1.5	3	2	1.5	2	2.5	2	2	1.5
s_i	10	10	10	10	10	10	10	10	10	10
time windows	6:20 -7:00	5:20 -5:50	6:10 -6:40	5:30 ~6:00	6:50 ~7:20	7:00 ~7:30	6:40 ~7:10	5:50 -6:20	6:30 -7:00	7:20 -8:00

Table5.The cost comparison table of three kinds of algorithm

Cost	Transportation cost	Cargo damage cost	Penalty cost	Breach time window	Average penalty time
Improved PSO	439.5	1782	1160	5	11.6min
Compared algorithm	430	1782	1880	5	12.6min
Traditional algorithm	530.5	1936	1960	5	19.6min

Table6. The calculation results table of three kinds of algorithm

	Traditional algorithm	Compared algorithm	Improved PSO
Optimum solution	4426.5	4092	3381.5
Optimal iterative times	24	17	20
Optimal alignment	0-2-3-9-5-1-0 0-4-8-7-6-10-0	0-2-1-3-9-5-0 0-4-8-7-6-10-0	0-2-1-7-9-6-0 0-4-8-3-5-10-0

Can be seen from Tab.5 and 6, the model and algorithm although in the speed of convergence is stronger than the traditional algorithm is 24 times and weaker in the improved genetic algorithm is 17 times, and compared with the improved algorithm in transportation costs increased slightly, but the model has advantages as follows:

1) Fully consider the customer's demand for time window, although two models make little difference in the times of violating time windows, but the traditional algorithm in the 5-1 distribution process late for 20 minutes, it is unacceptable for e-commerce enterprise; although compared algorithm avoid problems like these, while in the distribution process of 8-7, the delivery officer arrived 36 minutes early, penalty cost in this part is high; the average time of punishment and the maximum violation time are greatly reduced, which obviously shorten the waiting time of customers.

2) Integrating the time factor share of fresh electricity distribution, in considering the penalty cost and average in violation of the time window, compared to the previous model modified and traditional algorithm, in cargo damage costs and transportation costs did not too obviously increased and the total cost saving $1045 and $710.5, this model is more suitable for the distribution of fresh e-commerce supplier;

3) According to the cumulative prospect theory to highlight the customer requirements for time window, flexible adjustment penalty factor, to fine edge treatment of the distribution route, increasing customer satisfaction.

In conclusion, the optimization model mentioned in this paper, reduces the distribution cost on the whole and saves the customers' waiting time. Therefore, this model is more suitable for fresh e-commerce distribution path optimization.

6. CONCLUSIONS

To improve the efficiency of fresh agricultural e-commerce product, save its overall cost, considering the uncertainty factors of travel and the bounded rationality of people 's decision – making, combined with VRP problem model and timeliness of fresh e-commerce distribution, introduction PT and penalty cost, the path optimization model of fresh electricity suppliers with soft time windows is proposed. An improved Particle Swarm Optimization algorithm was respectively used to solve the model. According to CPT theory, electric business enterprise can accord to customer demand for time window, flexible adjustment penalty factor, thereby fine-tuning the distribution line, can improve customer satisfaction. Combined with specific case to be validated, by comparing and analyzing the three algorithms, proving the validity of the model, obtain the optimal route, reduces the overall cost, show that the feasibility of the model optimize the fresh electricity supplier distribution path.

7. ACKNOWLEDGMENTS

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The Fuzzy Comprehensive Evaluation Government-affiliated Institutions Performance Management Model Based on AHP

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Abstract: The government-affiliated institutions pay much attention to and actively implement the performance evaluation. But when evaluating, the personal relations will be considered. At the same time, many evaluation indexes are qualitative indexes which are not easily quantified. It will lead to the performance evaluation system without effects. In this research, we combine AHP with fuzzy comprehensive evaluation method. The weight coefficient of performance index can be determined by AHP. We will use fuzzy comprehensive evaluation method to evaluate the result of AHP, and finally establish government-affiliated institutions performance management model. After analyzing the examples, we have found the combination is workable and can evaluate scientifically and objectively. It can be regarded as the effective method to classify the employee performance assessment
Keywords: Performance Evaluation; AHP; Fuzzy Comprehensive Evaluation; Government- affiliated institutions.

1. INTRODUCTION

In 21st century, the economy develops very fast. When the foreign government-affiliated institutions and capitals entering China, they bring a lot of technologies and management experiences which promote the Chinese government-affiliated institutions. At the same time, more and more government-affiliated institutions realize that human resource plays a very important role in operation and development. In the human resource management, we can use performance evaluation to assess the working behavior and working result of the employee. The performance evaluation also can supervise the improvement of the employee quality. At the same time, it can find out the problems and disadvantages, which can improve the production and management of the government-affiliated institutions. The performance evaluation should be away from the subjective factors and strengthen the objectiveness, regularity and operability[1-5]. At present, more government-affiliated institutions think highly of the performance evaluation and begin to implement it. But the effect is not favorable. Because of the traditional impact, the personal relations will be considered which will lead to little effect. So the scientific and accurate performance evaluation has great significance to the development of Chinese government-affiliated institutions. In this article, we use AHP to determine the weight coefficient of performance indexes [6-10]. We will use fuzzy comprehensive evaluation method to evaluate the result of AHP, and finally establish government-affiliated institutions performance management model so as to improve the objectiveness, regularity and operability of the performance evaluation. It can be regarded as the effective method to classify the employee performance assessment.

2. THE THEORY OF FUZZY COMPREHENSIVE EVALUATION MODEL BASED ON AHP

The model of fuzzy comprehensive model based on AHP (Analytic Hierarchy Process) is made from two parts which are AHP and fuzzy comprehensive evaluation. Simply speaking, as the core of the model, AHP regards evaluating object or problem as a system. According to the nature of the problem and the overall target, it separates the problem into different elements and assembles the elements according to different layers. After finding element the weight proportion in the unity, one multiple layer structure system is formed, which can methodize the problems. As the comprehensive evaluation method, according to the membership grade of the weight projected level indexes got by AHP, Fuzzy determines the property of the evaluated objects [11-15]. Fuzzy comprehensive evaluation is implemented based on AHP. The two coordinate together and improve the accuracy and reliability of the model.

2.1. AHP Determines the Weight

AHP uses qualitative and quantitative systematical analysis methods. This method can make systemize, quantify and model the complicated problems. That is to say, we can separate the problem into several elements and then resolve them into more accurate, detailed and quantitative small elements which are indexes. We should determine the weights according

to the significance of elements in the same layer [16-18]. Then the weights connect the layers together forming a statistical model with multiple targets and layers. The basic steps are as follows:

1)Establish multilayer hierarchical structure and form a target tree figure. AHP model includes 3 layers which are high layer, middle layer and low layer. Please see Fig. 1. The high layer is the target layer which analyzes the overall target of AHP; the middle layer is also called constraint layer which includes some main factors influencing the overall target; the low layer is also called measurement layer which includes final measures solving problems. They are all quantitative indexes.

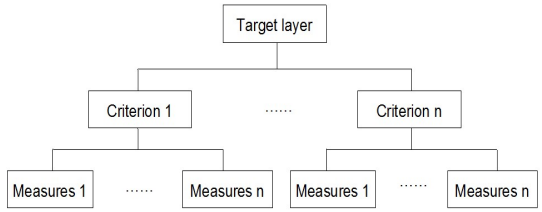

Figure 1. Model structure of AHP

Table 1. The score standard of each layer in AHP

The Significance Calibration a_{ij}	The Relative Importance
1	Equally important
3	Somewhat important
5	Basically important
7	Actually important
9	Definitely important
2,4,6,8	The intermediate value of adjacent degree of importance
Reciprocal	If the importance proportion of element i and element j is a_{ij}, the importance proportion of element j and ii is $a_{ji}=1/a_{ij}$

3)Consistency Text

After calculating the normalization weight coefficient, we should check whether the relative weight coefficient is logic. First we should calculate the consistency index CI

$$CI=\frac{\lambda_{\max}-m}{m-1} \tag{3}$$

$$\lambda_{\max}=\frac{1}{n}\sum_{i=1}^{m}\lambda_i/m \tag{4}$$

2)Construct comparison judgment matrix to calculate the weights. We use Satya's weight method. First we should compare the indexes and provide the scores which are shown in Table 1. According to the scores, we establish judgment matrix to get the weights of the indexes. The approximate weight of each index is formula 1

$$\overline{W_i}=\sqrt[m]{a_{i1}a_{i2\cdots a_{im}}} \tag{1}$$

We make the approximate weights have moralization procession according to the following formula 2

$$W_i=\frac{\overline{W_i}}{\sum_{i=1}^{m}\overline{W_i}} \tag{2}$$

Then each branch vector is the weight (as shown in Tab. 1).

$$\lambda_i=\sum_{j=1}^{m}a_{ijW_j/W_i} \tag{5}$$

Calculate the random consistency proportion

$$CR=\frac{CI}{RI} \tag{6}$$

In this formula, m is the number of the sub-goals in the tested layer. is the maximum latent root; is the latent root of the sub-goal pair comparison judgment optimal matrix of the layer; RI is the same order average random consistency index which is shown in Table 2.

Table 2. The value of average random consistency index

Exponent Number	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

When the random consistency proportion CR is less than 0.1, we believe that the consistency of the judgment matrix is favorable.

4)Use product method and calculate the combined weight of the low layer (solution layer). Combined weight is the coefficient got by multiplying the weighted indexes in different layers.

2.2 Fuzzy Comprehensive Evaluation

Based on obtaining the weights of evaluated indexes by AHP, we need to implement the index evaluation to the objects. Fuzzy comprehensive evaluation is to assess the belonging grade or categories and make decisions based on many evaluation factors by implementing fuzzy set theory. Because the dividing the number is fuzzy, the adapted fuzzy mathematical method makes the objects evaluation reasonable. The detailed calculating process is as follows,

1)Ensure the evaluation index set

$$X = (x_1, x_2, \cdots, x_n) \quad (7)$$

2)Determine the tested index weight set connected closely with the tested objects according to AHP.

$$W = (\omega_1, \omega_2, \cdots, \omega_n) \quad (8)$$

3)Determine the evaluation set.

$$Y = (y_1, y_2, \cdots, y_n) \quad (9)$$

4)Determine the standard membership grade of the evaluation set u.

$$u = (u_1, u_2, \cdots, u_m) \quad (10)$$

5)Establish fuzzy evaluation matrix of the tested objects R.

$$R = \begin{bmatrix} r_{11} & r_{12} \cdots r_{1m} \\ r_{21} & r_{22} \cdots r_{2m} \\ \cdots & \cdots \cdots \cdots \\ r_{n1} & r_{n2} \cdots r_{nm} \end{bmatrix} \quad (11)$$

6)Calculate fuzzy comprehensive membership grade set B

$$B = R \bullet u^T \quad (12)$$

7)Calculate overall comprehensive membership grade

$$U = A \bullet B \quad (13)$$

Comprehensive membership grad U is the overall score of tested object. So we can make comparatively objective evaluations to many tested objects.

3. THE ESTABLISHMENT OF FUZZY COMPREHENSIVE EVALUATION GOVERNMENT-AFFILIATED INSTITUTIONS PERFORMANCE MANAGEMENT MODEL BASED ON AHP

3.1 Choose Evaluation Indexes and Establish Hierarchical Structure

When evaluating the employees, the evaluation indexes are different as to different positions. In this article the managers are selected to be evaluated. After reading the references home and abroad and consulting the government-affiliated institutions management experts, we decide to evaluate the morality, ability, performance and development nurture. We will evaluate every aspect in different indexes. The established hierarchical structure of performance evaluation indexes is shown in Table 3.

Table 3. The hierarchical structure of performance evaluation indexes

Layer A	Layer B	Layer C
Perfor-mance Evalua-tion	Morality B1	Responsibility C1
		Clean and Fair C2
		Behavior C3
	Ability B2	Leadership C4
		Operational Ability C5
		Coordination Ability C6
		Employee Recognition C7
	Performance B3	Work Plan Implementation Status C8
		Work Plan Achievement Rate C9
		Management Innovation C10
	Development Nurture B4	Talents Training Program Implementation Status C11
		Talents Training Achievement Rate C12
		Training Innovation C13

3.2 Establish Pair Comparison Judgment Matrix and Calculate the Weights of Indexes

Use Saaty's weight method to get all levels evaluation system judgment matrix and indexes weights. Please see Table 4 to Table 8.

Table 4. The judgment matrix and weight of first level evaluation system

Evaluation Index	Morality	Ability	Performance	Development Nurture	Value of Weight
Morality	1	0.153	0.2	0.5	0.054
Ability	7	1	5	6	0.546
Performance	5	0.5	1	4	0.302
Development Nurture	2	0.167	0.25	1	0.098

Table 5. The judgment matrix and weight of second level evaluation system(Morality)

Evaluation Index	Responsibility	Clean and Fair	Behavior	Value of Weight
Responsibility	1	3	5	0.577
Clean and Fair	0.333	1	3	0.312
Behavior	0.2	0.333	1	0.111

Table 6. The judgment matrix and weight of second level evaluation system (Ability)

Evaluation Index	Leadership Ability	Operation Ability	Coordination Ability	Employee Recognition	Value of Weight
Leadership Ability	1	5	3	7	0.507
Operation Ability	0.2	1	3	3	0.228
Coordination Ability	0.333	0.333	1	5	0.212
Employee Recognition	0.143	0.333	0.2	1	0.053

Table 7. The judgment matrix and weight of second level evaluation (Performance)

Evaluation index	Work Implementation Status	Achievement Rate	Management Innovation	Value of Weight
Work Implementation Status	1	0.333	4	0.318
Achievement Rate	3	1	6	0.597
Management Innovation	0.25	0.167	1	0.085

Table 8. The judgment matrix and weight of second level evaluation(Development Nurture)

Evaluation Index	Implementation Status	Achievement Rate	Training Innovation	Value of Weight
Implementation Status	1	0.333	3	0.292
Achievement Rate	3	1	5	0.605
Training Innovation	0.333	0.2	1	0.103

3.3 Consistency Test

By using formula 3 to formula 6, calculate the random consistency proportion CR values of one first level matrix and four second level matrixes. The results are in Table 9.

Table 9. Results of Consistency Test

Matrix	CR	Consistency Results
First Level Matrix	0.036	Satisfied
Second Level Matrix B1	0.018	Satisfied
Second Level Matrix B2	0.029	Satisfied
Second Level Matrix B3	0.045	Satisfied
Second Level Matrix B4	0.021	Satisfied

3.4 Using product method, we calculate the combined weights of the indexes in the low layer The result is shown in Table 10.

Table 10. The value of combined weight of the indexes in low layer

A	B	C	Combined Weight
Performance Evaluation	Morality(0.054)	Responsibility(0.577)	0.031
		Clean and Fair(0.312)	0.017
		Behavior(0.111)	0.006
	Ability(0.546)	Leadership Ability(0.507)	0.277
		Operation Ability(0.228)	0.124
		Coordination Ability(0.212)	0.116
		Employee Recognition(0.053)	0.029
	Performance(0.302)	Work Plan Implementation Status(0.318)	0.096
		Work Plan Achievement Rate(0.597)	0.180
		Management Innovation(0.085)	0.026
	Development Nurture(0.098)	Talents Training Program Implementation Status(0.292)	0.029
		Talents Training Achievement Rate (0.605)	0.059
		Training Innovation (0.103)	0.010

From the ranking list of weights, the ability occupies a maximum proportion in second level indexes B and working performance ranks the second. In third level indexes C, responsibility, leadership ability, work plan achievement rate and talents training achievement rate occupy a larger proportion. The performance indexes of the managers involve the task performance indexes and peripheral performance indexes. The nature of the work of the managers will be considered in peripheral performance indexes. The leadership ability of the managers and the project operation with the core of coordination can describe the reality of the performance objectively. So in the performance evaluation indexes of the managers, the peripheral performance indexes occupy a large proportion.

The traditional performance evaluation method cannot provide the quantitative peripheral performance indexes. Even if we use grade fraction method to provide the fractional value, it will be pale because there is no basis to provide the value, which is totally the subjective judgment. Because the method has problems, people are stimulated to adjust and obtain the benefit. If the performance result can't make others convinced, the behavior is too formalized.

Because the evaluation standard and evaluation indexes are fuzzy of this kind of indexes, we should take fuzzy comprehensive evaluation method to deal with them, which can reduce the interruption of the subjective factors. And then a accurate performance evaluation result can be got.

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3.5 Using Fuzzy Comprehensive Evaluation to Assess the Objects

In this article, we evaluate the managers in Company X. We randomly select 7 persons from the high, middle and common employees as the evaluators by using stratified random sampling method. And then we score them. After the score conversion, the 7 evaluators provide the accurate scores which are shown in Table 11.

Table 11. The scores of the examinees provided by 7 evaluators

Evaluation Indexes	Z1	Z2	Z3	Z4	Z5	Z6	Z7
C1	86	82	80	87	79	79	89
C2	73	70	76	72	80	83	80
C3	90	91	84	71	82	75	80
C4	84	77	70	74	79	79	79
C5	88	72	69	79	81	89	82
C6	73	65	65	85	83	82	73
C7	70	79	77	80	87	81	89
C8	77	74	78	68	68	73	82
C9	74	73	81	82	86	80	74
C10	81	88	72	66	88	77	70
C11	79	85	83	74	73	70	69
C12	80	88	74	81	82	89	80
C13	77	80	88	78	70	79	87

In the scores, 85 points or above means excellent; 75-84 points means good; 60-74 points means pass; 60 points or below means failed. We sort out the scores according to the scores, the number of the samples in each grade is shown in Table 12.

Table 12. The score grade of Examinee's performance

Evaluation Indexes	Grade			
	Excellent	Good	Pass	Failed
C1	3	4	0	0
C2	0	4	3	0
C3	2	4	1	0
C4	0	5	2	0
C5	2	3	2	0
C6	1	2	4	0
C7	2	4	1	0
C8	0	3	4	0
C9	1	3	3	0
C10	2	2	3	0
C11	1	2	4	0
C12	2	4	1	0
C13	2	4	1	0

According to the scores, we use fuzzy comprehensive evaluation to evaluate.

1)The Evaluation Indexes System:

X = (Morality, Ability, Performance, Development Nurture)

2)The Weight Determination of the Assessed Indexes Set by Using AHP

According to the above result, the weight of the assessed indexes set in this article is

$W=(0.054, 0.546, 0.302, 0.098)$

3)Y:Determination of Assessed Grade:

Y = (Excellent, good, pass, failed)

4)u:The Determination of Standard Membership Degree of Evaluation Set

$u=$(1/excellent，0.8/good，0.6/pass，0.1/failed)

When calculating, we select

$u=(1,0.8,0.6,0.1)$

5)The Establishment of Fuzzy Matrix R of Assessed Objects

From Table 12, we can get the judgment matrixes of

morality B1, ability B2, performance B3, and development nurture B4 which are shown below,

$$B_1=\begin{bmatrix}3/8 & 4/8 & 0/8 & 0/8\\ 0/8 & 4/8 & 3/8 & 0/8\\ 2/8 & 4/8 & 1/8 & 0/8\end{bmatrix}$$

$$B_2=\begin{bmatrix}0/8 & 5/8 & 2/8 & 0/8\\ 2/8 & 3/8 & 2/8 & 0/8\\ 1/8 & 2/8 & 4/8 & 0/8\\ 2/8 & 4/8 & 1/8 & 0/8\end{bmatrix}$$

$$B_3=\begin{bmatrix}0/8 & 3/8 & 4/8 & 0/8\\ 1/8 & 1/8 & 3/8 & 0/8\\ 2/8 & 2/8 & 3/8 & 0/8\end{bmatrix}$$

$$B_4=\begin{bmatrix}1/8 & 2/8 & 4/8 & 0/8\\ 2/8 & 4/8 & 1/8 & 0/8\\ 2/8 & 4/8 & 1/8 & 0/8\end{bmatrix}$$

6)Calculating Fuzzy Comprehensive Membership Degree u

$$\bar{u}_1=B_1u^T=\begin{bmatrix}3/8\ 4/8\ 0/8\ 0/8\\ 0/8\ 4/8\ 3/8\ 0/8\\ 2/8\ 4/8\ 1/8\ 0/8\end{bmatrix}\bullet\begin{bmatrix}1\\0.8\\0.6\\0.1\end{bmatrix}=\begin{bmatrix}0.775\\0.625\\0.725\end{bmatrix}$$

$$\bar{u}_2=B_2u^T=\begin{bmatrix}0/8\ 5/8\ 2/8\ 0/8\\ 2/8\ 3/8\ 2/8\ 0/8\\ 1/8\ 2/8\ 4/8\ 0/8\\ 2/8\ 4/8\ 1/8\ 0/8\end{bmatrix}\bullet\begin{bmatrix}1\\0.8\\0.6\\0.1\end{bmatrix}=\begin{bmatrix}0.65\\0.7\\0.625\\0.725\end{bmatrix}$$

$$\bar{u}_3=B_3u^T=\begin{bmatrix}0/8\ 3/8\ 4/8\ 0/8\\ 1/8\ 1/8\ 3/8\ 0/8\\ 2/8\ 2/8\ 3/8\ 0/8\end{bmatrix}\bullet\begin{bmatrix}1\\0.8\\0.6\\0.1\end{bmatrix}=\begin{bmatrix}0.6\\0.65\\0.675\end{bmatrix}$$

$$\bar{u}_3=B_3u^T=\begin{bmatrix}1/8\ 2/8\ 4/8\ 0/8\\ 2/8\ 4/8\ 1/8\ 0/8\\ 2/8\ 4/8\ 1/8\ 0/8\end{bmatrix}\bullet\begin{bmatrix}1\\0.8\\0.6\\0.1\end{bmatrix}=\begin{bmatrix}0.625\\0.725\\0.725\end{bmatrix}$$

7)Calculating Overall Membership Degree U

Calculate the overall membership degrees of B1, B2, B3 and B4 which are U1, U2, U3 and U4 respectively.

$$U_1=\omega_1\bullet\bar{u}_1$$

$$=(0.577,0.312,0.111)\bullet\begin{bmatrix}0.775\\0.625\\0.725\end{bmatrix}=0.723$$

$$U_2=\omega_2\bullet\bar{u}_2$$

$$=(0.507,0.228,0.212,0.053)\bullet\begin{bmatrix}0.65\\0.7\\0.625\\0.725\end{bmatrix}=0.66$$

$$U_3=\omega_3\bullet\bar{u}_3$$

$$=(0.318,0.597,0.085)\bullet\begin{bmatrix}0.6\\0.65\\0.675\end{bmatrix}=0.636$$

$$U_4=\omega_4\bullet\bar{u}_4$$

$$=(0.292,0.605,0.103)\bullet\begin{bmatrix}0.625\\0.725\\0.725\end{bmatrix}=0.696$$ Finally, calculate the overall comprehensive membership degree U

$$\bar{u}=(U_1,U_2,U_3,U_4)$$

$$U=\omega\bullet\bar{u}=\begin{bmatrix}0.65\\0.7\\0.625\\0.725\end{bmatrix}\bullet(0.507,0.228,0.212,0.053)$$

$$=(0.039,0.36,0.192,0.068)$$

8)According to the Membership Degree Maximizing Principle, the Evaluation Result can be Got.

Analyzing the result U, we can get u_2=0.36 is maximum; so performance evaluation result of the managers is good.

4. CONCLUSIONS

In this article, we obtain the final performance result of the corresponding grade to the maximum membership grade in analyzing the case of Company X performance evaluation. This method belongs to the application of primary AHP fuzzy comprehensive evaluation model, which is easily operated. But the lost information is much and sometimes the result may be unreasonable. So we should test the final result of the evaluation to secure the accuracy of the result. Although AHP fuzzy comprehensive evaluation model has problems theoretically and practically, the basic method can explore a new way to make decision. In this article, we use this model and some mathematical theories in the human

resource management, which proves that the model is suitable for the performance management. The shortage of the theory has not caused errors in performance evaluation, which has not affected the effectiveness of the result. The theory of AHP fuzzy comprehensive evaluation needs is improving. Although it has shortage in theory system and practice, the shortage will not influence the position and significance of AHP fuzzy comprehensive evaluation model. At present, AHP has been regarded as the simple and effective multiple targets decision-making method in operation field and it application field is being enlarged. The decision support system which is called Expert Selection with the basic method of AHP is commercialized. This system is welcome abroad. More and more people are study the theory and research method. AHP-fuzzy model plays an increasingly important role in social economy as a practical decision-making tool.

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Study on Language Ability of Science and Technology College Students Evaluation System Based on AHP Fuzzy Comprehensive Evaluation

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Abstract: In order to evaluate the language ability of science and technology college students objectively, this study established language ability evaluate system based on Analytic Hierarchy Process (AHP) and Fuzzy comprehensive evaluation method. Evaluation indexes in the system included language competence, paralanguage competence and comprehensive quality. At first, AHP was used to determine the weight of each index in the evaluation system and calculated the combination weight of measure indexes. And then according to the amount of index weight and expert's evaluation scores, Fuzzy comprehensive evaluation method was used to evaluate graduates attending second-round examination. Owing to qualitative indexes quantified in the evaluation, evaluation results reflected students' real level more objectively and reasonably.
Keywords: Fuzzy comprehensive evaluation; technology college students; language ability; evaluation system.

1. INTRODUCTION

At present, china's universities of science and technology have high requirement of the students' practical ability and scientific research ability. But when most schools were emphasis on improving students' ideological and political quality, enhance physical and psychological quality education, at the same time, training language skills and improve the quality of language were ignored. In the end, students have solid professional foundation, strong operational capacity, but they can't express their opinions properly and accurately, let alone show their ability plenty [1-5]. According to the relevant survey, we found that the language quality and language skills of science and engineering students were inferior whether spoken or written expression. In terms of oral expression, due to less social communication and less networking opportunities, their command of the language expression ability was not enough. To solve this problem, most of polytechnic colleges had opened university language courses and hope to improve students' language skills by studying this course [6-10]. After the end of the course, the form of assessment is usually the exam, but this way of assessment can't fully response the language ability of students. Therefore, the study provided realization route to language proficiency test, employment and entrepreneurship mode reform by constructing and implementing language proficiency test ability evaluation system based on Analytic Hierarchy Process (AHP)and Fuzzy comprehensive evaluation method in order to develop and perfect language proficiency test ability, to improve the ability of language expression, and to make up for the shortage of quantitative analysis and to provide data support and theoretical basis for follow-up study.

2. THE PRINCIPLE OF AHF FUZZY COMPREHENSIVE EVALUATION MODEL

AHP fuzzy comprehensive evaluation model included two parts---- Analytic Hierarchy Process (AHP) and Fuzzy comprehensive evaluation (Fuzzy). In short, AHP was the core part of the model, in which the evaluation object was regarded as a system, and was evaluated by several different questions. Then according to the nature of these questions and the ultimate goal, every question was decomposed into some different composition elements which was divided into different layers according to the subordinate relations between the elements. Then the weight of every factor was obtained through certain methods, thus forming a multi-level hierarchical structure system [11-17]. This process made a complex problem well organized and more hierarchical which was easier to make quantitative analysis. Fuzzy was a common means in comprehensive evaluation, which calculated the membership degree of indexes of every layer based on the weight of every element calculated by AHP. Maximum membership degree principle was used to evaluate the ultimate attributes of every evaluation object. Following AHP analysis, Fuzzy was used to make fuzzy evaluation. Only the combination of the two methods could effectively improve the accuracy and reliability of the evaluation model.

2.1. AHP was used to determine the weights of every element

AHP was a systematic analysis method using the qualitative analysis and quantitative analysis at the same time. This method could make the complicated

question systematic, quantitative and modeling. That is to say, for a complicated question, first of all, it was decomposed into several composition elements, and these elements were further divided into more definite, specific and quantifiable small elements---indexes. Then the weights of every factor were determined according to the importance of the various factors within the same layer. At last a multi-goal and multi-level statistical mode was established after connecting each layer by using weights. The basic steps were as followed.

2.1.1 Establishing a multi-level hierarchical structure to form the target tree diagram

Hierarchical analysis model generally consisted of three layers, namely, top, middle layer and the lowest layer (figure 1). The top was the target layer, namely the general objective in hierarchy analysis. The middle, called constraint layer, was one of main factors influencing the total goal; the lowest , called measure layer, was the final measure to solve the questions. All of these were quantifiable indexes.

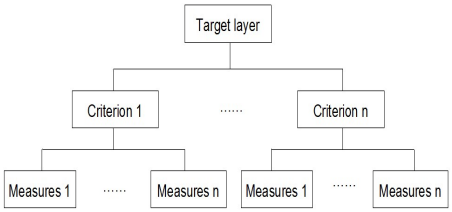

Figure 1. Model structure of AHP

2.1.2 Establishing pairwise comparison judgment matrix and calculating the weight value

Saaty 's weight method was used. At first, every index was compared and scores were given, and scoring standard was shown in Table 1. Then every index was compared and scores were obtained.

$$R=\begin{bmatrix} r_{11} & \mathrm{r}_{12} & \cdots & \mathrm{r}_{1n} \\ r_{21} & \mathrm{r}_{22} & \cdots & \mathrm{r}_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \mathrm{r}_{n1} & \mathrm{r}_{n2} & \cdots & \mathrm{r}_{nn} \end{bmatrix} \tag{1}$$

(1) $\mathrm{r}_{ii}=0.5, i=1,2,\cdots,n;$

(2) $\mathrm{r}_{ij}=1-r_{ji}, i, j=1,2,\cdots,n;$

(3) $\mathrm{r}_{ij}=r_{ik}-r_{jk}, i, j, k=1,2,\cdots,n.$

$$\begin{cases} 2a^2(n-1)\omega_1-2a^2\omega_2-2a^2\omega_3-\cdots-2a^2\omega_n+\lambda \\ =a\sum_{j=1}^{n}(r_{1j}-r_{j1}) \\ -2a^2\omega_1+2a^2(n-1)\omega_2-2a^2\omega_3-\cdots-2a^2\omega_n+\lambda \\ =a\sum_{j=1}^{n}(r_{2j}-r_{j2}) \\ \cdots\cdots\cdots\cdots\cdots\cdots \\ -2a^2\omega_1-2a^2\omega_2-2a^2\omega_3-\cdots+2a^2(n-1)\omega_n+\lambda \\ =a\sum_{j=1}^{n}(r_{nj}-r_{jn}) \\ \omega_1+\omega_2+\cdots+\omega_n=1 \end{cases} \tag{2}$$

At last, matrix was evaluated according to the established scores, and the weight of every index was got. The approximate weight of each index was

$$\overline{W_i}=\sqrt[m]{a_{i1}a_{i2\cdots a_{im}}} \tag{3}$$

The approximate weight was treated with normalized processing according to the following formula:

$$W_i=\frac{\overline{W_i}}{\sum_{i=1}^{m}\overline{W_i}} \tag{4}$$

The weight of index referred to different scores.(as shown in Tab. 1).

Table 1. Scoring standard of different layers by AHP

Importance Scale a_{ij}	Importance degree
1	Equally important
3	Slightly important
5	Basically important
7	Really important
9	Absolutely important
2,4,6,8	The middle value of two adjacent degree
Countdown	If the importance proportion of element i and element j is a_{ij}, the importance proportion of element j and ii is $a_{ji}=1/a_{ij}$

2.1.3 Consistency test

Consistency index

$$CI=\frac{\lambda_{\max}-m}{m-1} \tag{5}$$

$$\lambda_{\max}=\frac{1}{n}\sum_{i=1}^{m}\lambda_i/m \tag{6}$$

$$\lambda_i=\sum_{j=1}^{m}a_{ijW_j/W_i} \tag{7}$$

Ratio of calculation random consistency

$$CR=\frac{CI}{RI} \tag{8}$$

RI referred to average order random consistency index. Its score in different order was shown in table 2.

Table 2. Average random consistency index scoring

Number	*RI*
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45

If CR value was less than 0.1, you could think of the

consistency of judgment matrix as good.

2.1.4 Using multiplication to calculate combination weight

Combination weight referred to coefficient obtained by weight multiplication according to the weight of each index in different layers.

2.2 Fuzzy Comprehensive Evaluation

Using AHP to calculate the weight of each index, it was needed to evaluate the comprehensive level of the evaluation object. Based on fuzzy set theory, Fuzzy comprehensive evaluation considered the function of every evaluating factor and made the evaluation process to the evaluation object. Owing to this method's fuzziness in classifying numbers, fuzzy mathematics' principle and methods made the evaluation results to things more reasonable and reliable. The process of Fuzzy comprehensive evaluation was shown below:

1)Determining the main factors of evaluation

$$X = (x_1, x_2, \cdots, x_n) \tag{9}$$

2)Using the AHP to calculate the secondary evaluation index weight set.

$$W = (\omega_1, \omega_2, \cdots, \omega_n) \tag{10}$$

3)Determining the level of evaluation.

$$Y = (y_1, y_2, \cdots, y_n) \tag{11}$$

4)Determining the standard membership degree of each Level u.

$$u = (u_1, u_2, \cdots, u_m) \tag{12}$$

5)Constructing fuzzy evaluation matrix R to the evaluation object.

$$R = \begin{bmatrix} r_{11} & r_{12} \cdots r_{1m} \\ r_{21} & r_{22} \cdots r_{2m} \\ \cdots & \cdots \cdots \cdots \\ r_{n1} & r_{n2} \cdots r_{nm} \end{bmatrix} \tag{13}$$

6)For fuzzy comprehensive membership degree set B.

$$B = R \bullet u^T \tag{14}$$

7)For the total comprehensive membership degree.

$$U = A \bullet B \tag{15}$$

Comprehensive membership degree U was the total score obtained by fuzzy evaluation to the evaluation object and according to this total score, evaluation was made to every evaluation object.

3. MODEL CONSTRUCTION OF LANGUAGE SKILLS EVALUATION BASED ON THE AHP FUZZY COMPREHENSIVE EVALUATION

3.1 Selecting the evaluation index and constructing hierarchical level structure

After reading a large number of literature and consulting teachers long engaged in the work of college Chinese teaching in combination with my working experience for many years, the author decided to make evaluation to language skills from the following three aspects, language competence, paralanguage competence and comprehensive quality. And every aspect was evaluated according to different evaluation indexes. At last three-layered hierarchical level structure was shown in Table 3.

Table 3. Language skills evaluation index system

A level	B level	C level
Comprehensive level of language skills A	language competence B1	the level of language specification C1
		works comprehension C2
		language expression C3
	paralanguage competence B2	image temperament C4
		auxiliary force C5
		site appeal C6
	comprehensive quality B3	resilience C7
		psychological quality C8

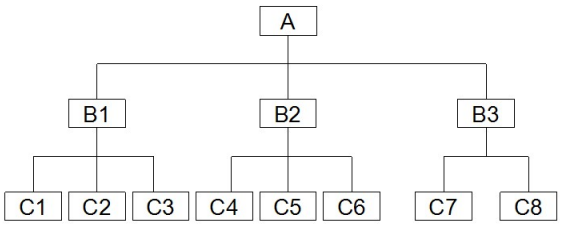

Figure 2. The hierarchical level structure

3.2 Establishing judgment matrix and calculating weight

Satya's weight method was used to establish judgment matrix of indexes in every level and the weight of every index, the results were shown as Table 4 to Table 7.

Table 4. Judgment matrix and weight of the first level evaluation system

A	B1	B2	B3	weight value
B1	1	2	3	0.540
B2	0.5	1	2	0.297
B3	0.333	0.5	1	0.163

Table 5. Judgment matrix and weight of the secondary evaluation system(language competence)

B1	C1	C2	C3	weight value
C1	1	1	1	0.333
C2	1	1	1	0.333
C3	1	1	1	0.333

Table 6. Judgment matrix and weight of the secondary evaluation system(paralanguage competence)

B2	C4	C5	C6	weight value
C4	1	1	1	0.333
C5	1	1	1	0.333

C6	1	1	1	0.333

Table 7. Judgment matrix and weight of the secondary evaluation system(comprehensive quality)

B3	C7	C8	weight value
C7	1	1	0.5
C8	1	1	0.5

3.3 Consistency Test

Formula 3 to 6 were used to calculate random consistency ratio CR value of the first level matrix and each secondary matrix. The results were shown as table 8.

Table 8. Consistency test results

Matrix	*CR*	Consistency Results
first level matrix	0.015	Satisfied
secondary matrix B1	0.020	Satisfied
secondary matrix B2	0.031	Satisfied
secondary matrix B3	0.028	Satisfied
first level matrix	0.015	Satisfied

3.4 Using multiplication to calculate combination weight of the lowest index

Combination weight of the lowest index was shown in table 9.

Table 9. Combination weight value of the lowest index

A level	B level	C level	combination weight
Comprehensive level of language skills	language competence(0.540)	the level of language specification(0.333)	0.180
		works comprehension(0.333)	0.180
		language expression(0.333)	0.180
	paralanguage competence (0.297)	image temperament(0.333)	0.099
		auxiliary force(0.333)	0.099
		site appeal(0.333)	0.099
	comprehensive quality(0.163)	resilience(0.5)	0.0815
		psychological quality(0.5)	0.0815

3.5 The evaluation results of Fuzzy comprehensive evaluation

In the process of graduate second-round examination, the judges were composed of 5 experts, each responsible for scoring the graduate in the terms of the above 3 aspects respectively. After score conversion, 5 experts presented the accurate score of the graduate attending second-round examination. The data were shown in Table 10.

Table 10. Summary of 5 experts' scoring to the graduate attending second-round examination

evaluation index	Z1	Z2	Z3	Z4	Z5
C1	85	84	90	83	88
C2	87	86	92	85	84
C3	82	85	86	80	83
C4	78	80	83	80	82
C5	90	84	87	86	84
C6	92	88	89	82	83
C7	84	85	83	79	86
C8	88	82	86	81	84

In scoring, 85 scores or more than 85 were considered as excellent; the score from 75 to 84 good; the score from 60 to 74 qualified; the score under 60 unqualified. The scores in Table 9 were classified and summarized according to the level. The results were shown in Table 11.

Table 11. Rating summary of evaluation score of the graduate attending second-round examination

evaluation index	rate			
	excellent	good	qualified	unqualified
C1	3	2	0	0
C2	4	1	0	0
C3	2	3	0	0
C4	0	5	0	0
C5	3	2	0	0
C6	3	2	0	0
C7	2	3	0	0
C8	2	3	0	0

According to the rating results, Fuzzy comprehensive evaluation method was used to evaluate.

1)Determining the main factors evaluated:

X=(Knowledge structure, scientific research ability, comprehensive quality)

2)The weight of the secondary index

Based on the above calculation results, the weights of evaluation index set in this study were

$$W = (0.540, 0.297, 0.163)$$

3)Determining evaluation level Y:

Y = (excellent, good, qualified, unqualified)

4)Determining the standard membership U of evaluation set

$u =$ (1/excellent，0.8/good，0.6/qualified，0.1/unqualified)

In the actual calculation, taking

$$u = (1, 0.8, 0.6, 0.1)$$

5)Establishing fuzzy evaluation matrix R on the evaluation objects

From table 9, it was seen that the evaluation matrix of knowledge structure(B1)、scientific research ability (B2)and comprehensive quality(B3)as followed

$$B1=\begin{bmatrix}3/5 & 2/5 & 0 & 0\\ 4/5 & 1/5 & 0 & 0\\ 2/5 & 3/5 & 0 & 0\end{bmatrix} \qquad B2=\begin{bmatrix}0 & 5/5 & 0 & 0\\ 3/5 & 2/5 & 0 & 0\\ 3/5 & 2/5 & 0 & 0\end{bmatrix}$$

$$B3=\begin{bmatrix}2/5 & 3/5 & 0 & 0\\ 2/5 & 3/5 & 0 & 0\end{bmatrix}$$

7)Calculating fuzzy comprehensive membership degree u

$$\overline{u}_1 = B_1 u^T = \begin{bmatrix}3/5 & 2/5 & 0 & 0\\ 4/5 & 1/5 & 0 & 0\\ 2/5 & 3/5 & 0 & 0\end{bmatrix} \bullet \begin{bmatrix}1\\ 0.8\\ 0.6\\ 0.1\end{bmatrix} = \begin{bmatrix}0.92\\ 0.96\\ 0.88\end{bmatrix}$$

$$\overline{u}_2 = B_2 u^T = \begin{bmatrix}0 & 5/5 & 0 & 0\\ 3/5 & 2/5 & 0 & 0\\ 3/5 & 2/5 & 0 & 0\end{bmatrix} \bullet \begin{bmatrix}1\\ 0.8\\ 0.6\\ 0.1\end{bmatrix} = \begin{bmatrix}0.8\\ 0.92\\ 0.92\end{bmatrix}$$

$$\overline{u}_3 = B_3 u^T = \begin{bmatrix}2/5 & 3/5 & 0 & 0\\ 2/5 & 3/5 & 0 & 0\end{bmatrix} \bullet \begin{bmatrix}1\\ 0.8\\ 0.6\\ 0.1\end{bmatrix} = \begin{bmatrix}0.88\\ 0.88\end{bmatrix}$$

7)Calculating the total comprehensive membership U

Calculating the total comprehensive membership U1, U2, U3 of evaluation objects B1, B2, B3 respectively.

$$U_1 = \omega_1 \bullet \overline{u}_1 =$$

$$(0.333,0.333,0.333) \bullet \begin{bmatrix}0.92\\ 0.96\\ 0.88\end{bmatrix} = 0.92$$

$$U_2 = \omega_2 \bullet \overline{u}_2 =$$

$$(0.333,0.333,0.333) \bullet \begin{bmatrix}0.8\\ 0.92\\ 0.92\end{bmatrix} = 0.88$$

$$U_3 = \omega_3 \bullet \overline{u}_3 = (0.5,0.5) \bullet \begin{bmatrix}0.88\\ 0.88\end{bmatrix} = 0.88$$

Finally calculating the total comprehensive membership U

$$\overline{u} = (U_1, U_2, U_3, U_4)$$

$$U = \omega \bullet \overline{u} = \begin{bmatrix}0.92\\ 0.88\\ 0.88\end{bmatrix} \bullet (0.540,0.297,0.163)$$

$$= (0.497,0.261,0.143)$$

8)According to membership degree maximum principle, evaluation results were presented.

Analysis to evaluation results showed that due to (this value was the biggest), the result of second-round examination of the graduate was “excellent”.

4. CONCLUSIONS

This study combined Analytic Hierarchy Process (AHP) and Fuzzy comprehensive evaluation methods to establish the evaluation system model of language skills examination. AHP calculated the weights of each evaluation index from the global perspective while Fuzzy comprehensive evaluation method used the fuzzy mathematics to make comprehensive evaluation to the language skills examination. This method quantified the evaluation indexes and got rid of the deficiency of the traditional qualitative evaluation method. The evaluation results were more accurate and reasonable. At the same time, this method made up for insufficient evaluation in the process of language skills examination, so it was worthwhile to popularize it in language skills examination.

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Study on the Degree 5 with 7 Nodes Quadrature Formula Based on Simplex

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Abstract: In this paper, we first take the minimum number modes in the degree 5 quadrature formula as the pointcut, draw out theorem 1, apply degree 3two elements orthogonal polynomial theory to prove that the 7 nodes are the minimum number of nodes required for degree 5 quadrature formula. Then, degree 5 with 7 nodes quadrature formula as research object, analyzes the construction conditions and construction method of quadrature formula, obtained the construction steps of degree 5 with 7 nodes quadrature formula in the general. Finally, take a 2 dimensional simplex region as an example, got the basic orthogonal polynomial in the area, proved the nodes and coefficients of degree 5 with 7 nodes quadrature formula based on simplex.

Keywords: quadrature formula; quadrature nodes; orthogonal polynomial; linearly independent; simplex region

1. INTRODUCTION

High dimensional numerical integration has many applications in engineering, social and financial disciplines. Actually, high dimensional numerical integration problem is the basic problem of multidimensional problems. Usually related scholars are accustomed to extend the classical one-dimensional numerical integration method to high dimension, however, due to the dimension effect, the classical one dimensional numerical integration method can not have extended to high dimension, which makes the research more difficult. It is for this reason that the high dimensional numerical integration has attracted the attention of the relevant scholars, and put forward a series of methods, such as: the algebra method[1] mainly refers to the work before 1970s of the American School of Hammer, Wymore, Stround and others, which based on algebraic methods; number theoretic method[2] mainly refers to the uneven grid quadrature formula and parallel grid quadrature formula and Hua-Wang method, trigonometric approximation method of numerical integration of multivariate periodic functions; Monte Carlo method[3] is a simulation experiment based on probability models; Lv Tao[4] proposed the application of splitting extrapolation method in high dimensional numerical integration method; Sloan[5] created the dot matrix at the end of 1980s.

In this paper, based on the research of synthesizes the above scholars about the high dimensional numerical integrate quadrature method, researched the minimum number of nodes on the required degree 5 quadrature formula and construction method of degree 5 quadrature formula, in order to improve the operability in the process of construction the high dimensional numerical integration quadrature formula.

2. REEARCH THE NUMBER OF QUADARATURE NODES BASED ON DEGREE 5 QUADRATURE FORMULA

Set D_n be a region of an n-dimensional Euclidean Space $\mathbf{R}^n$, remember $\mathbf{X}=(x_1,x_2,\ldots,x_n)$ and $d\mathbf{X}=(dx_1,dx_2,\ldots,dx_n)$ to discuss the form as shown in the formula (1), $\omega(\mathbf{X})=\omega(x_1,x_2,\ldots,x_n)$ is weight function, it is non negative, $\mathbf{X}_i$ is quadrature nodes, A_i is a constant that does not depend on $f(\mathbf{X})$, and is called the coefficient:

$$\int_{D_n} f(\mathbf{X})\omega(\mathbf{X})d\mathbf{X} \approx \sum_{i=1}^{N} A_i f(\mathbf{X}_i) \tag{1}$$

The formula is approximately equal on both sides, there are some errors, note the error is ρ_N, the error is equal to the left minus right. If for any monomial $x_1^{k_1}x_2^{k_2}\ldots x_n^{k_n}$, $\sum_{i=1}^{n} k_i \le k$, quadrature formula with (1) accuracy was established, and at least one degree $k+1$ monomial let type (2-1) which is not accurate, it is called the quadrature formula (1) with degree k quadrature formula.

According to the theory of multivariate orthogonal polynomial[6], the degree 3 orthogonal polynomial has4 bases in D, and the polynomial of these bases are shown as the formula (2):

Type (2), $q_2^{i,j} \in \mathbb{P}_2$, $i+j=3$, by double definite integral as shown in the formula (3) introducing three constant *A,B,C,* if the constant assumed region *D* makes *A,B,C,* is not all for 0, then there is a formula (4).

$$\begin{aligned} p^{3,0}(x,y) &= x^3 + q_2^{3,0}(x,y) \\ p^{1,2}(x,y) &= xy^2 + q_2^{1,2}(x,y) \\ p^{2,1}(x,y) &= x^2y + q_2^{2,1}(x,y) \\ p^{0,3}(x,y) &= y^3 + q_2^{0,3}(x,y) \end{aligned} \tag{2}$$

$$A=\int_D\left[p^{3,0}\cdot p^{1,2}-\left(p^{2,1}\right)^2\right]dxdy$$
$$B=\int_D\left[p^{3,0}\cdot p^{0,3}-p^{2,1}\cdot p^{1,2}\right]dxdy$$
$$C=\int_D\left[p^{2,1}\cdot p^{0,3}-\left(p^{1,2}\right)^2\right]dxdy \quad (3)$$
$$A^2+B^2+C^2>0 \quad (4)$$

In order to construct degree 5 quadrature formulas on the plane D, at least how many quadrature nodes are required? The problem is the starting point of the research on high dimensional quadrature formula.

Extraction the theorem 1, the theorem answers the problem of the number of quadrature nodes of degree 5 quadrature, it is described as follows:

Theorem 1. (Meisovskih) Set plane area D content type(4), in order to construct a degree 5 quadrature formula in D, the number of quadrature nodes cannot be less than 7.

3. RESEARCH ON THE CONSTRUCTION BASED ON DEGREE 5 WITH 7 POINT QUADRATURE FORMULA

3.1 CONSRUCTION CONDITION

Set D be arbitrary bounded domains in a plane, weight function $\omega(x,y)\equiv 1$, to construct 5 degree with 7 nodes quadrature formula on region D, need to seek three linear independent degree 3 orthogonal polynomials, they have 7 different common zeros, if such a polynomial has been found, it can be prove that quadrature formula takes the 7 public zero as quadrature nodes have 5 algebraic precision.

The features of degree 5 with 7 nodes quadrature formula can be described as follows [7]:

Let $p_k(x,y)$ and $p_{k,j}(x,y)$ express the real degree k two elements polynomial, and $q_k(x,y), q_{k,i}(x,y)$ express the two elements polynomial with the number is no more than k, that is $q_k\in\mathbb{P}_k$, $q_{k,i}\in\mathbb{P}_k$.

Theorem 2. if as type (7) shown the quadrature formula with 7 nodes have fifth accuracy, then there exits three cubic polynomials as shown type (8), and meet the following four conditions:

$$\int_D f(x,y)dxdy\approx\sum_{i=1}^{7}A_i f(x_i,y_i) \quad (5)$$
$$p_{3,1}(x,y), p_{3,2}(x,y), p_{3,3}(x,y) \quad (6)$$

Condition 1. The polynomial group (6) is linearly independent, and one of them is directly related to any polynomial in $\mathbb{P}2$;

Condition 2. The 7 quadrature nodes of the quadrature formula (5) are the common zeros of the three polynomials in the polynomial group (6);

Condition 3. If arbitrary cubic polynomial takes the 7 quadrature nodes in the quadrature formula (5) as the zero point, then is the linear combination of 3 polynomials in the polynomial group (6);

Condition 4. There exist three linear polynomials $q_{1,i}(x,y)=a_i x+b_i y+c_i, i=1,2,3$ (at least there are two linear polynomials are not constant for 0, make type (7) constant set up.

$$q_{1,1}(x,y)p_{3,1}(x,y)+q_{1,2}(x,y)p_{3,2}(x,y)+q_{1,3}(x,y)p_{3,3}(x,y)\equiv 0 \quad (7)$$

3.2 CONSTRUCTION METHOD

First of all, we need to introduce how to construct three linearly independent orthogonal polynomials $p_{3,i}\in\mathbb{P}_2$ and $i=1,2,3$, which makes the type (2-7) constant. Secondly, to point out the 7 common zeros in the type (7), and if these common zeros are different, they can be used the quadrature nodes of the degree 5 quadrature formula (5).

Theorem 3. If the A,B,C in the formula (3)are not all 0, then you can find 3 linearly independent orthogonal polynomials $p_{3,i}$, they meet the formula (7), where $p_{1,i}$ is the primary function, and at least two of them are not constant for 0.

In addition, there are several theorems, as shown below:

Theorem 4. Polynomial $p_{3,1}, p_{3,2}, p_{3,3}$ no common factor.

Theorem 5. polynomial $p_{3,1}, p_{3,2}, p_{3,3}$ has 7 common zeros.

Theorem 6. The common zeros $\rho_1,\rho_2,\cdots,\rho_7$ of $p_{3,i}(i=1,2,3)$ can not fall on a 2 curve at the same time.

Theorem 7. If $q_5(x,y)\in\mathbb{P}_5$, and $\rho_1,\rho_2,\cdots,\rho_7$ is the zero points of $q_5(x,y)$ then there is $q_{2,i}\in\mathbb{P}_2$, $i=1,2,3$ meet type (2-18):

$$q_5=q_{2,1}p_{3,1}+q_{2,2}p_{3,2}+q_{2,3}p_{3,3}$$

Theorem 8. Set $\rho_i=(x_i,y_i), i=1,2,\cdots,7$ are the seven common zero points of $p_{3,1}, p_{3,2}, p_{3,3}$, if they are different, then they can be used as the quadrature nodes of 5 quadrature formula in D.

4. ALGORUTHM EXAMPLE

Example description: Set D is simplex region $x\geq 0, y\geq 0, x+y\leq 1.$

The shape of the area is shown in figure 1.

The basic orthogonal polynomial in the region are

$$p^{3,0}=x^3-\frac{9}{7}x^2+\frac{3}{7}x-\frac{1}{35},$$
$$p^{2,1}=x^2y-\frac{1}{7}x^2+\frac{4}{7}xy+\frac{2}{21}x+\frac{1}{21}y-\frac{1}{105},$$
$$p^{1,2}=p^{2,1}(y,x),$$
$$p^{0,3}=p^{3,0}(y,x).$$

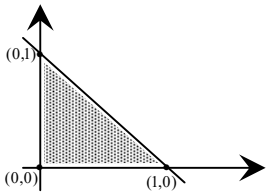

Figure 1 simplex region D

First of all, we need to solve:

$$A=\int_D\left[p^{3,0}\cdot p^{1,2}-\left(p^{2,1}\right)^2\right]dxdy=-\frac{8}{3\cdot5\cdot7\cdot7!}$$

$$B=\int_D\left[p^{3,0}\cdot p^{0,3}-p^{2,1}\cdot p^{1,2}\right]dxdy=\frac{8}{3\cdot5\cdot7\cdot7!}$$

$$C=\int_D\left[p^{2,1}\cdot p^{0,3}-\left(p^{1,2}\right)^2\right]dxdy=-\frac{8}{3\cdot5\cdot7\cdot7!}$$

from above type can be known $A^2+B^2+C^2\geq0$, so we can get a series of solution $\alpha=\beta=\gamma=1$.

$$\begin{bmatrix}0 & -\frac{8}{3\cdot5\cdot7\cdot7!} & \frac{8}{3\cdot5\cdot7\cdot7!}\\ \frac{8}{3\cdot5\cdot7\cdot7!} & 0 & -\frac{8}{3\cdot5\cdot7\cdot7!}\\ \frac{8}{3\cdot5\cdot7\cdot7!} & \frac{8}{3\cdot5\cdot7\cdot7!} & 0\end{bmatrix}\begin{bmatrix}\alpha\\ \beta\\ \gamma\end{bmatrix}=\begin{bmatrix}0\\0\\0\end{bmatrix}$$

Otherwise, we can get $p_{3,1}$, $p_{3,2}$ and $p_{3,3}$:

$$p_{3,1}=x^2y+xy^2+y^3-\frac{1}{7}x^2-\frac{8}{7}xy-\frac{10}{7}y^2+\frac{1}{7}x+\frac{4}{7}y-\frac{1}{21},$$

$$p_{3,2}=-x^2y-xy^2-x^3-\frac{1}{7}y^2+\frac{8}{7}xy+\frac{10}{7}x^2-\frac{1}{7}y-\frac{4}{7}x+\frac{1}{21}.$$

$$p_{3,3}=xp_{3,1}+yp_{3,2}=\frac{1}{21}(y-x)\left[3\left(y^2+xy+x^2\right)-6xy-3(y+x)+1\right].$$

we can get:

$$\begin{cases}0=x^2y+xy^2+y^3-\frac{1}{7}x^2-\frac{8}{7}xy-\frac{10}{7}y^2+\frac{1}{7}x+\frac{4}{7}y-\frac{1}{21}\\ 0=-x^2y-xy^2-x^3-\frac{1}{7}y^2+\frac{8}{7}xy+\frac{10}{7}x^2-\frac{1}{7}y-\frac{4}{7}x+\frac{1}{21}\\ y=x\end{cases}$$

then we get 3 quadrature nodes of quadrature formula.

$$\begin{cases}0=y^3-x^3-\frac{11}{7}y^2+\frac{3}{7}y+\frac{9}{7}x^2-\frac{3}{7}x\\ 0=\frac{1}{21}(y-x)\left[3\left(y^2+xy+x^2\right)-6xy-3(y+x)+1\right]\end{cases}$$

Get 3 quadrature nodes of quadrature formula.

Finally, as shown in Table 1.

Table 1: the nodes and coefficient of the degree 5 with 7 nodes based on simplex:

x_i	$\frac{1}{3}$	$\frac{6+\sqrt{15}}{21}$	$\frac{9-2\sqrt{15}}{21}$	$\frac{6+\sqrt{15}}{21}$
y_i	$\frac{1}{3}$	$\frac{9-2\sqrt{15}}{21}$	$\frac{6+\sqrt{15}}{21}$	$\frac{6+\sqrt{15}}{21}$
A_k	$\frac{9}{80}$	$\frac{155+\sqrt{15}}{2400}$	$\frac{155+\sqrt{15}}{2400}$	$\frac{155+\sqrt{15}}{2400}$

x_i	$\frac{6-\sqrt{15}}{21}$	$\frac{9+2\sqrt{15}}{21}$	$\frac{6-\sqrt{15}}{21}$
y_i	$\frac{9+2\sqrt{15}}{21}$	$\frac{6-\sqrt{15}}{21}$	$\frac{6-\sqrt{15}}{21}$
A_k	$\frac{155-\sqrt{15}}{2400}$	$\frac{155-\sqrt{15}}{2400}$	$\frac{155-\sqrt{15}}{2400}$

5. CONCLUDING

In this paper, to construct the degree 5 with 7 nodes on 2-dimension simplex with orthogonal polynomial theory, and the construction method of strong operability. But at present, with orthogonal polynomial theory to construct a high dimensional quadrature formula for arbitrary precision polynomial theory is not a complete theory, therefore, there is a lot of space in the field of research. In future research, if the research focus on the structure of quadrature formula of arbitrary degree and arbitrary dimensions in dimensional numerical integration may affect the more far-reaching.

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The Monte Carlo Method Based on High-Dimensional Integral Calculation

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Abstract: The high-dimensional integral problem is common in engineering science computing. Its diversity is strong and tough to deal with. Cause it is hard to get accurate results by general treatment methods, the demand for high-accuracy result is higher and higher. The Monte Carlo method is an effective tool in terms of solving complex high-dimensional integral problem. This paper mainly discusses the basic ideas of the Monte Carlo method, that is regarding the integral as mathematical expectation to solve and then using sampling method to estimate. Due to the result of traditional Monte Carlo simulation is approximate, came up with an improved method to improve accuracy, whose basic method is averaging the results powered by repeated Monte Carlo simulation. In the other words, it based on the pre-existing results and gain on, so the final value can be used as the most-accurate result. After lots experiments, the improved Monte Carlo method can improve the accuracy and decrease error. It is meaningful of improving the accuracy of complex high-dimensional integral problems.
Keywords: integral calculus; improve accuracy; Monte Carlo; average.

1. INTRODUCTION

The existence of high-dimensional integral problem is difficult. [1-4] The low result accuracy need to be improved. Based on the traditional Monte Carlo method to make improvement. Monte Carlo method is also known as stochastic simulation method and statistical test method. The basic idea is that according to the specific problem, establishing a probability model and random process and then seting requirements to the solution of the problem. Then by observing the simulation of process or sampling test to calculate for statistical characteristic parameters. Finally gives the solving of approximation. The standard error of estimate can be used for the accuracy of the results. Any integral can be regarded as a random variable of mathematical expectation, therefore, using this random variable is approximated by the arithmetic mean of it. Aiming at the uncertainty of the result itself, considering that multiple simulations have multiple sets of estimated results, average the results in order to improve the accuracy of the results. Quickly and efficiently generate the appropriate random number to complete some computing tasks is the key to the application of Monte Carlo method. The generation of random numbers as well as the selection of sampling method are key factors in the Monte Carlo method.

2. EXPERIMENTAL

Step1. Build probability model

For the general S integrals: construct a distribution density function on the integral area. Freely take a probability density $f(P)$ on the Vs, which satisfies the following conditions: $f(P) \neq 0$ .When $P \in V_s, G(P) \neq 0$, the mathematical of the random variable $g(P)$

$$g(P) = \begin{cases} G(P)/f(P) & f(P) \neq 0 \\ 0 & else \end{cases} \quad (1)$$

the mathematical expectation of the random variable $g(P)$

$$\theta = \int_{V_s} g(P) f(P) dP = E[g(P)] \quad (2)$$

So, it is complete to build the required model. So that solving the integral can be converted to solving the mathematical expectation that can be realized by Monte Carlo [5-12].

Step2. produce the random number and sampling

According to the theorem:[6] Assumes that the random variable X's distribution function is $F(x)$,

$$F^{-1}(y) = \inf\{x : F(x) \geq y\} \quad 0 \leq y \leq 1 \quad (3)$$

So: Assumes that the random variable U obey uniform distribution in the interval (0, 1), the distribution function $F(x)$ is $X = F^{-1}(U)$.

So reason to produce the random numbers from $F(x)$, as long as to generate random numbers from the interval (0, 1), then calculate them.[7-9] Then use appropriate sampling method to get samples.

Step3. the approximate estimates

When the sample is large enough, mathematical expection of $g(P)$ can be replaced by arithmetic mean. Firstly, extract N samples from $f(P)$: $\{P_i\}_{i=1}^N$, the arithmetic mean

$$g_N = \frac{1}{N} \sum_{i=1}^{N} g(P_i) \quad (4)$$

is the approximation of required integral value.Then determine the $f(P)$. The easiest way to determine

the $f(P)$ is obey uniform distribution on Vs:

$$f(P)=\begin{cases}1/V_s & P\in V_s\\ 0 & else\end{cases} \quad (5)$$

|Vs| said the volume of Vs, so $g(P)=|V_s|G(P)$.

Step4. error analysis

According to the strong law of large numbers, the probability of θ_N converge to θ is 1.

$$P\{\lim_{N\to\infty}\theta_N=\theta\}=1 \quad (6)$$

If there is finite variation σ_g^2 at g(P),

$$\sigma_g^2=\int_{V_s}(g(P)-\theta)^2 f(P)d(P)<+\infty \quad (7)$$

The approximation error formula is[10-12]

$$|\theta_N-\theta|\le\frac{X_\alpha\sigma_\alpha}{\sqrt{N}} \quad (8)$$

So increase N or decrease σ_g can improve accuracy and reduce the error.

3. RESULTS AND DISCUSSION

In calculation of $v_1=\int_0^1(x^3+\cos(x))d_x$ for example. The geometric meaning is as Fig.1.

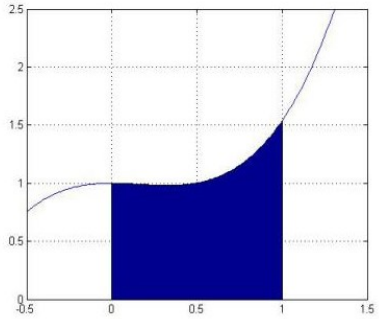

Figure.1 Definite integral geometry diagram

Firstly, build probability model: The condition is $\begin{cases}0\le x\le 1\\ x^3+\cos x-y\le 0\end{cases}$. Represented the ratio of random number that satisfies the condition as the probability P; Then get the sample that obey uniform distribution. If take n random numbers and n_1 numbers satisfy the condition.

$$P=n_1/n,\ I=S*P \quad (9)$$

Cause the generation of random numbers is with uncertainty, the sample extraction is uncertain. So using monte-carlo many times can obtain different results. Produce 20000 random numbers from [0, 1]and sample by Matlab. The results are shown in the Tab.1.

Table.1 The results from simulation statics

No.	1	2	3	4	5
Resut	1.0924	1.0908	1.0919	1.0910	1.0912
No.	6	7	8	9	10
Resut	1.0903	1.0918	1.0932	1.0912	1.0910
No.	11	12	13	14	15
Resut	1.0922	1.0905	1.0916	1.0909	1.0890
No.	16	17	18	19	20
Resut	1.0922	1.0909	1.0917	1.0902	1.0916
No.	21	22	23	24	25
Resut	1.0907	1.0899	1.0921	1.0904	1.0912

Annotation: 27 sets of data

It is easy to find all results are different from each other, but there is no obvious difference cause each reasult is the approximation. Inorder to improve the accuracy, deal with the results further to reflect the overall level. The specific step is $\overline{g}_N=\frac{1}{N}\sum_{i=1}^{N}g(r_i)$.

The final result is 1.0912 which close to the actual value much. In the same way, using Monte Carlo method to calculate high-dimensional integral is effective and accurate.

4. CONCLUSIONS

This paper combines the Monte Carlo method with sample average, comes up with a improved method which based on high-accuracy result, analysis the production of random number and sample method and gets lots meaningful conclusions. Compared with the existing traditional Monte Carlo method, this paper puts forward an improved method. The probability model is raised and accuracy of the results is improved. It offers a new way to improve the problem of precision. How to improve the accuracy of the simulation results is a worthy of further research topic. This method still has some problems to be solved in practical applications, such as random number of time consumption, the best selection of distribution density function and so on. They all need further research.

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Application of Improved Analogue Annealing Algorithm in the Optimization Route

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Abstract: Based on the solution of combinatorial optimization problem, made simulated annealing algorithm find out the optimal answer from the compiex solution.Traditional simulated annealing algorithm is beads on process of crystal annealing , .At the initial temperature, when the state is transformed into another state on the probability level to find random acceptable solution, until the end of annealing , output optimal solution.Simulated annealing algorithm has the problems such as cumbersome process, slow speed and so on.On basis of the principle of fractional Brownian motion, the paper improves the simulated annealing algorithm.And change the probability of receiving a result.So the algorithm can increase the memory function and eliminate the local optimal solution.And make up for the deficiency of simulated annealing algorithm. Finally, use the improved algorithm of the paper to solve the problem of Aircraft Cruise.The improved algorithm of the paper has a better efficiency and gets a better result.
Keywords: Simulated annealing algorithm; Markov Chain Brownian movement; Combinatorial optimization

1. INTRODUCTION

Along with the progressive development of humanity society, human beings are facing more and more problems. One of the important problems is to solve the optimization problem including commercial manufacture, mineral processing, circuit design, building materials and so on. In the age of information, circuit optimization problem is the most representative problem. Generally speaking, this kind of problem is in large-scale and solved with difficulty. It requires of being solved by intelligent algorithm.

The earliest thought of Simulated Annealing (SA for short) put forward by N. Metropolis et al in 1953.The thought developing fast in the last 80 centuries is a kind of random algorithm to solve the large scale combinatorial optimization problem. It is a kind of random optimization algorithm basing on Monte-Carlo iterative solution. It also bases on the similarity of the materials searching the global optimal solution during the annealing process. The Paper [1] of the simulated annealing algorithm is used to adjust the temperature update function of the simulated annealing algorithm. The simulated annealing algorithm and genetic algorithm are combined to form an adaptive simulated annealing algorithm in paper [2]. In the paper [3-5], the research on the simulated annealing algorithm is applied to the practical problems.

In this paper, the simulated annealing algorithm is improved based on the theory of Brown motion. Because the time that particles of Brownian movement can be equivalent to the time that the temperature fall down during the annealing process and they both have continuity. If we change that it generates neighbor function of probability density, the simulated annealing algorithm solving process will be more simple and the result will be more accurate.

2. THEORETICAL BASIS

Simulated annealing algorithm of the basic flow chart is shown in fig. 1.

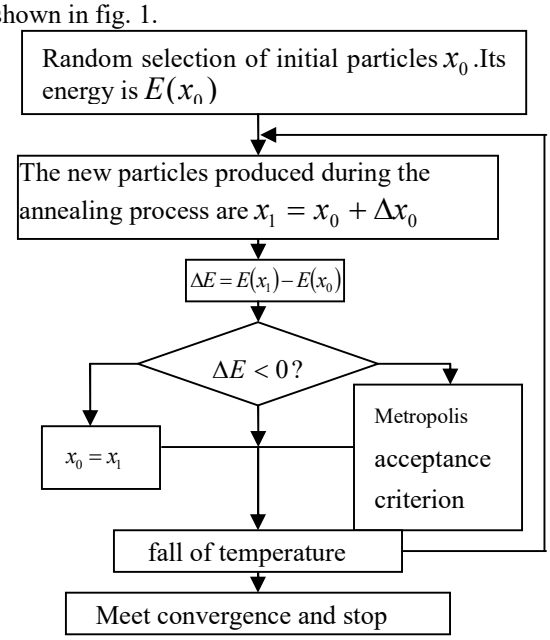

Figure 1 Algorithm of the basic flow chart

Metropolis algorithm defines the energy of the particles as the state of the particle. If the energy of the particles in the initial state i is $E(i)$, when the particle from state i to state j, the particle follow the following principles:

(1)when $E(j) \le E(i)$, accept this state.(2)when $E(j) \ge E(i)$, accept in the following probability: $e^{\frac{E(i)-E(j)}{KT}}$

Among them, K is the Boltzmann constant in physics, T is the material temperature.

Through the study of the Boltzmann constant's

distribution under each temperature, we can get to know: When the temperature drops to very low, the particle has great probability to turn into minimum energystate [6]. And each state of the simulated annealing process that changes with the change of temperature is a Markov chain process

Using this theory to analyze the process of simulated annealing, Is a new state probability formula for x' acceptable probability, When from the high temperature to low temperature, as long as the cooling-off process is slow enough. Then the conversion process will slow down. This will have more search times, Can reach thermal equilibrium at each temperature, to make the rate of finding optimum solution be 1. It can be said the Simulated annealing can be used to find optimum solution[7]。

3. THE DESIGN OF THE ALGORITHM

Simulated annealing is one of the Intelligent Heuristic Algorithm study. The deficiency is a longer time, annealing temperature annealing process for setting the parameters of large effect on the accuracy of the optimal solution is obtained, Is likely to fall in local minimum. Therefore, this paper puts forward the following improvement scheme:

1)This paper is based on neighborhood function in the thought of Brown's movement. And then get the probability density of focal functions. The rate of accepting traditional Simulated annealing will be improved.

2)It can make Simulated annealing have memory. Let it to remember ever achieve the best results in the process of search, so that the quality of solutions can be improved.

3.1 THE NEIGHBORHOOD FUNCTION OF BROWN MOTION

Brown motion is Mark off process in a continuous time. When $t > 0$, it is a continuous state function. And the sample function is a continuous function, so if the change process is $\{B(t), t \geq 0\}$, there will be the following definitions:

a) $\{B(t), t \geq 0\}$ is a non even and independent process of stationary increment.b) $B(0) = 0$;c) $E(B(t)) = 0$, and for arbitrary t, $B(t)$ is a random variable accords with Gaussian distribution

The probability density of the neighborhood function of the improved algorithm is combined with the Bsrown's theory of motion:

$$f(y_1, y_2, \cdots, y_n) = \frac{e^{-0.5A} \times \prod_{i=1}^{n-1} T_i}{\sqrt{2\pi \times \prod_{i=1}^{n-1} [2\pi (T_i - T_{i+1})]}} \quad (1)$$

$$A = T_1 \times y_1^2 + \sum_{i=2}^{n} \frac{T_i \times T_{i-1} \times (y_i - y_{i-1})^2}{T_i - T_{i-1}} \quad (2)$$

By proving the probability density of the neighborhood function, The probability distribution of the probability distribution of $B(1/T)$ is similar to that of the increment of the annealing temperature. The probability density generated by the neighborhood function is:

$$f(y_1, y_2, ..., y_n) = f_{1/T_1}(y_1) \prod_{i=2}^{n} f_{1/T_i - 1/T_{i-1}}(y_i - y_{i-1}) \quad (3)$$

so taking the formula into probability density formula, this theorem can be proved.

3.2. TEMPERATURE DROP FUNCTION OF BROWN MOTION

When the temperature drop function derived from the probability density formula that satisfies certain conditions, the probability of the symmetric coordinates within the region at random generated to zero including the origin during annealing tends. The theorem is proved by the following procedure:

$$T_n = \frac{T_1(e^q - 1)}{T_1(e^{qn+q} - e^{2q}) + e^q - 1} \quad (4)$$

The assumed solution interval is $[-x, +x]$, $x \in R^n$. In the process of annealing, the random number generated by the annealing function is y_i $(1 \leq i \leq n)$ .And setting annealing temperature coefficient is q, so there is $|y_i| \leq x$.

$$P\{|y_i| \leq x, i = 1,2,...,n\} =$$

$$\int_{-x}^{x} \cdots \int_{-x}^{x} f_{1/T_1}(y_1) \cdots f_{1/T_n - 1/T_{n-1}}(y_n - y_{n-1}) dy_1 \cdots dy_n \quad (5)$$

can be obtained by the formula of probability density. Take the A expression into expressions. The probability of state transition is replaced by the above expressions, and the efficiency of solving the global optimization problem is improved.

3.3. SIMULATED ANNEALING ALGORITHM WITH MEMORY

Set memory variable x' and $f(x')$, used to remember the current optimal solution and the optimal value of the objective function. At the beginning, $x' = x_0$ and $f(x') = f(x_0)$. After the start of the iteration, when accepting a new explanation, the value of the objective function of $f(x_k)$ and $f(x')$ were compared.If $f(x_k)$ better than $f(x')$, then $x' = x_k$ and $f(x') = f(x_k)$. When the algorithm terminates, one of the current solution and memory variables is selected as better approximate global optimal solution of the problem.

4. EMPRRICIAL TEST

Nest in this paper, taking the classic aircraft cruise as an example, to verrify the feasibility andaccuracy of the simulated annealing algorigithm that adopt design optimization path:

We have known aircrafe will be the investigation of the 100 targets of the enemy longitude、latitude as shown in Fig. 3

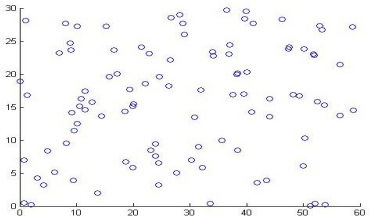

Figure 3 The longitude、latitude chart

The traditional simulated annealing algorithm is used to solve it: The shortest time is 45.21 hours; the flight path of the aircraft is shown in Fig. 4:

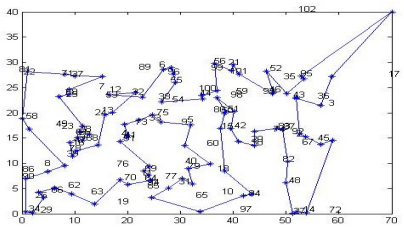

Figure 4 Schematic diagram of aircraft cruise route

Based on the above analysis of examples, cruise timeis not the minimum flight time.and find more optimal solutions, the soving process is complicated, and the optimized simulated annealing process of traditional solution quality is not high, need solving process of simulated annealing is improved.

Using the improved program to solve the problem of aircrafe cruise again, and the result of the solution is shown in Fig.5:

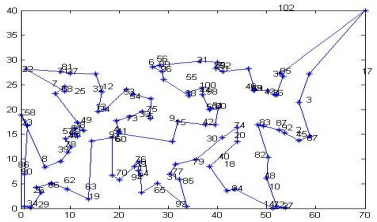

Figure 5. Improved optimal path graph

And by running the program to get the flight time is 42.37 hours, to be better than the previous results, which also proves the use of the Brown movement and combination of the feasibility and accyracy of the algorithm.

The following is the use of the momory of the annealing process.the process of increasing the memory of the corresponding solution is obtained by modify the program. And once again on the aircraft cruising problem to solve the optimization. The results of the solution as shown in Fig. 6.

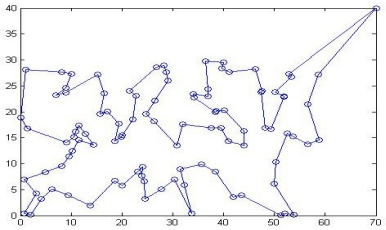

Figure 6 Optimal path graph

And get the flight time of 40.07 hours. The results of the aircraft's flight time are shorter. Proves that the simualated annealing algorithm to solve the optimal accuracy and feasibility of using this methord the solution of memory. To avoid falling into local optimal solution predicament. And also reduces e very time in the coling process searches for optimal. Every memory of the obtained solution, so that the optimal solutimal solution is more accurate, higher quality.

5. CONCLUDINGS

In view of the deficiency of simulated annealing algorithm in solving process.In this paper, the principle of combining sports with Brown, set up a link between the annealing temperature of the moving particle temperature of the moving particle movement time Brown and simulated annealing algorithm, to simulate the neighborhood function are changed, reduces each time for annealing process the optimal solution search, eliminating the local optimal solutions may exist, the simulated annealing algorithmis more efficient, simple, can obtain more accurate result.

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Quantitative Evaluation of Influence of Tangshan Horticultural Exposition Based on Data Envelopment Method

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Abstract: The World Horticultural Exposition was held at Hebei-Tangshan in 2016. It will have a certain influence on Tangshan that is just a prefecture-level city. For this problem, we establish the establishment of data envelopment model and the improved data envelopment model, which is based on genetic algorithm to do a quantitative assessment of the World Horticultural Exposition. And we get a conclusion: Tangshan Horticultural Exposition have a great influence on the outside.
Keywords: World Park Impact Influence; Data Envelopment Analysis Genetic Algorithm; Improved Data Envelopment Analysis

1. INTRODUCTION

Tangshan World Horticultural Exposition was held in 2016, and it becomes China's first contractor of the World Horticultural Exposition of the prefecture-level cities. Tangshan World Horticultural Exposition will have a great impact on the outside world, so the influence of Tangshan World Horticultural is becoming people's study of the hot issues.

Data Envelopment Analysis (DEA) is a model for evaluating the performance of multi-objective decision-making units (MDUs). This method is based on the relative efficiency and evaluate the same type Decision making unit by the Multi-indicator inputs and multi-indicator outputs. This method does not need to define the production frontier function in the form of parameters, and allows the production frontier function to have different units, besides, it does not need to clarify the relationship between the input and output of each evaluation decision unit.

In this paper, according to the data envelopment can deal with the characteristics of multi-input multi-output problem, we establish the data envelopment analysis model, then select the past seven years, the World Park area, investment funds, the number of pavilions as input, and Participation in national, green area and flower types of data as output to get the efficiency of the unit countries. And the efficiency of the World Expo will be used as an indicator of the impact evaluation. Then we compare the influence of China with other countries and different regions of China on the economic impact of Tangshan Horticultural Exposition. According to the efficiency of different countries will affect the World Horticulture sort. And then we can conduct a quantitative assessment on the impact of Tangshan World Horticultural.

2. MODEL SELECTION AND SOLUTION

2.1 THE BASIC ASSUMPTIONS OF THE MODEL

1) The input and output of the data envelopment model are unaffected by the interference.
2) Short-term municipal planning and construction will not be a big change.
3) Air quality in April-August 2016 will remain basically unchanged.
4) 2016 years from April to August the tourist population growth rate constant.

2.2 THE ESTABLISHMENT OF THE DATA ENVELOPMENT BASED ON THE IMPACT OF THE EXPO BEFORE THE OPENING OF THE ANALYSIS MODEL

Data envelopment analysis (DEA) is a nonparametric method for estimating the relative effectiveness of the performance of decision making units. [1] By means of mathematical methods and statistical data to determine the relative effectiveness of the production frontier, each decision unit is projected onto the production frontier of the DEA, and the relative effectiveness of the decision units is compared by comparing them with the DEA frontier.

There is a decision unit (n), each decision unit has the same input (m), and the same output (s):

Input

$$\begin{Bmatrix} 1\rightarrow \\ 2\rightarrow \\ 3\rightarrow \\ \\ m\rightarrow \end{Bmatrix} \begin{pmatrix} x_{11} & x_{12} & x_{13} & \cdots & x_{1n} \\ x_{21} & x_{22} & x_{23} & \cdots & x_{2n} \\ x_{31} & x_{32} & x_{33} & \cdots & x_{3n} \\ \vdots & \vdots & \vdots & & \vdots \\ x_{m1} & x_{m2} & x_{m3} & \cdots & x_{mn} \end{pmatrix} \begin{pmatrix} y_{11} & y_{11} & y_{11} & \cdots & y_{11} \\ y_{11} & y_{11} & y_{11} & \cdots & y_{11} \\ y_{11} & y_{11} & y_{11} & \cdots & y_{11} \\ \vdots & \vdots & \vdots & & \vdots \\ y_{11} & y_{11} & y_{11} & \cdots & y_{11} \end{pmatrix} \begin{matrix} \rightarrow 1 \\ \rightarrow 2 \\ \rightarrow 3 \\ \\ \rightarrow s \end{matrix}$$

Output

If we take v_i as the weight of the item input (i), u_r is

used to represent the weight of the rth item, so the expression for the rate of the input-output ratio h_j is:

$$h_j = \frac{\sum_{r=1}^{s} u_r y_{rj0}}{\sum_{i=1}^{m} v_i x_{ij0}} \tag{1}$$

For $h_j \le 1$, then the performance evaluation of the j_0 th decision unit can be classified as follows optimization model:

$$\max h_{j0} = \frac{\sum_{r=1}^{n} u_r y_{rj0}}{\sum_{i=1}^{m} v_r x_{rj0}}$$

$$st.\begin{cases} \dfrac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1 (j=1,...,n) \\ v_i \ge 0 (i=1,...,m), u_r \ge 0 (r=1,...,s) \end{cases} \tag{2}$$

We can transform the second formula into a problem of equivalent linear programming by the third formula:

$$t = \frac{1}{\sum_{i=1}^{m} v_i x_{ij}}, \quad w_i = tv_i, \mu_r = tu \tag{3}$$

$$\max h_{j0} = t\sum_{r=1}^{s} u_r y_{rj0} = \sum_{r=1}^{s} \mu_r y_{rj0}$$

$$\text{st.}\begin{cases} \sum_{i=1}^{m} w_i x_{ij} - \sum_{r-1}^{s} \mu_r yrj \ge 0 (j=1,...,n) \\ \sum_{i=1}^{m} w_i x_{ij0} = 1 \\ w_i \ge 0 (i=1,...,m), \mu_r \ge 0 (r=1,...,s) \end{cases} \tag{4}$$

The dual variable (θ) is introduced, then the front dual variable problem can be write as:

$$\min \theta$$

$$st.\begin{cases} \sum_{j=1}^{n} \lambda_j x_{ij} \le \theta x_{ij} (i=1,...,m) \\ \sum_{j=1}^{n} \lambda_j y_{ij} \ge y_{rj0} (r=1,...,m) \\ \lambda_j \ge 0 (j=1,...,n) \end{cases} \tag{5}$$

For the formula, θ is the efficiency of the decision unit, the larger the rate (θ) is, the more output of the unit inputs will be. That is, the closer to 1, the higher the efficiency of decision-making unit. [2]

In this model we take the area, investment funds, the number of pavilions as input, the participation in national, green area and flower species as the output to get the value(θ).The external radiation intensity of the World Horticultural Exposition will increasing with the value.

However, when the efficiency indexes of multiple units are 1, the effective sorting can't be carried out. In order to make up for the above-mentioned defects, the DMU method is introduced to order the DMUs. [3-5] The basic idea is as follows:

An ideal DMU with minimum input and maximum output is introduced into all DMUs, and take the weight of this ideal DMU as the maximized to determine the effectiveness of the solution. Because the ideal DMU is an optimal ideal state, it must be the most effective, and its evaluation efficiency index should be 1. Therefore, the optimal value it obtains about the weight is to make the ideal DMU valid to determine the significance, and the ideal DMU is valid relative to other DMUs, so the weights calculated in this sense are reasonable for all DMUs. [6-8] Thus avoiding the traditional model emphasizes the weight of each DMU calculated one-sided, there is no universal applicability characteristics.

Method:

1) Suppose for each input metric $k(1 \le k \le m)$, the minimum input vector for all DMUs is $X_{\min k}$, then the minimum input vector for production activities is:

$$X_{\min} = (X_{\min 1}, X_{\min 2}, ..., X_{\min m})$$

The maximum output vector is:

$$Y_{\max} = (Y_{\max 1}, Y_{\max 2}, ..., Y_{\max s})$$

2) We defined $(X_{\min}, Y_{\max})$ as the production activity corresponding to the ideal DMU, which is an ideal state because the selected input is the smallest and the output is the maximum. This is taken as a reference and then a common weight is obtained which is reasonable for all DMUs. Construct a model as follows:

$$\max \frac{U^T Y_{MAX}}{V^T X_{MIN}}$$

$$st.\begin{cases} \dfrac{U^T Y_j}{V^T X_j} \le 1, \ j=(1,2,.....,n) \\ \dfrac{U^T Y_{MAX}}{V^T X_{MIN}} \le 1 \ U \ge 0, \ V \ge 0 \end{cases} \tag{6}$$

In this paper, we choose the last seven sessions of the World Horticultural Exposition as a comparison. In order to facilitate comparison, we make the seven countries of the statistical data of the World Horticultural Association into a bar chart for easy observation, the specific graphical situation shown in Fig. 1:

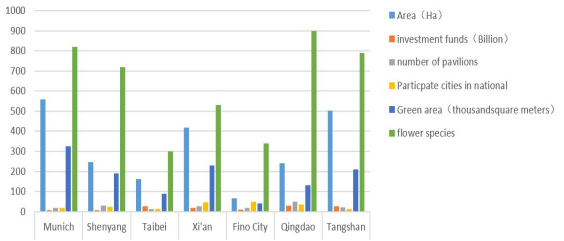

Figure 1 Data for the seven regions of the World Horticultural Exposition

3. RESULTS AND DISCUSSION

According to the above data, we get the result though the MATLAB program operation, and the result is shown in Tab. 1:

Table 1. Comparison of external influence of the World Horticultural Exposition

Area	Munich	Shenyang	Taipei	Xi'an	Fino City	Qingdao	Tangshan
θ	0.9210	0.6985	0.6320	0.9435	1.0000	1.0000	0.9100

According to the Table 1, we can know that the output and input rate of different regions' World Horticultural Exposition is different. The external radiation intensity (external influence) of the fund input can be reflected by the Horticultural Exposition rate.

According to the contrast of the different countries in the Netherlands, the Fino city Qingdao, have the largest unit of funds generated and the greatest impact. By analyzing the original data, it can be seen that the more the participating countries are, the greater the external influence of the World Horticultural Exposition will have. It indicated that the number of participating countries in this impact evaluation program accounted for the largest proportion of external influence, which is consistent with the actual situation that proves the effectiveness of the evaluation scheme.

In five different regions of China, the influence of Tangshan World Horticultural Exposition is in the middle, behind the two major tourist cities of Qingdao and Xi'an. The reason is Qingdao and Xi'an are more influential than those of Tangshan for Qingdao is a famous seaside city at home and abroad. As the ancient capital of the Six Dynasties, Xi'an has a strong relationship with cultural influence. Tangshan as a prefecture-level city, the influence is greater than Shenyang and Taipei is worthy of recognition.

However, according to the above efficiency table we can see: there are three units are EDA effective, it can't be based on the value of its efficiency index to determine which region of the World Expo will be the most influential.

Using the method of introducing ideal DMU, [9-10] according to the decision making unit to introduce a decision-making unit with the smallest input index and the largest output in all aspects,

Input indicators is $x_{\min} = (65, 2.5, 10)$ and the output indicators is $y_{\max} = (22, 305, 600)$.

Using the optimized procedure to obtain the efficiency index and sort the results:

Table 2. Optimized efficiency index

Year	1990	1992	1993	1999	2002	2003
θ	0.9946	1.0000	0.8345	0.9342	0.9876	0.9643

Sorted by the efficiency index we can get the year order from large to small: year1992, year 1990, year 2002, year 2003, year 1999, year 1993.

The data envelopment method of ideal data unit is used to comprehensively consider the overall situation of external radiation efficiency in each region, including not only input and output, the higher the utilization efficiency is, the more the weight of the output in the ideal model will be, which indicates that the influence of the Horticultural Exposition on other cities will be greater.

4. CONCLUSIONS

Tangshan as a prefecture-level city, which successfully held the 2016 World Horticultural Exposition, not only can stimulate the local economic growth of Tangshan, but also can promote the sustainable development of Tangshan. At the same time, the event that Tangshan held the World Horticultural Exposition successfully will cause a great impact to the outside world.

5. ACKNOWLEDGMENT

The authors wish to thank all of the mentors and enthusiastic seniors in the modeling process, and the classmates who silently paid for us. This work was supported by the Mathematical Modeling Innovation Lab, North China University of science and technology.

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Study of the Influence after Housing Estate Open Based on the Plume and MLRM Model

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Abstract: The paper uses traffic volume, Road structure and Rush hours to make the plume model, which ensures the range of influence surrounding after the housing estate open. Then get the deta of influence index in Least square method and make the MLRM, which is used to know the influence to the surrounding traffic after the opening of the housing estate.
Keywords: Fuzzy Neural Network, Plume Model, Least Square Method, Multi Factor Liner Regression

1. INTRODUCTION

There are many different ideas about the influence of the housing estate opening in public. Some think small spacing and high density road network can solve the traffic problems better, because the roads in estate can link up with the main roads outside, in which reason the housing estate can ease city traffic pressure. Therefore our team has made the mathematical model by collecting detas to do some study about this problem.

2. Model BUILDING

2.1 SET UP OF THE EVALUATION MODEL

Fuzzy neural network combine the advantages of fuzzy evaluation and artificial neural network , therefore[1-2] .We select the surrounding road structure , housing estate structure , traffic volume and travel characteristics as the whole evaluation index , then refine every index and convering them into score index of $[0,1]$, and specifies the provisions of the score is more closer to 1 , the influence is more greater[3-4].

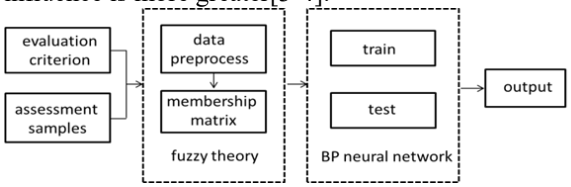

Figure 1 .The assessment prosess of fuzzy neural network

2.2 PLUME MODEL BASED ON INSTANTANEOUS LINE SOURCE

The transportation generated by the opening housing estate , which assigns the influence to the surrounding can be compared to the instantaneous line source spreads on surface. The instantaneous line source model is along an infinitely long source (set to Z zxis)at one moment , then introducing one line source of mass m on a unit length. At this moment , the concentration of any two points on the straight line that is over a point (x, y) and perpendicular to the surface XY are equal[8-9].

The mathematical expression for the model is:

$$C(x, y, t) = \frac{Q}{4\pi DT} \exp\left(-\frac{x^2 + y^2}{4Dt}\right) \tag{1}$$

In the formula , C is concentration , T is the length of time , D is constant , t is time period , Q is the traffic volume on the rush hours.

The roads are influced by the maximum distance model is:

$$r_i = 2\sqrt{DT \ln \frac{k_i Q}{s_i\left(\frac{\eta_i}{\alpha}\right)^{\frac{1}{\beta}} - q_i^0}} (i = 1,2,\cdots,n) \tag{2}$$

In the formula , D , α , β is constant , the variables those need to input are k_i , Q , η_i , s_i , q_i^0 .

2.3 THE ESTABLISHMENT OF MULTIPLE REGRESSION MODEL

We can see the influence of the housing estate opening on surrounding road traffic as dependent variable y , see the scope of influence after the housing estate opening r , the mode of egression, the state of rush hours, the status of intersection traffic, the canalization of entrances and exits, land areas, the hosting ratio of road, the number of entrances and exits, the purpose of egression as independent variable $x_1, x_2, \cdots, x_j (j = 1.2,\cdots,n)$. We use multi factor liner regression to analyze the relationship between the dependent variable and the independent variable [10] and make the mathematical model:

Hypothesis the linear regression model of dependent variable y and independent variable $x_1, x_2, \cdots, x_j$ is:

$$y = a_0 + a_1x_1 + a_2x_2 + ... + a_jx_j + \varepsilon \quad (j = 1,2,...n) \tag{3}$$

According to the idea of the minimum value in Calculus, we can know that deviation square and SSE have minimum value. If you want the value of SSE to reach the minimum, the partial derivative of $a_0, a_1, ..., a_j$ to SSE must be zero.

Using SSE to calculate the partial derivative of $a_0, a_1, ..., a_j$ and make it be zero, we can get $j + 1$ equations:

$$\begin{cases} \dfrac{\partial SSE}{\partial a_j} = -2\sum \left(y - \hat{y}\right) = 0 \\ \dfrac{\partial SSE}{\partial a_j} = -2\sum \left(y - \hat{y}\right)x_i = 0 \end{cases} \quad (4)$$

By solving this equation, we can get the estimated value $\hat{a}_0, \hat{a}_1, \cdots, \hat{a}_j$ of $a_0, a_1, ..., a_j$.

2.4 THE INFLUENCE OF RESIDENTIAL AREAS'LAYOUT

Different cells' design concepts play an important role, the mainly layout of housing estate are sheet type, axial type, concentric type, enclosed type, intensive and metaphorical[11-12].

From the relevant date and regression constants can be obtained the regression epuation that indicates the transportation influence before the housing estate open

$$\begin{aligned} y = {} & 0.7820 + 0.1176x_1 + 0.0568x_2 - 0.2864x_3 \\ & - 0.5423x_4 - 0.0492x_5 + 0.0378x_6 + 0.1814x_7 \\ & + 0.1824x_8 - 0.2334x_9 - 0.5423x_{10} \end{aligned} \quad (5)$$

In the same way , we can obtain the regression epuation that indicates the transportation influence after the housing estate open.

$$\begin{aligned} y = {} & 1.0000 + 0.2600x_1 + 0.0600x_2 + 0.1900x_3 \\ & - 0.1700x_4 + 0.0000x_5 + 0.1300x_6 - 0.5500x_7 \\ & - 0.9800x_8 \end{aligned} \quad (6)$$

Bringing the date into the regression epuation (5) and (6) can be calculated the results those show the transportation influence about 6 types housing estate before and after they open.

Table 1 .The transportation influence before and after housing estate open

Types	sheet	concentric	metaphorical
Before	0.5010	0.3189	0.2143
After	0.6194	0.3963	0.1061
Increase(%)	23.63	24.27	-50.49
Types	axial	intensive	enclosed
Before	0.4093	0.0018	0.3600
After	0.7526	0.0237	0.3671
Increase(%)	83.87	12.17	1.97

Corresponding schematic diagram, as shown in figure:

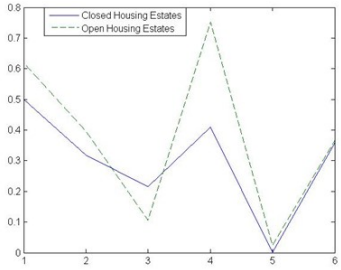

Figure 2 . the sketch map of the trasportation influence about housing estate before and after open

3. CONCLUSIONS

According to above-mentioned analytical result, we think that sheet type , radial typed and intensive type housing estates are suitable for opening; axis type housing estate is more suitable for opening ; after enclosed type residential opening, it is little or no affect on the transportation; however, metaphorical type housing estate is inappropriate to open.

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Effects of Residence Community Opening on Road Traffic

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Abstract: In order to study the influence of different community opening on road traffic, first of all, when the community is closed, the actual traffic capacity model is constructed. On the basis of this, taking into account when the district open, some vehicles' route will change. The model is modified by introducing Lane change coefficient and the mixed intensity coefficient. A dynamic model based on the actual capacity is constructed. Secondly, the district is divided into three types: "multi master", "one main multi branch" and "multi main and multi branch". The intersection of the road is divided into T-mouth and cross the mouth, therefor 6 different types of community were constructed. By using practical capacity model and its dynamic model, the practical traffic capacity of 6 different communities before and after opening are given. Applying the actual traffic capacity of the growth rate to compare the impact of the road traffic on various types of residential open before and after. When the internal structure of the community as "more than the main multi - intersection", it has the largest actual traffic capacity of growth rate, and road is more smooth.
Keywords: Community open; actual capacity; dynamic model; Capacity growth rate

1. INTRODUCTION

Urban traffic problems are becoming increasingly prominent. Because urban space and road resources are limited, The State Council issued a document in principle that is no longer the construction of a gated community and actively promote opening residential quarter. For different opening residential quarters can achieve the optimization of road network structure and help the road traffic capacity, which also can improve the purpose of traffic conditions and better the effectiveness of the study. The road traffic capacity and its dynamic model were used to evaluate the capacity of the road traffic capacity, then 6 different types of residential quarters were constructed, and the optimal residential quarter was found through the evaluation of the model. Through the process of the establishment of the model and the actual traffic situation, it puts forward some reasonable suggestions, so as to provide a reference for the relevant departments.

2. ROAD TRAFFIC CAPACITY MADEL

2.1 BEFORE THE OPENING OF THE ACTUAL CAPACITY OF DISTRICT

The basic of traffic capacity that is the basic traffic, refers to the unit of time through the road section of the maximum number of vehicles and also known as theoretical capacity [1-5]. The basic capacity of a single lane is the maximum traffic flow of the lane in the unit time, which is related to the minimum safety distance between vehicles. Based on the above analysis, the expression of the basic traffic capacity is:

$$C_b = \frac{1000}{l_0} v \quad [1]$$

The actual capacitywhich consider the actual road conditions is the basic capacity of the amendment [2]. The impact of road traffic capacity's main factor is the number of lanes and the lateral width and the horizontal distance between the outer edge of lane to roadside obstacles and passenger car equivalent coefficient and the number of traffic lights and so on. By analyzing, the actual traffic capacity's expression: $Q_x = C_b \cdot N \cdot r_1 \cdot r_2 \cdot r_3 \cdot r_4$ N is the number of lanes, r_1 is the lane width coefficient, r_2 is the lateral clearance effect correction factor [3], r_3 is the correction coefficient of large vehicles, r_4 is the correction coefficient about the driver's condition's impact on traffic capacity [4].

2.2. AFTER THE OPENING OF THE ROAD, THE ACTUAL CAPACITY OF THE ROAD

After the opening, the overall structure of the road will be changed. The use of the road area and the number of lanes are increased [5]. The area surrounding the road after the opening. The actual capacity of the original model is no longer applicable. In order to get the model which is suitable for open road traffic capacity. On the basis of the original model, the parameters are introduced.

2.21 CORRECTION OF LANE CHANGE COEFFICIENT

Open area will increase the traffic network area. The formation of a road junction in and out of the cell junction will form a street intersection. The vehicle can flow freely from the surrounding roads, which has a certain share on the traffic of the surrounding road. When the vehicles are out from the area around the main road, they will be remitted to the main road. So the vehicle and the intensity of lane will increase. And when the driver change into the main road, the vehicle's speed and vehicle distance will change. It

will form a mixed flow. The same main road vehicles will be due to the fork in front of the intersection and then slow down. So the traffic will be reduced and it need to introduce a lane change coefficient to modify the model. According to the change of traffic flow and vehicle speed, the lane change coefficient is obtained [6]:

$$r_j = 1 - \frac{Q_s}{n_k Q} = 1 - \frac{K_j V_f q_i |\Delta v| t_c}{n_k \left(4 l_g + K_j V_f q_i |\Delta v| t_c\right)} \quad [2]$$

Among them K_f are free flow rate. q_i is the rate of lane change? l_g is the unit time in the free flow of the running distance? K_j is the density of the blockage? ΔV is the difference between the speed of lane changing and the speed of freedom?

2.2 MODIFICATION OF MIXED STRENGTH COEFFICIENT

Under normal circumstances, you can divide the road inside the community into straight line that doesn't cross and straight line that cross. For straight line that doesn't cross, the main change is the area and route of the road. So it can be based on the direct observation of the surrounding road data to get its actual traffic. For the straight line crossing the road, it will form a crossroads. When the vehicle runs to the mixed intersection, it needs to slow down. Thus affecting the change of the traffic. Therefore, we need to take into account the impact of the traffic lights at a crossroads and road that has mixed intersection on the vehicle. The mixed strength coefficient is an index to describe the influence of the vehicle on the average speed of the vehicle. The formula is as follows [7]:

$$W_i = \frac{\alpha \left(1 - V_R\right)^b \left(\frac{v}{N}\right)^c}{\left(3.28L\right)^d} \quad [3]$$

Among them, W_i is the mixed strength coefficient. V_R is the flow rate. L is the total flow rate. a、b、c、d is the length of the mixed section, and the 6 is the given constant.

According to the different inside course of the District, the actual capacity can be divided into two kinds, that is:

$$\begin{cases} Q = Q_s \cdot r_j \cdot W, & \text{cross} \\ Q = Q_s \cdot r_j & \text{straight} \end{cases}$$

3. OPEN ROAD TRAFFIC CHANGES IN DIFFERENT TYPES OF RESIDENTIAL AREAS

3.1 CONSTRACTION OF DIFFERENT COMMUNITY TYPES

Comprehensively consider of community structure, the surrounding road structure and traffic flow of the three aspects of the situation. Then district division type. Different types of cases are as follows:

Table 1. community type combination

Community structure	The intersection of the main road	Traffic flow
Multi Trunk	T-Junction	city center
A main branch	Crossroads	Suburb
Multi trunk and multi branch		

As the city center of the car traffic is certainly greater than the suburbs, so we do not consider the impact of the factors. The first fixed community structure, in which the actual capacity of the road structure under the condition of larger capacity and then compared the three kinds of community structure. Finally, it is concluded that the effect of which type of community opening is the best.

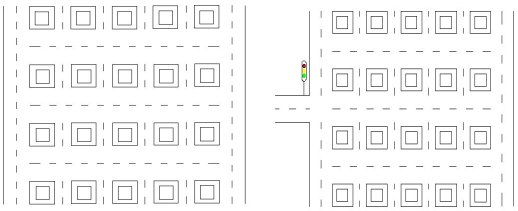

Figure 1 The type of "Multi trunk and multi branch" and "Multi trunk and multi branch - T junction"

3.2 CHANGES IN ROAD TRAFFIC

Select the community data of different types, the actual traffic capacity model in front of the application can obtain six kinds of area before and after the opening of the actual traffic capacity. In order to get more direct influence on the road traffic after the opening, the actual capacity for the force of each community growth rate. The same with "multi master and multi branch - T-mouth" and "multi master and multi branch cross - export" as an example. By solving the model to get the actual passage ability of the cases before and after the opening respectively:

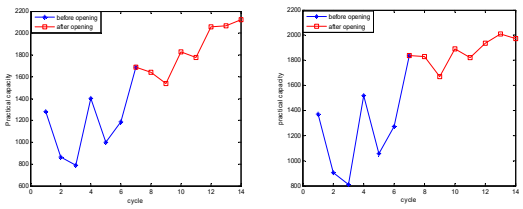

Figure 2 According to figure

we can directly see the surrounding roads when the T-junction, respectively before and after the opening of data averaging. It can be got that traffic mean opening up to 1170.52 pcu and after the opening of 1715.57 pcu, the growth rate is 46.56%. When the roads around the crossroads, by calculating the mean of the data processing, the average traffic volume can be found before the opening of 1170.52 pcu and 1845.11 pcu after the opening. After the opening of the increase rate of 57.63% compared to the previous.

The same method can be used to get the actual capacity of the other five kinds of different types of cells before and after opening. Then the growth rate of the actual traffic force is calculated:

Table2. the actual rate of traffic growth

Type	Growth rate	Type	Growth rate	Type	Growth rate
Multi Trunk-T junction	0.0002	A main branch - crossroads	0.2989	Multi trunk and multi branch - T junction	0.4656
Multi trunk-crossroads	-0.00016	A main branch - T - junction	0.1925	Multi trunk and multi branch - crossroads	0.5763

From the table2 we can clearly see that the various types of community growth rate. For "the Lord", "one main support" and "more" these three types of community, all the surrounding road conditions for the crossroads open best. Integrated six types of community can be found more than the main multi branch - the intersection of this type of residential open road traffic growth rate of 0.5763, which is the most suitable for the open cell types.

4. CONCLUSIONS AND RECMMENDATIONS

In this paper, the influence of different types of residential area on road traffic is given, and the model with practical capacity is used to analyze and simplify the problem. In order to determine the best community type, the rate of growth of six different types of community to the open road traffic is compared, and concluded that this type of “Multi trunk and multi branch’s effect” is the best.Then according to the results of the previous model and the analysis of the modeling process, combined with the current stage of community opening. The advice is as follow: future open community should be to build a "Multi trunk and multi branch" type and open road surrounding roads should be based on crossroads and open area should be mainly built in the traffic flow position.

5. ACKNOWLEDGMENT

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Reasonable Exploration of Open Residential Area

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Abstract: Today, the establishment of an open residential estate has become a hot topic, but the actual effect of open areas affected by many factors. First of all, through AHP, Selecting the evaluation index of the weight value of the density of road network, the village road area, the driving time per kilometer, the motor vehicle intervention degree, and normalizing weight value, conducting FSE. Then, according to the disturbance coefficient of vehicle and pedestrian, the traffic time and traffic flow model are established. Next, select different types of cells to test the model. Finally put forward reasonable suggestions that include traffic-intensive, crowded city center for the establishment of open area, the relatively undeveloped township is not suitable for the establishment of open area. Calculate the critical value of the ratio of the area and the surrounding area of the road and the number of vehicles. If the car around the built-up area density is greater than the critical value, then suitable for open area, or is not suitable for the district open.
Keywords: AHP; FSE; Impedance function; Sensitivity analysis

1. INTRODUCTION

Chinese cities have developed rapidly, but there are also many problems. Such as the blind pursuit of scale expansion of urban construction, traffic congestion and other "urban disease" spread increased. Closed cell is a major cause of urban disease. We need to quickly manage urban disease". Thus, people pay more and more attention to the open cell.

Many papers have studied the advantages of open cell with respect to the closed cell [1-5]. they proposed the contradiction between the closed cell and the rapid development of the current urban traffic. And put forward to the closed cell transformation planning strategy [3]. they optimized Braess model, pulled in case analysis and drown a conclusion that is closed cell opening can not only improve the road network accessibility, but also reduce the cost of travel [6]. we know Seaside town; Florida is successful cases of foreign open area. Shenzhen Vanke City and Yibin Rhine Sichuan River is successful cases of domestic open area.

In this paper, we bound the traffic flow model, carried on sensitivity analysis, obtain critical value. And according it to judge whether the closed cell has been built into an open area. We also selected the district to carry out investigation and analysis of the district. Finally get suitable area for open cell.

2.EVALUATION MODEL OF THE IMPACT OF COMMUNITY OPENING ON THE SURROUNDING ROAD TRAFFIC

2.1 SELECTION OF EVALUATION INDEX BASED ON AHP

The evaluation indexes of the road surrounding traffic were selected as the road density, the road area, the intersection, the driving route, the driving time per kilometer, the degree of non-motor vehicle intervening and the number of parking spaces. The above indexes were compared with each other. The comparison results are expressed as a pairwise comparison matrix.

By solving the MATLAB software, the weight vector corresponding to R is obtained. As Tab. 1.

Table 1. Weight value of each index

Index	Density of road network	Road area	Intersection	Driving route	Driving time per kilometer	Degree of non-motor vehicle intervening	Parking spaces
Weight value	0.1191	0.4482	0.0363	0.0294	0.1530	0.1944	0.0206

To sum up, reflecting the surrounding road traffic index determined as network density, road area per kilometer area, travel time and non-motor vehicle intervention.

2.2 THE FSE BASED ON WEIGHTED AVERAGE

The road network density, road area per kilometer area, travel time and vehicle intervention level four indicators to establish the fuzzy comprehensive evaluation model [1]. Define the evaluation index set, set the evaluation set, and establish the single factor evaluation matrix, the closed area and open area two evaluation matrix were recorded as R_1, R_2. The

weight vector of evaluation factors is $W \cdot W = (0.11, 0.50, 0.18, 0.20)$ .Synthetic fuzzy synthetic evaluation result vector B .According to the maximum membership principle, the maximum membership degree of the closed area is 0.51,and open area of maximum degree of membership is 0.558. Preliminary judgment, the surrounding capacity of the open area is better than the closed area. Using $M(\wedge, \vee)$ to determine the fuzzy evaluation set B. As a result, the evaluation result of the closed area is $\mu_1 = 2.2778$ .The evaluation results of open area is $\mu_2 = 2.3493$. From the above formula, obtained $\mu_2 > \mu_1$ .Further determine the open area than the closed area surrounding capacity is good.

3. VEHICLE PASSAGE TIME AND VEHICLE FLOW MODEL

3.1 THE CHANGE OF EACH INDEX AFTER THE COMMUNITY OPENING

There are two main effects after the opening of the community: on the one hand, the density of the road network increases, the available paths of the vehicles increase, the congestion of the roads decreases, the speed of the vehicles increases, the fixed path decreases, and road traffic flow increased; the other hand, the intersection of inflow of vehicles and pedestrians will increase the surrounding road, which also increases the vehicle's driving time, reducing road traffic. The influence of closed cell and open cell on road traffic is shown in Fig.1 and Fig.2.

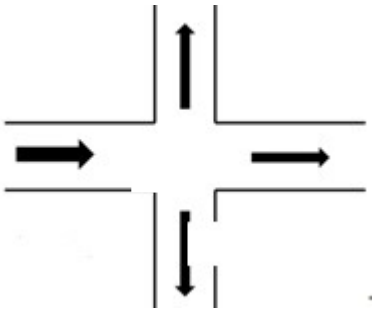

Figure 1 traffic volume of closed cells

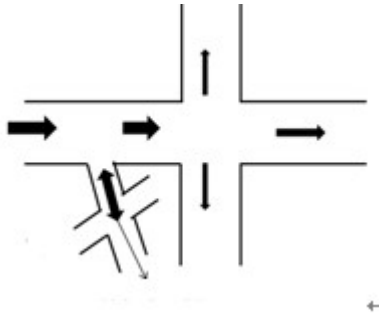

Figure 2 the open area of traffic flow

3.2 PASSING TIME AND TRAFFIC FLOW MODEL

Area before the opening, the surrounding road vehicles can not enter the district, only on the main road. So the density of the area, the measure of area and other conditions on the surrounding road traffic has no effect. The time when the vehicle on the surrounding road passes through a road is $t_0 = l_{ij} / v_1$.

Form in: l_{ij} is the distance of ij . v_1 is through the section of the free flow speed.

After the opening of the area, the road has increased, and the corresponding increase in the road area. The density of the network increases, increasing the speed of the vehicle, the number of vehicles entering the area and the surrounding roads remain unchanged, the vehicle density per unit area decreases, thereby alleviating the surrounding road traffic pressure. The vehicle density per unit area is $k=N/S$, Speed density model is $v = v_1 / (1 - k_2 / k_1)$, Vehicles traveling the same distance time becomes shorter, as $t_1 = l_{ij} / v$. Considering the influence of vehicle and pedestrian flow at the interface between the residential road and the surrounding road, the driving time of the road is affected, the BPR impedance function is improved [2]. Vehicle disturbance coefficient is η_1. Pedestrian interference coefficient is η_2 .The improved BPR impedance function is $t_2 = 0.15(V / (\eta_1 \eta_2 C))^4$. Comprehensive above, after the opening of the surrounding area of vehicle traffic time is $t = t_1 + nt_2$. [4] Area surrounding the road traffic is $q = kv$.

Table 2 Survey data of three kinds of cells

Cell types	Area of residential area	Peripheral road length(km)	Peripheral average vehicle number
Downtown residential quarters	33.533	4.5	409
Suburban residential quarters	30.400	3.5	285
Local residential quarters	28.333	3.2	246

4. DIFFERENT TYPES OF RESIDENTIAL OPEN BEFORE AND AFTER THE IMPACT

According to the area of residential area, the length of the surrounding roads, the number of vehicles surrounding the average, respectively, the survey of urban residential areas, suburban residential areas and

local residents of the relevant data, as shown in Tab 2.

Through the investigation of each cell in the peak and off peak time around the road vehicle number and speed, the traffic time and traffic flow model, the closed and open time and traffic vehicles were calculated.

According to the data in the Tab3 a stream of dense, crowded places, open area will make the free flow speed increasing, reducing travel time and the traffic flow increasing, will promote the area surrounding the road traffic, so suitable for the establishment of open area; but the area that the traffic is sparse, the population is not concentrated, open will increase per kilometer of travel time, reduce the density of vehicles per kilometer and the traffic flow, so it is not appropriate to establish an open area.

5. BASED ON SENSITIVITY ANALYSIS TO DETERMINE THE AREA SUITABLE FOR CLOSED TO OPEN

We based on vehicle density to discriminate whether the traffic is concentrated. Sensitivity analysis of the model is established. Therefore, urban planning and traffic management departments in the analysis of whether the opening of the district based on Ratio of open area and surrounding area and number of vehicle to vehicle density. Critical value is $0.0095pch/m^2$. If the value is greater than the critical value for the establishment of an open area, otherwise it is not suitable for Residential Open.

6. THE ANALECTS OF CONFUCIUS

Based on Modeling and analysis, this paper puts forward the reasonable suggestion about the opening of the residential district from the angle of traffic passage. They are that in the road network density, road traffic around the downtown residential area is necessary to open, to promote the role of road traffic, and the road density, road traffic around the small local residential areas need not open open, but will aggravate the impact of road traffic, road pressure.

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Selection of Indicators for the Impact of Community Opening on Road Traffic Capacity

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Abstract: In recent years, with the increasing size of the urban population, as well as China's Automobile Holdings increased, urban traffic congestion has become one of the reasons for the development of the city. And the influence of the open area on the road traffic capacity has gradually become the focus of discussion. The selection of evaluation indexes is crucial for an evaluation system. At first, this paper introduces the function requirements, principles and ideas of index selection, and finally uses the frequency statistics method to select the indexes related to the surrounding road capacity, construct the evaluation index system.
Keywords: evaluation index; traffic capacity; residential opening.

1. INTRODUCTION

Multi index comprehensive evaluation method as a comprehensive understanding of the important things, has been widely used, according to incomplete statistics, comprehensive evaluation of 2002 to 2015 of the Chinese journals in China published academic papers of more than 2 thousand and 770 article, the scope of the study relates to the society, economy, technology etc. In the comprehensive evaluation method, the construction of index system is one of the key problems. To construct a reasonable evaluation index system is the premise of scientific evaluation. And on each of the different issues, it should be cut from the research direction, the establishment of the evaluation index system to adapt to the problem. In this paper, the evaluation index system is constructed based on the functional requirements and principles of the construction of the index.

2. INDEX SELECTION

2.1EVALUATION INDEX SYSTEM FUNCTIONAL REQUIRMENTS

The evaluation index system of the impact of open community on the surrounding road traffic should at least have the following functions [1,2]:

First of all, it can describe and express the traffic capacity of the whole network in a certain area through a series of indicators, such as road network accessibility, road network patency, road saturation and so on. Secondly, it can describe the surrounding road traffic in different traffic flow, different road structures and different cell structure under the influence of its capacity to change the way. Finally, it can reflect the main factors and minor factors that affect the capacity of road traffic in the model, and it is convenient to introduce the correction coefficient in order to make the analysis of the actual situation more accurate.

2.2 INDEX SYSTEM CONSTRUCTION PRINCIPLES

(1) the principle of overall completeness

The evaluation index system as a whole, should be reflected from different aspects surrounding the road capacity, but also reflect the dynamic changes in the system, and can reflect the development trend of the regional road network traffic conditions.

(2) the principle of comparability

It is necessary to compare traffic saturation, delay time and vehicle average speed to analyze and evaluate the capacity of road network in the region. It can realize the comparison of the traffic capacity before and after the opening of the community, and compare the influence of the traffic capacity on the capacity of the road network after the district is opened in the different district structure or the traffic flow.

(3) the principle of operability

According to the actual situation, no matter how perfect the index system, if the operation difficulty is too high, will greatly limit its usefulness, may make the index system failure probability of operation is greatly increased in the process of using. So to ensure that the index system is simple and easy to operate, data is easy to obtain, deal with, otherwise it will be difficult to promote the use of.

(4) the principle of Science

The road traffic system comprehensive evaluation index system is established on the basis of scientific theory, to reflect the basic situation of road traffic conditions, combined with the reality and the future trend of development, scientific analysis area opens to traffic impact on the surrounding roads, for the district to open the provisions provide a strong basis for the planning of the government.

(5) the principle of sensitivity

The selected indicators should be able to directly reflect the impact of the open area on road traffic. That is, in the model, the perimeter roadway affected state can be sufficiently sensitive to changes in the indicators involved.

(6) the principle of prominence

The choice of indicators to be comprehensive, but should distinguish between primary and secondary roles, to highlight the current overall and extremely key security issues, to ensure the focus and concentrate on the high frequency of occurrence, the serious consequences of the incident.

2.3 INDEX CHOICE

This paper believes that the selection of indicators not only consider a wide range, but also to ensure that the choice of careful. The selected indicators should have the basic indicators obtained directly from the original data, used to directly reflect the characteristics of the first and second indicators, but also on the basic indicators of the abstraction and summary, to illustrate the link between the two indicators, as comprehensive index. In this we use frequency statistics method [3] and expert consultation method set index, in order to meet the scientific and complete principle. Through the combing of the literature, to the authority of the classic point of view of high-frequency indicators [4,5] as the focus, select the relevant indicators. According to observability of the principle of data is difficult to obtain the selection of indicators to remove, and finally get the evaluation index system.

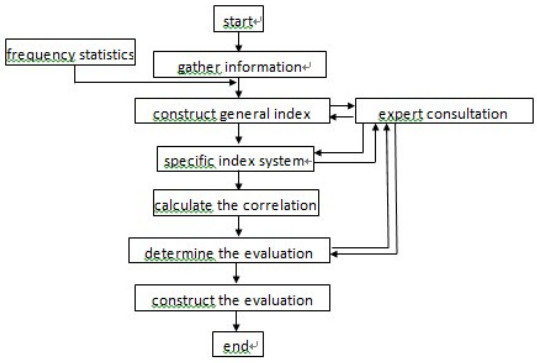

Figure 1 Indicator screening program diagram

2.4 DESIGN INDEX SYSTEM

In this paper, the evaluation index system is constructed by using the index hierarchy. First, confirm the target layer as "the impact of community opening on the surrounding road capacity", and then construct the first-level index by the frequency statistic method and expert consultation method as the road network structure (A1), traffic condition (A2) and road traffic efficiency (A3). According to the above principles and processes of screening indicators, analysis of 12 secondary indicators, the specific indicators Tab. 1.

Table 1 The impact of open area on the surrounding road capacity index system

index	number	influencing factors
road network structure	1	density of road network
	2	road area
community	3	intersection width
traffic conditions	4	intersection waiting time
	5	lateral clearance
	6	lack of line of sight
road traffic efficiency	7	segment saturation
	8	intersection Saturation
	9	average driving speed
	10	average delay time
	11	the length of the link
	12	intersection queue length

In order to make the evaluation index system more clear, detailed explanation of the following indicators.

(1)road network density

Road network density [6] refers to the ratio of effective road network length to service area area:

$$L_i = \sum_{m=1}^{n} A_m \times L_{im} \tag{1}$$

$$D_i = \frac{L_i}{S_i} \tag{2}$$

(2) road saturation

Table 2 China's urban road service level division standards. [8]

saturation	service Level	road congestion level
0~0.6	1	smooth traffic
0. 6~0.8	2	traffic is slightly congested
0.8~1.0	3	traffic congestion
>1.0	4	serious congestion

3. CONCLUSIONS

Based on the functions and principles of selected indicators, the frequency statistics method and the expert consultation method are used to set up the indicators, and finally the index is divided into two categories: The first layer is the road network structure, traffic condition, road traffic efficiency, the second layer is the network density, road area, the width of the intersection, the intersection waiting time, lateral clearance, horizon shortage, road saturation and intersection saturation degree, average speed, average delay time, queue length, intersection

queue length.

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Optimal Design of Mooring System Based on Genetic Algorithm

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Abstract: The mathematic model of steel pipe and steel bucket inclination angle in mooring system is established based on the micro-element method and the improved genetic algorithm. Firstly, the mechanics model of the buoy, steel pipe, steel drum and anchor chain is analyzed by using the theory of mechanics. The mechanical model of the static equilibrium is established. Then, the force of anchor chains The differential equation describing the shape of the chain is established by combining the characteristics of catenary equation. Finally, the improved genetic algorithm is used to solve the obtained anchor chain equation, and the inclination angle of steel tube and steel drum is obtained. The model established in this paper can calculate the inclination angle of steel tube and steel drum in mooring system under different wind speed and water depth, which lays a certain theoretical foundation for the establishment of mooring system.

Keywords: Theoretical mechanics, differential element analysis, differential equations, catenary equations.

1. INTRODUCTION

With the land and sea oil and gas resources increasingly scarce, from offshore to deep sea has become the inevitable trend of the development of marine energy and the economy. Marine competition, especially in the deep-sea areas of international competition is becoming increasingly fierce, the development of deep-sea high-tech is to achieve our participation in international deep-sea competition. The harsh environment on the ocean and the location requirement of offshore mining platform make the research, design and manufacture of mooring system face new opportunities and challenges. Because of the design and calculation of various parameters of the mooring system is the foundation of mooring system. In this paper, a mathematical model for calculating the inclination angle of steel pipe and steel bucket in mooring system is established. Expecting to provide reference for the future design and development of deep water mooring system in China.

2. MOORING SYSTEM

2.1 THE MAIN FEATURES OF THE MOORING SYSTEM

Characteristics of the wind system: single-point mooring system can be 360 degree unrestricted free rotation，The system around the mooring center point of rotation, the whole system is like a wind standard, the buoy in the wind downstream position and improve the system's force conditions, the so-called system of the wind characteristics.[1] Therefore, it is contemplated that portions of the mooring system may be considered to be in the same plane.

Elasticity of the system: A single-point mooring device is a kind of elastic system. It has the original reaction to the external force and has the capability of absorbing and consuming energy. As the position of the floating body is shifted, the mooring system will increase the anchor force and the potential energy of the mooring system will increase.

2.2 THE IMPACT OF WIND

In the wind flow process, by the structure of the obstruction, it will have a corresponding force on the structure, known as the wind load. The wind load is divided into two parts: the horizontal wind load along the wind speed direction and the lift force perpendicular to the wind speed direction. When calculating, the lift force perpendicular to the wind direction is very small and neglects, only the horizontal wind force is considered. The horizontal wind load is related to the height, shape, wind area and wind pressure of the structure, In accordance with CCS "Maritime mobile platform classification and construction specifications", the formula

$$F = C_h C_s P_o A \tag{1}$$

$$P_o = 0.613 \times V^2 \tag{2}$$

In the formula: P_o —Wind pressure, unit Pa; V is wind speed, unit m/s; C_s —Wind component shape factor; C_h is Height coefficient, among them, h refers to the vertical height from the design surface to the center of the component; A is the vertical projection area of the component perpendicular to the wind direction, unit m^2 ; F is the wind, unit N.[2]

3. MODEL ESTABLISHMENT

Mooring system is a complex physical system, and its response to environmental loads is also a complex mechanical problem. In order to solve the problem, the system is simplified, the force of each part is

analyzed, and the mechanical model is obtained [3].

3.1 STRESS ANALYSIS

The buoy system, the mooring system and the underwater acoustic communication system are analyzed as a whole. The state of the buoy is regarded as the floating state. The vertical force analysis of the system is shown in Fig 1

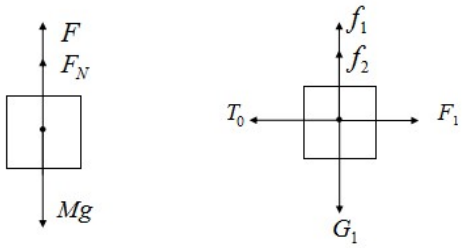

Figure 1 The whole vertical force analysis

Figure 2 Stress analysis of the system with anchor removed

From the force analysis diagram can be seen

$$F + F_N = M_g \tag{3}$$

Among them, F is the buoyancy of the overall system, F_N is the support of the seabed to the overall system, M_g is the total system gravity.

Next, the stress-free analysis of the system for removing the anchor is shown in Fig 2

From the force analysis diagram can be seen

$$f_1 + f_2 = G_1 \tag{4}$$

$$T_0 = F_1 \tag{5}$$

Among them, f_1 is the buoyancy received by the buoy, f_2 is the buoyancy of the portion of the buoy excluding the buoy, G_1 is the total gravity of the anchor removal system, T_0 is the pull provided by the anchor, and F_1 is the wind.

The buoyancy formula is known

$$f = \rho g V \tag{6}$$

Similarly, the mooring system in the steel pipe, steel drum for stress analysis

$$f_3 + T_{i,j}\cos\beta_j = m_0 g + T_{i+1,j+1}\cos\beta_{j+1} \tag{7}$$

$$T_{i,j}\sin\beta_j = T_{i+1,j+1}\sin\beta_{j+1} \tag{8}$$

Among them, $T_{i,j}\left(i = 1,2,\cdots,n; j = i+1\right)$ is the tension between steel pipe i and steel pipe $i+1$ or the tension between steel pipe and steel drum, β_j is the angle between the steel pipe j and the vertical direction or the angle between the steel drum and the vertical direction, f_3 is the buoyancy of the steel pipe, m_0 is the weight of the buoy.

All the angles and the depth of the existence of the relationship between H :

$$L\cos\alpha + l\cos\beta_j + h = H \tag{9}$$

Among them, L is the length of anchor chain, l is the length of steel pipe or steel drum, α is the angle between anchor chain and vertical direction, h is the buoyancy drainage height, H is the depth of mooring system.

3.2 CATENARY CATENARY EQUATIONS

When the buoy is subjected to wind or water, the icon will deviate from its equilibrium position and apply tension to the mooring system. Consider the force of the anchor chain [4-5].

Take any micro-segment of the chain, For this section under the action of the tensile force analysis shown in Fig3

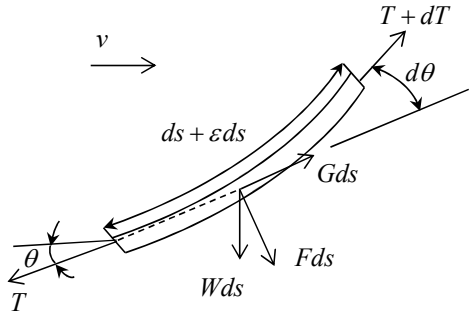

Figure 3 Stress Analysis of Micro - Segments on Anchor Chain

Thus the static equilibrium equation of the element can be established:

$$(T+dT)\cos d\theta - T - Wds\sin\theta + G(1+\varepsilon)ds = 0 \tag{10}$$

$$(T+dT)\sin d\theta - Wds\cos\theta - F(1+\varepsilon)ds = 0 \tag{11}$$

Among them, T is the pulling force of the chain; W is the weight per unit length of the anchor chain; θ is the angle between the tension T and the horizontal direction; F and G are the normal and tangential flow forces on the chain length per unit length; ds is the length of the micro-segment; dT is the amount of change in length; $d\theta$ is the amount of change in the angle; ε is the elongation of the anchor chain per unit length; Is defined as follows:

$$\varepsilon = \frac{\Delta S}{S} = \frac{T}{EA} \tag{12}$$

E is the elastic modulus of the chain, and A is the cross-sectional area of the chain.

From the perspective of geometric relations, The second-order infinitesimal quantities are ignored, Can be obtained:

$$\frac{dT}{ds} = W\sin\theta - G(1+\varepsilon) \tag{13}$$

$$\frac{d\theta}{ds} = \frac{1}{T}\left[W\cos\theta + F(1+\varepsilon)\right] \tag{14}$$

The material of the chain is rigid, not consider of its deformation, so A is equal to zero. In this question, The sea is still, thus G and F is equal to zero. The equation can respectively be simplified as

$$\frac{dT}{ds} = W\sin\theta \tag{15}$$

$$\frac{d\theta}{ds} = \frac{1}{T}W\cos\theta \tag{16}$$

(13) and (14) are the control equations to be solved.

By the geometric relationship between the elements, can be obtained

$$\frac{dx}{ds} = \cos\theta \tag{17}$$

$$\frac{dy}{ds} = \sin\theta \tag{18}$$

To sum up, by equation(15)(16)(17)(18)can be obtained a set of differential equations. According to the given anchoring line conditions, Solve this set of differential equations, Tensile force T at each point along the mooring line, inclination θ , The coordinates of each pointandX, Y can be obtained

Among them, a is the anchor chain parameter

$$a = \frac{T\cos\theta}{W} \tag{19}$$

4. GENETIC ALGORITHM AND CONCLUSION

Genetic algorithm is an intelligent optimization algorithm imitating the natural selection and genetic mechanism. The implicit parallelism and the global search feature are two remarkable features of it. It has strong robustness. For some large and complex nonlinear systems, Has a unique superior performance. In this paper, we try to solve the nonlinear equations in the above-mentioned problems from the angle of optimization and iteration, and get the inclination angle of each steel pipe and steel drum in the mooring system. Based on the characteristics of genetic algorithm and the characteristics of the classical algorithm, a hybrid algorithm for solving nonlinear equations is designed. The algorithm inherits the global searching ability of the genetic algorithm and has global convergence. At the same time, in the genetic algorithm The classical algorithm is introduced as a meta-operator to improve the local search ability of the algorithm, and the algorithm has high convergence speed and precision [6].

The general form of non-linearity listed above is:

$$\begin{cases} f_1(\beta_1,\beta_2,\cdots,\beta_j) = 0 \\ f_2(\beta_1,\beta_2,\cdots,\beta_j) = 0 \\ \vdots\ \vdots\ \vdots\ \vdots\ \vdots\ \vdots \\ f_j(\beta_1,\beta_2,\cdots,\beta_j) = 0 \end{cases} \tag{20}$$

Solving this system is equivalent to solving one of the following extremum optimization problems:

$$\begin{cases} X = \left[\beta_1,\beta_2,\cdots,\beta_j\right] \\ \min f(X) = \sqrt{\sum_{i=1}^{j} f_i^2(X)} \end{cases} \tag{21}$$

When the minimum value is 0, the corresponding X is the solution of the equation. According to this principle, and through MATLAB programming to achieve this algorithm can be obtained for each section of steel pipe and drum tilt angle.

In addition, when the wind speed is 12m/s and 24m/s, the inclination angle of steel drum is 0.908 degree and 3.860 degree, 0.929 degree, 0.934 degree, 0.939 degree, 0.945 degree and 3.951 degree, 3.974 degree, 3.998 degree, 4.021 degree respectively.

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Evaluation of the Effect of Community Opening on Road Traffic Based on Entropy-Weight and Matter-Element

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Abstract: In order to study the area, open to traffic, according to whether the impact of community opening on the surrounding road capacity, that determined the road trip time, the average delay time, intersection density and other 12 indicators to measure the capacity of the surrounding area of the road. Using entropy method to determine the weight of indicators, and the establishment of the matter element analysis model, that get the different types of district open before and after the division of the road traffic capacity.at the same time , making correlation test and taking multiple linear regression model to test, after the opening of the area of road saturation have different degrees of improvement, the more close to the city center, the greater the degree of saturation.By using the above method.it is concluded that the influence of the opening on the road traffic capacity is good and the distance between the residential area and the city center has a great impact on the road traffic capacity.

Keywords: entropy method; matter-element analysis; correlation test; multiple regression analysis.

1. INTRODUCTION

1.1 MATTER ELEMENT ANALYSIS

The physical analysis theory is applied to the system research; it can be obtained based on matter element analysis method [1]. The research was used in decision theory of matter element analysis, established the method of "extension decision". Using the maximum method to satisfy the main system, the main condition and other systems, the matter element transformation method, the structural transformation and so on, which can be transformed into compatible problems, and it can be reasonably solved.

1.2 BASIC STEPS

(1) the basic characteristic value of matter element

The matter element is as the basic unit to describe things with order a triple $R=(Q,c,v)$, n dimensional element is Q by n characteristics $c_1,c_2,\cdots,c_n$ and the corresponding value $v_1,v_2,\cdots,v_n$ to describe, it is expressed as:

$$R=\begin{bmatrix} Q & c_1 & v_1 \\ & c_2 & v_2 \\ & \vdots & \vdots \\ & c_n & v_n \end{bmatrix} \tag{1}$$

(2) determination of the matter element to be evaluated

The measurement data is expressed by the matter element $R=\begin{bmatrix} P & c_1 & x_1 \\ & c_2 & x_2 \\ & \vdots & \vdots \\ & c_n & x_n \end{bmatrix}$.The P represents the unit to be evaluated; $x_i(i=1,2,\cdots,n)$ represents the measured value of c_i on the P.

(3) the determination of classical domains and joint domains

N_j is represented by the division of the j quality level, c_i is said to be the quality level of N_j features, X_{ji} is N_j about c_i range, the classic domain is the corresponding characteristics of the corresponding characteristics of the amount of value range:

$$[R_j]=(N_j,c_i,X_{ji})=\begin{bmatrix} N_j & c_1 & X_{j1} \\ & c_2 & X_{j2} \\ & \vdots & \vdots \\ & c_n & X_{jn} \end{bmatrix}$$
$$=\begin{bmatrix} N_j & c_1 & <a_{j1},b_{j1}> \\ & c_2 & <a_{j2},b_{j2}> \\ & \vdots & \vdots \\ & c_n & <a_{jn},b_{jn}> \end{bmatrix} \tag{2}$$

(4) the determination of the correlation function and the correlation degree of the classical matter element model

$$\begin{cases} \rho(x_i,X_{ji})=|x_i-(a_{ji}+b_{ji})/2|-(b_{ji}-a_{ji})/2 \\ \rho(x_i,X_{pi})=|x_i-(a_{pi}+b_{pi})/2|-(b_{pi}-a_{pi})/2 \end{cases} \tag{3}$$

$$|X_{ji}|=(b_{ji}-a_{ji}) \tag{4}$$

The degree of correlation [2] is determined as:

$$K_j(x_i)=\begin{cases}\dfrac{-\rho(x_i,X_{ji})}{|X_{ji}|} & x_i\in X_{ji}\\ \dfrac{\rho(x_i,X_{ji})}{[\rho(x_i,X_{pi})-\rho(x_i,X_{ji})]} & x_i\notin X_{ji}\end{cases} \quad (5)$$

(5) the determination of weight coefficient

A method for determining the weights of AHP, Delphi method, principal component analysis, entropy method, classification standard of proportion method, this paper adopts weighted entropy method [3] to calculate the index, it uses specific data to objectively determine the weight value, a greater degree of index variation, information entropy is smaller. The amount of information provided by the greater the corresponding larger weight. It is based on the definition of entropy concept of traditional j evaluation index entropy $H_j=-(\sum_{i=1}^{m} f_{ij}\ln f_{ij})/\ln m$, and thus the entropy weight indexes for the i:

$$\omega_i=\frac{1-H_i}{m-\sum_{i=1}^{m}H_i} \quad (6)$$

(6) the calculation of the comprehensive correlation degree to determine the evaluation level based on the above formula, the comprehensive correlation degree of the object to be evaluated with regard to the grade j is determined:

$$K_j(P)=\sum_{i=1}^{m}\omega K_j(x_j) \quad (7)$$

2. DESIGN ALGORITHM

2.1 DETERMINATION OF CLASSICAL DOMAIN AND JOINT DOMAIN

Referring to a number of technical standards and domestic residential roads [4], the average level of facilities and services, the evaluation level is divided into excellent, good, poor three levels from high to low, it can determine the evaluation index system of grading standards of classical domain, based on classical domain maximum and minimum range, it determined section domain objects element matrix, using the following Tab.1.

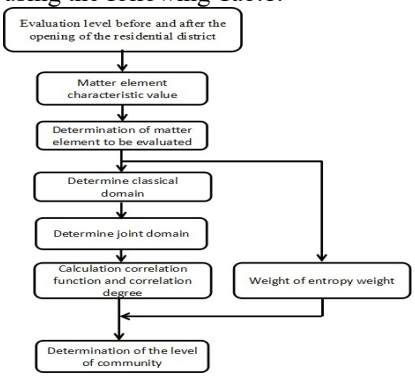

Figure 1 Flow chart of algorithm design

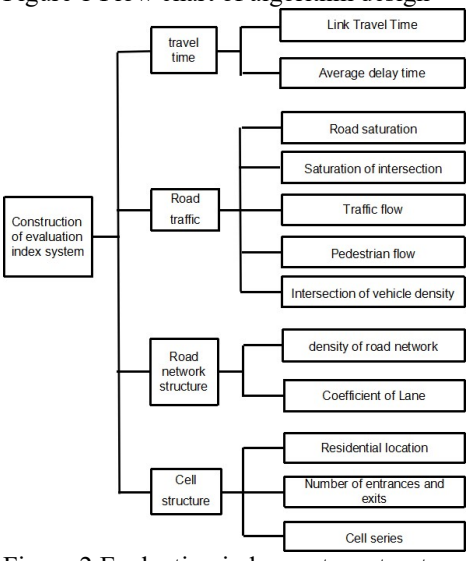

Figure 2 Evaluation index system structure

Tabl 1. Classical domain and joint domain

index	Evaluation level(Classical domain R_{oj})			joint domain
	excellent	good	poor	
Link Travel Time(s)	<0, 7>	<7, 14>	<14, 21>	<0, 21>
Average delay time(s)	<0, 10>	<10, 20>	<20, 30>	<0, 30>
Road saturation	<0, 1000>	<1000, 2000>	<2000, 4000>	<0, 4000>
Saturation of intersection	<0, 200>	<200, 500>	<500, 1000>	<0, 1000>
Traffic flow	<0, 6000>	<6000, 12000>	<12000, 18000>	<0, 18000>
Pedestrian flow	<0, 2000>	<2000, 4000>	<4000, 6000>	<0, 6000>
Intersection of vehicle density	<80, 120>	<40, 80>	<0, 40>	<0, 120>
density of road network	<6, 9>	<3, 6>	<0, 3>	<0, 9>
Coefficient of Lane	<0, 1>	<1, 2>	<2, 3>	<0, 3>
Residential location	<0, 1>	<1, 3>	<3, 4>	<0, 4>
Number of entrances and exits	<8, 12>	<4, 8>	<0, 4>	<0, 12>
Cell series	<0, 2>	<2, 4>	<4, 6>	<0, 6>

2.2 USING ENTROPY METHOD TO DETERMINETHE WEIGHT OF INDICATORS

Table 2. Index weights determined by entropy weight method

factor	travel time		Road traffic					Road network structure		Cell structure		
index	T_1	T_2	D_1	D_2	D_3	D_4	D_5	E_1	E_2	G_1	G_2	G_3
weight	0.0911	0.089	0.102	0.092	0.096	0.076	0.095	0.085	0.085	0.071	0.065	0.058

3. APPLICATION OF THE MODEL

Selecting three different types of cell. The A cell from the centre of 1.2km is the axis type structure, a total of 9 buildings, the A cell from the centre of 6km is centripetal type structure, a total of 7 buildings, The A cell from the centre of 12km is intensive type structure, a total of 5 buildings. three areas were collected before and after the opening corresponding to the data of each index.

3.1 EVALUATION SYSTEM OF ROAD CAPACITY

The entropy weighted matter-element comprehensive evaluation model to evaluate the A cell, using the correlation function determined the evaluation index of the correlation degree of each index, which can be concluded that A district belongs to grade, the weight of index with each index level obtained A cell grade. According to the above method analysis of B area and C area, the the results are shown in Tab. 3.

Table 3 Before and after the opening of the district level

	Before	after
A	poor	excellent
B	good	excellent
C	good	good

According to the analysis of Table 3, it can be seen, A cell evaluation before opening level is poor, but after the opening of the evaluation grade is excellent, which shows the influence of open cell A on the surrounding road capacity is obvious; the B cell open before the assessment is good, excellent grade evaluation after the opening, that open access area on the surrounding road capacity has little effect; C cell open before the assessment is good, opening after the assessment is good, indicating that C did not affect the cell opening capacity of the surrounding roads. In summary, the open area capacity impact on the surrounding road is better overall and residential location closer to the center of effect will be more obvious.

3.2 VERIFICATION OF MULTIPLE LINEAR REGRESSION

(1) the correlation analysis of multiple indexes

According to all the factors that affect the capacity of the road, use the following formula:

$$r_{C_i} = \frac{\sum\left(C_{ij} - \overline{C_i}\right)\cdot\left(N_j - \overline{N}\right)}{\sqrt{\sum\left(C_{ij} - \overline{C_i}\right)^2 \cdot \sum\left(N_j - \overline{N}\right)^2}} \tag{8}$$

Type: A for the original data, B for the average value of each column of data. Putting the data into the formula, finally it determines that the link travel time, the average delay time, traffic intersection, vehicle lane and road density, coefficient of saturation [5] has a very strong correlation, Therefore, the above five indexes are selected as the factors to study the influence of the opening on the surrounding roads, which can be used to establish a multiple linear regression model [6].

(2) the determination of multivariate linear equations

The regression equation can be obtained by calculating:

$$Y = 0.826X_1 - 0.357X_2 + 2.002X_3 + 1.368X_4 + 1.072X_5 + 0.002 \tag{9}$$

(3) the calculation of road saturation

The index data into the regression equation of three different types of cell corresponding statistics of the obtained Y value, under the Tab. 4.

Table 4 Saturation before and after the opening of the residential area

	Before	after
A	1.8311	0.9559
B	2.0981	1.0549
C	2.5178	1.2727

We all know that the saturation value is higher, the lower the level of road service. we can see three different types of cell before opening more open after saturation from table 4, this shows that the service level of the road is increased after the opening. Considering the area of A, B, C can be seen from the city closer to open after the saturation value is small, and the saturation value before and after the opening of more changes, the area from the city closer, the better effect on the service level of the road after the opening.

4. CONCLUSIONS

Quantitative analysis of cell types and the surrounding road types by using the method of entropy weighted matter-element analysis.Although the quantitative value of the index before and after the opening of the same, the size of the different types of area and the surrounding road conditions are different, Comprehensive consideration, it can still more fully reflect the effect of the opening of the community.using multiple linear regression model will be saturation of various types of community specific data into this equation.after comparing the three types of open area after the opening of the saturation is smaller than before, and the area is close to the city center, the more recent saturation changes more obvious.Comprehensiving consideration of the above two models in the classification and establishment of regression equation.comprehensive evaluation of the district level or lower the saturation value of the road area, which shows that the impact of the opening of the surrounding road capacity of the better.

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Evaluation Model of road Traffic Capacity Based on TOPSIS

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Abstract: Community open problem is a hot issue in the community, and domestic and foreign scholars on the impact of the opening of the community on the surrounding road traffic holds a different point of view. In order to objectively explore open area is how to influence the surrounding roads, as well as the degree of influence, take the Jiaxing Park District Changsha city as an example, using TOPSIS comprehensive evaluation method of the open area before and after the change of surrounding road conditions were analyzed. Taking into account the impact of various indicators on the road traffic is different, through the analytic hierarchy process to determine the weight of each index, and then combined with TOPSIS method to determine the road traffic close to the area before and after opening. The results directly reflect the close degree after the opening of the community is significantly greater than the open, the study shows that: Jiaxing, Changsha, after the opening of the park district, the surrounding road traffic becomes more open.
Keywords: TOPSIS Comprehensive evaluation, Entropy weight method, Practical capacity.

1. INTRODUCTION

Residential patterns in our country are mostly closed, However, urban space and road resources are very limited. The phenomenon of large scale residential area in the city can cause the public resources to waste to a certain extent. With the rapid development of China's economy, the scale of the city is growing, the population and the number of cars are increasing, which leads to the problem of urban transportation. Due to the surrounding road congestion caused by the closure of the district has occurred, to bring a negative impact on the life of the residents. In view of this increasingly serious social problems, the State Council decides to extend Block system and no longer construct gated community. It also expresses that Residential areas and units of the compound which are already built should be gradually open. The issue of this policy has aroused widespread concern and discussion. One of the focus of the discussion is whether the opening district can achieve the optimization of road network structure, improve the capacity of road traffic, improve the purpose of traffic conditions. The TOPSIS evaluation method based on analytic hierarchy process is used to evaluate and analyze the changes of the road traffic before and after the opening of the residential area.

2. TOPSIS EVALUATION BASED ON ANALYTIC HIERARCHY PROCESS

The traditional TOPSIS method is a kind of comprehensive evaluation method. This method can reflect the dynamic change of land use situation objectively and comprehensively. It by defining a measure in the target space, to measure the target close to the positive ideal solution and far away from the negative ideal solution to assess the extent of area before and after the opening of the road level [1-7]. But the traditional TOPSIS does not take into account the impact of different indicators of the weight of the results. Therefore, in order to solve the problem, the weight set of the indicators is constructed by using the high degree of recognition and extensive use of the analytic hierarchy process.

2.1 MODEL PREPARATION

2.1.1 INDEX SELECTION

For road traffic, road traffic saturation (V/C), traffic delay, speed, traffic flow is an important indicator to measure the level of road traffic. In practical application, the traffic police can judge the degree of traffic through the measurement of these four indicators. So we can choose these four indicators as the evaluation index of road.

2.1.2 DATA PREPROCESSING

In the application of the TOPSIS method to evaluate the requirements of the various indicators have the same trend of changes that indicators are high or low. According to this principle, the road traffic saturation and traffic delay are taken down, so that it is transformed from low to high. In addition, in order to eliminate the different influence of each index unit, the data is standardized by using the standard deviation formula. The formula is [2-6]:

$$\hat{X}_{ij} = \frac{X_{ij} - \bar{X}_i}{\sqrt{\sum_{j=1}^{N} (X_{ij} - \bar{X}_i)^2}} \tag{1}$$

2.2 ANALYTIC HIERARCHY PROCESS

The method is a combination of qualitative and quantitative analysis to solve the problem of multiple objectives. It has the characteristic of strong objectivity. The basic principle is to divide the problem into different factors, and in accordance with the interaction between factors and affiliation to the factors at different levels of aggregation combinations, the formation of a multi-level analysis model, to determine the relative weight of each factor value. The method steps are as follows:

2.2.1 STRUCTURE JUDGMENT MATRIX

For road traffic, the different indicators of the impact are different. Therefore, the judgment matrix of road traffic is constructed with the "influence" as the criterion layer.[3] The four indexes are set as x_1, x_2, x_3, x_4 respectively. And then Relative the importance of comparative indicators. According to the analytic hierarchy process, the matrix can be obtained:

Table 1. The form of Judgment matrix

indexes	x_1	x_2	x_3	x_4
x_1	1	3	4	2
x_2	1/3	1	2	4
x_3	1/4	1/2	1	3
x_4	1/2	1/4	1/3	1

Each rows of the Judgment matrix A will be divided into four weight vector W_1, W_2, W_3, W_4. Assuming that $\lambda_{\max}$ is the characteristic root of A. We can get a conclusion that $AW = \lambda_{\max} W_i$ .And Its weight vector is:[4]

$$w_i = W_i \Big/ \sum_{i=1}^{n} W_i \tag{2}$$

So its biggest characteristic root is:

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(AW)_i}{w_i} \tag{3}$$

2.2.2 CONSISTENCY TEST OF JUDGMENT MATRIX

The weight vector constructed by AHP method is subjective. Therefore, it is necessary to remove its subjectivity and make it into an objective description. That is to say the judgment matrix should be tested for consistency. The formula is:

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{4}$$

$$CR = \frac{CI}{RI} \tag{5}$$

The meaning of CI is Consistency index, the RI represents Average random consistency index and CR is Consistency ratio.[5] According to the law of the analytic hierarchy process, it can be known that the constructed matrix is reasonable when the consistency ratio is less than 0.1.

2.3 TOPSIS COMPREHENSIVE EVALUATION

After processing the acquisition of four indicators of data, we constructed a decision matrix $V = (v_{i \cdot j})_{4\times 4}$.

In order to eliminate the influence of different indexes on the road traffic, we normalized the decision matrix. Then give the result as follows:

$$V' = \begin{bmatrix} v_{11} \cdot w_1 & v_{12} \cdot w_1 & \cdots & v_{1n} \cdot w_1 \\ v_{21} \cdot w_2 & v_{22} \cdot w_2 & \cdots & v_{2n} \cdot w_2 \\ \vdots & \vdots & \vdots & \vdots \\ v_{m1} \cdot w_m & v_{m2} \cdot w_m & \cdots & v_{mn} \cdot w_m \end{bmatrix} \tag{6}$$

The distance between the positive and negative ideal solutions can be obtained according to the weighted decision matrix.

$$D_j^+ = \sqrt{\sum_{i=1}^{m} (v_{ij} - v_i^+)^2} \tag{7}$$

$$D_j^- = \sqrt{\sum_{i=1}^{m} (v_{ij} - v_i^-)^2} \tag{8}$$

The V_i^+、V_i^- Separately represent the maximum and minimum values of each row of the judgment matrix. The calculating formula of the closeness degree is given:

$$C_j = \frac{D^-}{D^- + D^+}, (1 \le j \le n) \tag{9}$$

3. RESULTS AND DISCUSSION

3.1 DETERMINATION OF WEIGHT

Using MATLAB to solve the judgment matrix, the weight of the four indexes is:

$w = [0.2971, 0.3183, 0.3178, 0.0688]$

The consistency requirement for the comparison matrix is that the absolute value of the absolute value of the matrix is the largest characteristic value and the dimension of the matrix is not quite different.[6] We get the result is that $\lambda_{\max} = 4.0092$ using MATLAB. The consistency ratio is 0.079<0.1, So the judgment matrix has certain rationality.

3.2 CHANGES IN ROAD TRAFFIC

In order to facilitate the study of the influence of the road traffic before and after the opening of the residential district, we selected Jiaxing District, which is located in the center of Changsha, to make a quantitative analysis of the change of road traffic before and after opening. Since 2014, this community began to open, this paper studies the situation after the opening of 2014. We obtain four evaluation indexes, the average delay time, the average queue length, the road traffic saturation and the traffic flow. [7]The final evaluation index data table is as follows:

Tab. 2 Evaluation index data table

Average delayed time	Vehicle flow	Average speed	Road traffic saturation
40.66	9.375	15	0.914
45.12	8.36	17	0.953
38.17	9.78	14	0.814
39	9.395	16.5	0.861
29.8	11.725	16	0.815
28.77	12.39	12.5	0.754
25.9	15.39	10	0.725
31.4	10.835	11	0.786

In the Tab.3, we can find that close degree increase of the surrounding road after the opening of the residential area. In order to make the analysis result

more reliable and reasonable, the average value of the two groups of data is worth to be 0.14985 and 0.6549 respectively. According to the TOPSIS Rating Scale (table) can be drawn before the opening of the community capacity for serious congestion, after the opening of the capacity of the community is slow.

The data into the standard matrix can be obtained through similarity respectively before and after the opening of the road:

Tab.3 Road traffic close degree

Sample number	Sample 1	Sample 1	Sample 1	Sample 1
Close degree before opening	0.1587	0	0.2748	0.1659
Close degree after opening	0.4451	0.6216	1	0.5529

Based on the results of the data in the following table, It can be seen that after the opening of the District, the close degree from 0.14985 to 0.6549. It reflect s that the area surrounding the road traffic situation is gradually becoming better, the road from the original serious congestion into slow. After the opening of the residential area, the number of road traffic in the city is increased, the density of the road network is increased, and the area of the road is also increased which makes the surrounding main roads flexible.

Tab.4 The corresponding table of close degree and capacity

Closeness degree	traffic capacity
$0<C\leq 03$	Severe congestion
$0.3 < C \leq 0.6$	congestion
$0.6 < C \leq 0.8$	slow
$0.8 < C \leq 1$	Unobstructed

4. CONCLUSIONS

In the study of the influence of the opening on the road traffic, the TOPSIS comprehensive evaluation model based on analytic hierarchy process is established. We get the average closeness of road traffic before and after the opening of the residential area was obtained. According to the TOPSIS evaluation system gives the concrete road of the area before and after the opening of the traffic fluency, reflecting the impact on Road traffic before and after the opening of jiaxing changsha community.

5. ACKNOWLEDGMENT

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The Quantitative Analysis of Village Open On Surrounding Traffic Capacity

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Abstract: In recent years, with the increasing of urban population scale, as well as car ownership in China is rising, the urban traffic congestion has become one of the reasons for the urban development. And open community influence on traffic capacity gradually become the focus of discussion. This paper, using the frequency statistics, focusing on high frequency index, to find the indicators related to the surrounding road traffic capacity, peripheral traffic capacity evaluation index is established, and based on this general area open the impact on the surrounding traffic capacity is divided into effect on the whole section and plane intersection traffic capacity, build the mathematical model of vehicle capacity.
Keywords: Entropy weight method, Vehicle traffic capacity, Indicators reduction.

1. INTRODUCTION

With the rapid development of economy in our country, the city scale expands rapidly, the urbanization rate by the end of 2015 has reached 56.1%. The national motor vehicle ownership has reached 285 million, motor vehicle drivers, 342 million people per hundred households have 31 private cars. So the traffic jams, become one of the most serious "urban ill"[1].

At present, there have been many scholars to study the question of road traffic capacity, xiao-ming Chen, chun-fu shao [2], etc. To quantify the pedestrian traffic intersection traffic capacity of signal, the influence of the conflict of traffic capacity model is established using the team analysis, and the calibration model parameters using experimental data and to calculate capacity under the influence of the pedestrian signal intersection provides analysis basis; Xiao-guang Yang, the side by the who use cities such as large circular intersection traffic control technology [3], this paper proposes a method to raise the capacity of city traffic circular intersection.

The influence factors of road traffic capacity are many, in this paper, the selection of indicators used the frequency statistics, selection of indicators more scientific and comprehensive. At the same time, the traffic capacity calculation of quantitative analysis, joined the correction parameters, makes a more complete calculation model.

2. SCHEMATIC DIAGRAM OF INDICATORS

Road and the surrounding surrounding roads can be divided into the surrounding road and road intersection to the community [4]. Open the impact on the surrounding traffic research area, this paper respectively the research community open the impact on the surrounding road sections and intersections traffic, and then combined with roads and intersections of the capacity of different influence degree, integrated into a comprehensive impact index of road capacity. Established the analysis indicator diagram, as Fig.1 follows:

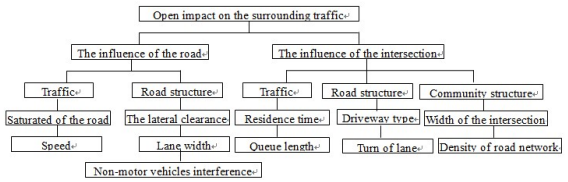

Figure 1 Schematic diagram of indicators

3. TRAFFIC MODEL OF SURROUNDING ROADS

In order to represent the surrounding traffic capacity changes before and after open, the residential area used by the community structure, flow and structure of surrounding roads as variables, combined with the known, compare the situation of traffic in mature expression formula to establish its impact on the surrounding traffic capacity model after opening.

3.1 ROAD TRAFFIC CAPACITY

(1) The basic capacity

Basic capacity refers to the road and traffic in the ideal situation, each lane through the largest traffic volume in unit time can.

$$N_{\max} = \frac{3600}{t_0} = \frac{3600}{l_0 / (v / 3.6)} = \frac{1000v}{l_0} \qquad (1)$$

Among them: l_0 is the minimum distance between two cars which can be checked by related regulations

(2) The actual capacity

Actual capacity is the basic capacity, on the basis of considering the influence of the actual community structure of surrounding roads and traffic, determine its correction coefficient, then correction coefficient multiplied by the basic capacity, as a condition that is relatively accurate surrounding roads traffic capacity.

In this article, the lane width, lateral clearance and non-motor vehicles interference, stadia as correction factor, to fix the basic capacity of expression, through access to relevant data, it can be concluded that correction coefficient table (note: the coefficient of lateral clearance lanes at the 3.5 m, reflected by the number of people crossing the street, non-motor vehicle interference visibility at speed degree of 72-72 km/h for analysis) as shown in Tab.1[5].

Table 1 Correction coefficient reference table

	Visibility is less than 450 m stretch

	of percentage /%					
parameter	0	20	40	60	80	100
Correction coefficient	1.00	0.96	0.89	0.80	0.69	0.56
	Non-motor vehicle interference/person					
parameter	600	500	400	300	200	100
Correction coefficient	0.5	0.6	0.7	0.8	0.9	1.0

By the above available around the possibility of road traffic capacity as follows:

$$N_k = N_{\max}\gamma_1\gamma_2\gamma_3\gamma_4 \quad (2)$$

(3) Desicn capacity

Design capacity is the way to the service traffic volume, usually used as the basis for road planning and design. Design capacity is equal to the product capacity and road saturation.

$$N_{sj} = N_k \times (\frac{V}{C}) \quad (3)$$

3.2 PLANE INTERSECTION TRAFFIC CAPACITY

At present domestic commonly used method of computing the intersection traffic capacity is you section method, namely on the basis of the lane you as inlet surface through the cross section of the vehicle is considered have through the intersection. Traffic capacity of intersection refers to the sum of each intersection traffic capacity of road inlet, vehicle traffic on each inlet direction is divided into straight, turn right and left three scenarios, each import lane use specific provisions for special and mix again. Therefore, import lanes of traffic capacity calculation formula of different. The following points is introduced.

(1) A special straightlane capacity

$$N_1 = \frac{3600}{T_1} \times \frac{t_l - t_s}{t_j} \quad (4)$$

Among them: for the light cycle time, take 60 ~ 90 s; For before and after the two cars through the mean time between you, compact car takes 2.5 s, large cars take 5.5 s; For each time period of time. Lost time for each time period, generally only the loss of the vehicle acceleration time, regardless of people and vehicles start time loss (assuming a green light yellow light time is ready before), acceleration time lost (general car, medium trucks, medium car)

(2) A special right turn lanes of traffic capacity

$$N_2 = 3600 / t_2 (liang / h) \quad (5)$$

Among them: for the two right turn vehicles before and after continuous you cross section through the time interval to the car to take 4.5 s.

(3) A special traffic capacity of the left lane

$$N_3 = n \times \frac{3600}{T_Z} \quad (liang / h) \quad (6)$$

Among them: for in a cycle allowed to turn left on the number of vehicles.

Given the right of the road network density and intersection influence on traffic capacity, this article by querying data, add to the capacity of road network density and intersection right correction coefficient. As shown in Tab.2.

Table 2 Road network density correction coefficient table

The density of road network km/km^2	Correction coefficient $/\gamma_5$	Intersection right/m	Left correction coefficient $/\gamma_6$
7	1	2.9	0.9142
7.5	0.9896	3.0	0.9285
8	0.9582	3.1	0.9428
8.5	0.9269	3.2	0.9571
9	0.8956	3.3	0.9714
9.5	0.8643	3.4	0.9857
10	0.8330	3.5	1

To sum up, in the overall capacity of a road with the need to by determining weights of intersection traffic capacity and weight of road traffic capacity.

4. BASED ON THE ENTROPY WEIGHT METHOD TO DETERMINE THE OVERALL TRAFFIC CAPACITY

Due to road traffic capacity and traffic capacity of intersection traffic capacity on the regional transportation network affects the size is different, therefore, the two indicators to give different weights, based on the principle of data analysis and expert consultation, the entropy weight method is used to determine the weight vector.

Calculate the i-th item's proportion at the j-th index:

$$p_{ij} = \frac{r_{ij}}{\sum_{i=2}^{m} r_{ij}} \quad (7)$$

Calculate the j-th index' entropy e_j :

$$e_j = k\sum_{i=1}^{m} p_{ij} \bullet \ln p_{ij}, \quad k = \frac{1}{\ln m} \quad (8)$$

Calculate the j-th index' entroy weights ω_j :

$$\omega_j = \frac{1 - e_j}{\sum_{j=1}^{n}(1 - e_j)} \quad (9)$$

Determine the index of comprehensive weight β_j :

$$\beta_j = \frac{\alpha_j \omega_j}{\sum_{i=1}^{m} \alpha_i \omega_i} \quad (10)$$

5. CONCLUSIONS

In this paper, using the method of frequency selection index of road traffic capacity, from the plot structure, the structure of road, traffic of three parts, the quantitative analysis of the road traffic capacity, can calculate the ability of village road passage before

and after the opening, so as to compare with open community influence on surrounding roads.

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A Research on Measure of New Urbanization Development Quality Based on Entropy Method—Taking Hebei Province as an Example

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Abstract: The research of new urbanization measure is elaborated. This article builds a new index system of urbanization development quality from four aspects of urbanization level, which are basic public services, infrastructure, resources and environment. The new urbanization development quality in Hebei Province from 2010 to 2015 are measured by using entropy method. The results show that the new urbanization development quality of Hebei Province from 2010 to 2012 has decreased, while from 2012 to 2015 the new urbanization development quality of Hebei Province significantly has been improved. Through the weight analysis, the key factors affecting the quality of new urbanization development in Hebei Province are urbanization level and basic public services. The new urbanization development quality of Hebei Province is improved by four aspects which include improving the level of urbanization, promoting the transfer of rural population into urban residents, strengthening the construction of urban infrastructure, strengthening the construction of urban public service system and strengthening the construction of resources and environment.
Keywords: new urbanization; development quality; measurement

1. INTRODUCTION

Since reform and opening-up, the urbanization has developed very fast in China. In nearly a decade years, urbanization rate always keeps on 1% growth. In 2014, urbanization rate can reach 54.77% in China. The rapid development of urbanization also brings many problems, such as unbalanced regional urbanization degree, lagging urbanization in small and medium-sized cities. Besides, the model of urbanization is given priority to extensive development, which destroyed the original ecological environment. The urbanization development attaches great importance to the quantity but not quality. Urbanization makes gap between the urban and rural larger. To solve these problems, prime minister Li Keqiang put forward that as the greatest potential to expand domestic demand, the urbanization should get rid of traditional urbanization path and follow a new path of the urbanization. China should maintain the level of urbanization development, meanwhile improve the quality of new urbanization. How to improve the quality of new urbanization? For this hot topic, more and more scholars have begun to study the quality problems in the development of new urbanization from the multiple perspectives of qualitative. But there is less about the new urbanization quality assessment research of local urban. This paper will use entropy method to assess the quality of new urbanization development in hebei province, and put forward countermeasures and Suggestions for the quality improvement of new urbanization development in hebei province in view of the evaluation results.

In abroad, the research about the new urbanization development is mainly concentrated in two aspects: (1) the study of the new urbanization development level. Northam (1979) applied the method of single index to measure out the urbanization development level by the proportion of urban population in a region. The English geographer Cloke (1996) analyzed from 16 indexes such as the population, occupation, living and distances from the center of the city, and constructed the index system of urbanization. (2) the study of new urbanization efficiency. Northam analyzed the linear relationship between urbanization level and economic development by using panel data. Etcusing regression analysis method, Moomaw analyzed that the factors affecting the urbanization rate are GDP, import and export and agricultural development.

Domestic scholars' studies for the new urbanization mainly focused on three aspects: (1) studies on efficiency of the new urbanization [1]. Chen Rong, Xu Xinyu (2015) studied the efficiency of the new urbanization development by using DEA method in anhui province. Chen Xiao-hua, Li Jiulin, Chu Jinlong (2015) evaluated the efficiency of wan jiang city by using DEA-ESDA method. (2) studies on new urbanization development quality. Ye Yumin(2001) did the first quantitative research on the quality of urbanization development, and build the corresponding evaluation index system from two aspects which are urban modernization and urban-rural integration. Zhu Hongxiang (2007) build

the evaluation system of urbanization quality from population, economic development, urban construction, social development, residents' life and so on, and evaluated urbanization quality of Shandong province by using AHP. Zhang Yin, Yang Qingyuan(2015) chose 17 indexes from two aspects of urbanization development level and development efficiency to construct the quality of the new urbanization development evaluation system, and evaluated the quality of new urbanization in chongqing by using AHP method. (3) Studies on new urbanization development level. Wang Qinmei, Yang junge (2015) constructed the new urbanization development level index system from aspects: the power system quality system and fair system of the new urbanization development, and comprehensively evaluated the new urbanization development level of Guantian economic zone by using PCA method.

2. THE QUALITY MEASURE INDEX SYSTEM OF NEW URBANIZATION DEVELOPMENT

2.1 CONSTRUCTION OF INDEX SYSTEM

The new urbanization development quality is a comprehensive concept reflecting the new urbanization level, mainly referring to the development quality coordinate and promote efficiency of the component elements of new urbanization development. The evaluation of new urbanization development quality involves many aspects such as population, economy, society and environment. So when we choose the evaluation index, we should adhere to the scientific, comprehensive, representative, operational principles to build the evaluation system which can integrated reflect the real level of the regional new urbanization development [2]. Combining with the existing literature, this article constructed the new urbanization development quality drawing lessons from the national planning of new urbanization (2014-2020), and constructed the new urbanization development quality evaluation system of Hebei province based on the reality of the new urbanization development of Hebei province [3] from four aspects, such as the urbanization level, the basic public service, basic infrastructure and environment resources. Except to four first-level indexes, the index system includes sixteen second-level indexes, such as permanent population urbanization rate, the tertiary industry employment proportion. The index system is shown in Tab. 1.

Table 1 the new urbanization development quality evaluation system of Hebei province

General goal	first-level indexes	Second-level indexes
the new urbanization development quality evaluation system of Hebei province	Urbanization level	permanent population urbanization rate(%)
		the tertiary industry employment proportion(%)
		Ratio of urbanization rate and industrialization rate
		The proportion of the added value of the third industry to GDP (%)
	the basic public service	basic old-age insurance coverage rate of permanent population(%)
		basic medical insurance coverage rate of permanent population(%)
		public transport cars own by every ten thousand people
		urban unemployment insurance year-end coverage rate(%)
	basic infrastructure	internet board band users in ten thousand households(ten thousand households)
		Per capita urban road area(square meter)
		per capita domestic consumption (KWH)
		per capita water(ton)
	environment resources	built up area green coverage rate(%)
		per capita urban construction land
		urban wastewater treatment rate(%)
		urban living garbage innocent treatment rate(%)

2.2 EVALUATION METHOD

From the aspect of evaluation method, the quantitative research methods for the new urbanization quality mainly include the factor analysis method, analytic hierarchy process (ahp), entropy method, subjective values method and so on. the factor analysis method is easy to loss some information. The analytic hierarchy process (ahp) and the subjective values method have strong subjectivity. Therefore, this paper used entropy method to evaluate the new urbanization development quality of Hebei province. Entropy method determined the index weight based on the variation degree of evaluation index. It is a very objective and comprehensive evaluation method. The calculating process of entropy method [4] is as following.

(1) standardization of data

Because of the different dimension and scales of every index in index system, when we do evaluation calculation, we should be standardizing the indicators data. Calculation methods are as following:

$$X'_{ij} = \frac{X_j - X_{\min}}{X_{\max} - X_{\min}}; X'_{xj} = \frac{X_{\max} - X_j}{X_{\max} - X_{\min}}$$

If we need a lager index, we should use the first standardization formula. If we need a smaller index, we should use the second formula for standardization.

(2) Calculate the first year's proportion yij under j

index.

$$y_{ij} = \frac{x'_{ij}}{\sum_{i=1}^{m} x'_{ij}}$$

(3) Calculate information entropy e and information utility value d under the j index:

$$e_j = -K\sum_{i=1}^{m} y_{ij} \ln y_{ij}, k = \frac{1}{\ln m}; d_j = 1 - e_j$$

,m is evaluation years.

(4) Calculate the index weight

calculating index weight by using entropy method. The core of this calculation is the value coefficient of index information. The lager the value coefficient is, the lager the index weight is. The calculation for the weights of j indicators is as following:

$$w_j = \frac{d_j}{\sum_{i=1}^{m} d_j}$$

(5) Calculate the evaluation value of the sample.

Calculating the evaluation value of the sample by using the method of weighted summation

$$U = \sum_{i=1}^{n} y_{ij} w_j * 100$$

U is comprehensive evaluation value，n is the number of indicators，Wj is the weights of j inde. The lager the U values，the better the sample results is

3. EMPIRICAL ANALYSIS

3.1 DATA SOURCES

The data sources of this thesis involve the data from "Chinese city statistics yearbook (2010-2015), the statistics bulletin of the national economy and social development in Hebei province (2010-2015), and statistical data of related years in Hebei province. We use the mean value to instead some missing data table. Tab. 2 shows index data of the new urbanization development quality in Hebei province from 2010 to 2015.

Table 2 index data of the new urbanization development quality in Hebei province from 2010 to 2015.

year	2010	2011	2012	2013	2014	2015
permanent population urbanization rate(%)	44.55	45.59	46.8	48.11	49.32	51.33
the tertiary industry employment proportion(%)	59.48	57.35	54.4	54.99	56.18	56.48
Ratio of urbanization rate and industrialization rate	0.85	0.84	0.89	0.92	0.97	1.06
The proportion of the added value of the third industry to GDP (%)	33.97	33.95	35.32	35.47	37.23	40.19
basic old-age insurance coverage rate of permanent population(%)	30.88	32.09	33	33.86	34.63	34.65
basic medical insurance coverage rate of permanent population(%)	47.42	47.16	47.73	47.47	46.6	44.66
public transport cars own by every ten thousand people	14.71	10.92	10.94	15.55	12.83	12.99
urban unemployment insurance year-end coverage rate(%)	15.41	15.11	14.71	14.28	13.97	13.41
internet board band users in ten thousand households(ten thousand households)	667	846.3	963.9	1031.6	1127.6	1226.50
Per capita urban road area(square meter)	14.8	15.41	15.35	16.34	14.34	15.25
per capita domestic consumption (KWH)	17.02	17.96	17.52	19.9	20.4	18.56
per capita water(ton)	0.96	0.88	0.9	0.86	0.89	0.90
built up area green coverage rate(%)	44.25	43.48	41.79	42.77	46.96	43.85
per capita urban construction land	35.43	35.6	33.48	32.96	34.51	34.40
urban wastewater treatment rate(%)	89.04	90.76	90.28	93.83	93.56	93.90
urban living garbage innocent treatment rate(%)	97.66	88.96	96.07	80.13	91.88	90.94

3.2 THE DETEMINATION OF COMPREHENSIVE EVALUATION VALUE

According to the calculating process of entropy method, we evaluated comprehensively on new urbanization development quality of Hebei province from 2010 to 2015, and determines the new urbanization development quality of Hebei province in nearly six years. The evaluation results are shown as following in tab. 3.

Table 3 Comprehensive evaluation value new urbanization development quality of Hebei province from 2010 to 2015

Year	2010	2011	2012	2013	2014	2015	weight
permanent population urbanization rate(%)	0.00	0.06	0.12	0.19	0.26	0.37	6.29%
the tertiary industry employment proportion(%)	0.41	0.24	0.00	0.05	0.14	0.17	6.82%
Ratio of urbanization rate and industrialization rate	0.02	0.00	0.10	0.16	0.27	0.45	8.87%
The proportion of the added value of the third industry to GDP (%)	0.00	0.00	0.11	0.12	0.26	0.50	11.19%
basic old-age insurance coverage rate of permanent	0.00	0.09	0.15	0.22	0.27	0.27	4.68%

population(%)							
basic medical insurance coverage rate of permanent population(%)	0.21	0.19	0.23	0.21	0.15	0.00	3.57%
public transport cars own by every ten thousand people	0.31	0.00	0.00	0.37	0.15	0.17	8.93%
urban unemployment insurance year-end coverage rate(%)	0.30	0.27	0.20	0.14	0.09	0.00	4.97%
internet board band users in ten thousand households(ten thousand households)	0.00	0.10	0.16	0.20	0.25	0.30	4.59%
Per capita urban road area(square meter)	0.08	0.20	0.19	0.37	0.00	0.17	5.30%
per capita domestic consumption (KWH)	0.00	0.10	0.05	0.31	0.37	0.17	6.95%
per capita water(ton)	0.44	0.09	0.18	0.00	0.13	0.17	6.47%
built up area green coverage rate(%)	0.20	0.14	0.00	0.08	0.42	0.17	6.24%
per capita urban construction land	0.29	0.31	0.06	0.00	0.18	0.17	5.49%
urban wastewater treatment rate(%)	0.00	0.10	0.07	0.28	0.26	0.28	5.70%
urban living garbage innocent treatment rate(%)	0.27	0.14	0.25	0.00	0.18	0.17	3.95%
Comprehensive evaluation value	0.151	0.108	0.104	0.172	0.219	0.245	

According to the weight value of each index, it can be seen that the proportion of the added value of the third industry to GDP (%), Ratio of urbanization rate and industrialization rate, and the public transport cars own by every ten thousand people are main factors influencing the new urbanization development quality in Hebei province. Therefore, when we evaluate new urbanization development quality, we should consider the regional urbanization level and basic public service. Fig. 1 shows comprehensive evaluation value of new urbanization development quality from 2010 to 2015 in Hebei province. The "urban landscape changing in three years" construction in Hebei province starting in 2008 reduced the new urbanization development quality of Hebei province. In 2012, all construction targets of the "urban landscape changing in three years" were implemented. Then according to the construction ideas "raising level, upgrading, bring wealth, raising living" new urbanization construction was planned and implemented, which makes the quality of new urbanization in Hebei province improved, rising from 0.104 in 2012 to 0.245 in 2015, raising 135.77%.

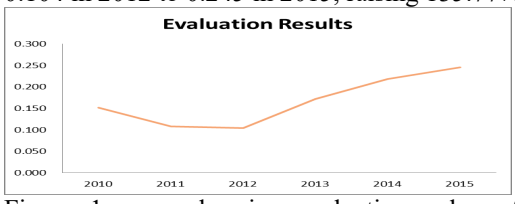

Figure 1 comprehensive evaluation value of new urbanization development quality from 2010 to 2015 in Hebei province

4. CONCLUSIONS AND SUGGESTIONS

4.1 CONCLUSIONS

New urbanization is the inevitable requirement of economic development in nowadays society. The development of new urbanization is a systematic project, involving many aspects such as population, industry, rural areas and towns. When we constructed the new urbanization development quality evaluation index system, the comprehensive index can fully reflect new urbanization development quality. This paper constructed the new urbanization comprehensive index system of quality evaluation, measure new urbanization development quality in hebei province from 2010 to 2015 comprehensively by using entropy method. The results showed that because of "urban landscape changing in three years" construction in Hebei province starting in 2008, while from 2012 to 2015 the new urbanization development quality in Hebei province was improved. Through the analysis, we can also see that the key factors affecting new urbanization development quality in Hebei province are basic public services and urbanization level. The analysis results and the reality of new urbanization development in Hebei province. Under the environment of the integration of the Beijing-Tianjin-Hebei region, the overall level of the new urbanization development in hebei province remains to be further improved.

4.2 SUGGESTIONS

Based on the analysis of the new urbanization development quality measure results in Hebei province, we put forward the following Suggestions in order to improve the overall quality of new urbanization development in Hebei province:

(1) Improving the urbanization development level, and promoting the process of rural population becoming urban residents. The urbanization development level of Hebei province directly affects the quality of the new urbanization development. Only if we raise the level of urbanization development, we can improve the quality of the new urbanization development in Hebei province [5]. We should furtherly enhance the ability of gathering industry and absorbing population in small and medium-sized cities and small towns of Hebei province, strengthen the management of population, furtherly relax the conditions of rural population becoming urban residents, establish the urban social security system, and resolve the problem of employment, entrepreneurial, children school-entering, and public health when rural residents going into urban. We should also furtherly

intensify the training for rural labor, and improve the employment rate.

(2) Strengthening the construction of urban infrastructure. We should build a perfect infrastructure with perfect traffic, communication, water supply, power supply and so on, and implement the "integration of three networks" comprehensively [6]. We should develop public transport firstly, forming the fast public transport system with large capacity. We should strengthen the development of underground space in urban area, and meet the needs of modernization and sustainable development in urban area.

(3) Strengthening the construction of urban public service system. In large and medium-sized cities of Hebei province, We should adjust the existing medical service mode, construct of regional comprehensive medical service system, further complete the community health service facilities, construct the fully functional fitness facilities, accelerate the construction of old-age service facilities, set up family endowment and community endowment system which are suitable for the situation of China.

(4) Strengthening the construction of resources and environment. We should firmly establish the concept of ecological construction, increase urban greening rate, implement greening projects of the main urban area, surrounding urban area and traffic around corridor. We should also vigorously promote green building, encourage the development of renewable energy sources such as solar energy, wind energy and biomass energy, actively promote water-saving appliances. Life garbage in urban area should be sorted collected.

5. ACKNOWLEDGMENT

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Reliability Assessment Methods of Electric Multiple Units (EMU) System Based on Bayesian Network Inference

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Abstract: During actual operation process, the reliability and safety of Electric Multiple Units (EMU) should never be ignored. And the mechanical system, the guarantee of reliability and safety of EMU, is of vital importance. This paper has defined a construction method of mechanical networks for EMU and built a Bayesian Network Model on the basis of the system reliability. Based on the Bayesian Network Model , this paper has also put forward a system reliability assessment method. Furthermore, this paper has built one reliability network model for EMU system by using complex network theory. These methods or model come up with in this paper can provide the foundation for further research of EMU system's reliability, safety and life prediction. And taking China Railways CRH5 EMU as an example, this paper has given some related theoretical analyses as well as practical calculations. These analyses and calculations have proved that the reliability assessment method of EMU based on Bayesian Network is a reasonable and useful modeling and analysis method. For one thing, it can be applied to high-speed EMU. For another, it is free from the restriction of variables' status and distribution.
Key words: Reliability; Bayesian Network; Electric Multiple Units (EMU); analysis

1. INTRODUCTION

Theoretical studies, which are centered on the reliability and safety about EMU on the basis of data glitches[1,2,3], have already made certain achievements. However, there are still many problems in practical situations. For example,

(1) Concerning about the reliability evaluation research of EMU traditional research method, such as fault tree analysis (FTA) [4,5], reliability block diagram (RBD) and failure mode and effect analyze (FMEA) [6], are mainly reliability assessment mode based on logical relationship between components and the overall system. But these methods have following problems: 1) They are just suitable for non-repairable simple systems. The components are mutually independent and failure distribution would obey exponential distribution in these systems; 2) Current system reliability assessment methods are all static analysis methods which are hard to reflect the complex coupling relationship among components as well as dynamic behaviors of the system.

(2) That system fault diagnosis method, which is based on the changes of system state and Markov chain, try to determine whether the system is normal or not through analyzing those changes among system states by using stochastic theory. Though this method could describe those dynamic behaviors of the system, it needs the time distribution or life distribution of each system state to meet the demands of exponential distribution. Obviously, this method does not apply to EMU because their components are closely connected and relevant coupling relationship is very complex and variable.

(3) Current safety assessment methods, such as fault tree analysis, expert evaluation method and preliminary hazard analysis, have not taken those complex coupling relationships among components in the running train into account. And they have also neglected the the relationships[7] between security factors and the system's structure and function. Therefore, there is no doubt that current safety assessment methods are not fit for the EMU system. In addition, current safety assessment methods are usually focused on one subsystem instead of the whole system.

In the twentieth century, the rise of complex network theory[8], especially small-world networks and scale-free networks[9], brought some new ideas for reliability and safety research of EMU system. This is because the structure of EMU has typical complex network characteristics. Complex network could be used to discover or describe the evolution mechanism, the evolution law (structure) and whole behavior(function) with the help of graph theory and statistical physics. Therefore, complex network theory would be very helpful for the research of Electric Multiple Units' reliability, safety and life prediction.

2. CONSTRUCTION METHOD OF MECHANICAL NETWORKS FOR EMU

1.1 definition of mechanical joint

Mechanical joint, consisting of detachable joint and non-detachable joint, puts components together by fasteners. Detachable joint mainly includes bolted joint, stud joint, screw joint, threaded fastener and pin joint while non-detachable joint mainly rivet joint, welding joint and glue joint.

1.2 the networked expression of mechanical joint

According to the definition of mechanical joint, mechanical network model would be got when machines of EMU from different parts connected with networked expression:

(1) mechanical network model node : real components or combination of components in CRH5 EMU system would be used to express each node in this paper.

(2) mechanical network in CRH5 EMU system: the component in CRH5 EMU system is the node. The mechanical joints between nodes would form various sides (lines) that further form into a directed-weighted network model like a network topology. This paper uses to express them:

-node sets;

-line sets;

-node property sets including failure rate , node reliability , fault propagation probability and pressure , as shown in Figure 1:

Table 1 The Property Sets of Mechanical Network Node

Node	Property Sets
n_1	$\left\{\lambda_1, r'(n_1), r''(n_1), r'''(n_1), r(n_1), MTBF(n_1), \eta\left(e^m_{1,3}\right), \cdots\right\}$
n_4	$\left\{\lambda_4, r'(n_4), r''(n_4), r'''(n_4), r(n_4), MTBF(n_4), \eta\left(e^n_{4,3}\right), \eta\left(e^n_{4,5}\right), \ldots\right\}$
n_{10}	$\left\{\lambda_{10}, r'(n_{10}), r''(n_{10}), r'''(n_{10}), r(n_{10}), MTBF(n_{10}), \eta\left(e^n_{10,8}\right), \eta\left(e^n_{10,11}\right), \eta\left(e^m_{10,12}\right), \ldots\right\}$
n_{25}	$\left\{\begin{array}{l}\lambda_{25}, r'(n_{25}), r''_i(n_{25}), r'''_i(n_{25}), r_i(n_{25}), MTBF(n_{25}), \eta\left(e^n_{25,23}\right), \\ \eta\left(e^m_{25,28}\right), \eta\left(e^n_{25,29}\right), p(n_{25}), \ldots\end{array}\right\}$
n_{32}	$\left\{\lambda_{32}, r'(n_{32}), r''(n_{32}), r'''(n_{32}), r(n_{32}), MTBF(n_{32}), \eta\left(e^m_{32,24}\right), p(n_{32}), \ldots\right\}$
n_{59}	$\left\{\lambda_{59}, r'(n_{59}), r''(n_{59}), r'''(n_{59}), r(n_{59}), MTBF(n_{59}), p(n_{59}), \ldots\right\}$
…	…

Y_m -side property sets including interaction strength like $g\left(e^m_{ij}\right)$.

2 The Construction of Bayesian Network Model Based on System Reliability Network

The reliability network model is actually a very complicate network with more than 20,000 nodes. Though this complicate network has its advantage over describing structure characteristics of the whole system, there are some difficulties in calculating system reliability by using reliability network directly. Hence, reliability network model should be transformed into maturer Bayesian Network Model[10].

There are nodes whose failure can result in the failure of the whole network and the set of these minimum nodes is the minimal cut set of the network. This paper first selects the output block according to the functional characteristics of EMU system and then takes the output block as the top event to seek the minimal cut set in the system reliability network by breadth-first search method. Below is the main idea of breadth-first search method: It is assumed that all nodes at the initial state have not been accessed. Breadth-first search method starts from one node called and accesses its neighbor nodes one by one. Then it would start from these neighbor nodes traversing the whole network. If there are any nodes that has not been accessed, it would select one of them and repeat the above mentioned processes until all nodes in the network have been accessed. Below is the flow chart of breadth-first search method (Figure 1).

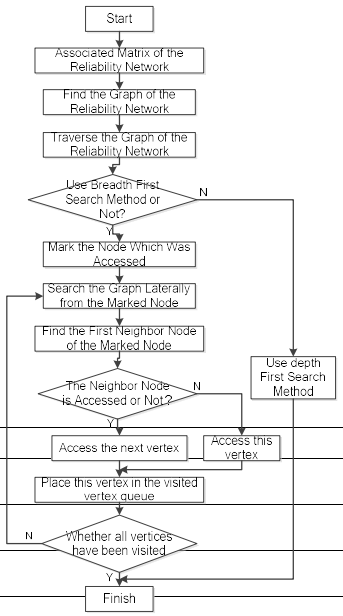

Figure 1 Use Breadth First Search Method Flow Chart

2.3 Bayesian Network Model Based on the minimal cut set

Bayesian Network Model, which is built on the basis of minimal cut set, is used to analyze the reliability of the system. Below are the logical relationship in Bayesian Network Model.

All units in the minimal cut set are connected in parallel. Therefore, the subsystem would fail only when every unit in the cut set breaks down.

All unis in the minimal cut set are connected in series. In this situation, the system would fail once one unit breaks down.

Below are the steps explaining how Bayesian Network Model is built.

Calculate three minimal cut sets separately according to the mechanical function, electronic function and informative function of the system reliability network. These three cuts are C_m , C_i and C_e .

Build the Bayesian Network Model BN_m , BN_i , and C_e separately under C_m , C_i ,and C_e situation using the logical relationship mentioned above.

3 Reliability Assessment Based on the Bayesian Network

3.1 Method of Probabilistic Inference in Bayesian Networks

Through the method of probabilistic inference in Bayesian Networks[11], five different things could be gained: conditional probability, prior probability, posterior probability, total probability formula and

Bayesian formula.

3.1.2 Bayesian Network Inference

In nature, BN probabilistic inference is a process of probability calculation based on Bayesian probability theory[12] and its core lies in the calculation of posterior probability distribution. Through Bayesian Network, joint probability distribution can be clearly displayed in the form of graph and probability table. Then after the elimination calculation, any one variable's marginal probability distribution or part variables' probability distribution can be gained. Assume that the set of all variable is X, evidence variables E and query variable Q. Formula of reasoning process could be got according to the following formula.

$$P(Q \mid E=e)=\frac{P(Q,E=e)}{P(E=e)}$$

Bi-direction reasoning is one of the remarkable characteristics of Bayesian network inference. It includes causal reasoning and diagnostic reasoning.

3.2 System Reliability Assessment Method Based on the Bayesian Network Inference

This paper has put forward the reliability calculation method based on Bayesian Network. But conditional probability and prior probability of each node should be generated first. Below are the generation rules:

According to the failure rate of the node in BN_m, prior probability of the root node could be directly gained. This paper uses $P(n_i=1)=p_{n_i}, i=1,2,\cdots$ to demonstrate the prior probability;

Determine the non-root node's ($\tilde{n}_j$)conditional probability.

There are two kinds of non-root node in Bayesian Network. They are relevant failure nodes $r\tilde{n}_j$ and non-relevant failure nodes $ur\tilde{n}_j$.

$\Longrightarrow$ Determine the conditional probability of non-root node $r\tilde{n}_j$.

In Bayesian network, $G=(N,E)$, any failed factor c_k which belong to $r\tilde{n}_j$ set would result in the failure of $r\tilde{n}_j$. Otherwise, if c_k does not fail, node $r\tilde{n}_j$ fails according to its own failure rate. Thus the conditional probability of non-root node $r\tilde{n}_j$ is

$$P\left(r\tilde{n}_j=1 \mid \prod_{c_k\in pa(r\tilde{n}_j)} c_k=1\right)=1.$$

$\Longrightarrow$ Determine the conditional probability of non-root node $ur\tilde{n}_j$.

In Bayesian Network $G=(N,E)$, if there is a side or sides from one root node n_i to another non-root node $ur\tilde{n}_j$ and n_i together with $ur\tilde{n}_j$ works normally, then conclusion can be drawn that n_i could be connected with $ur\tilde{n}_j$. Otherwise, n_i could not be connected with $ur\tilde{n}_j$. Hence, the conditional probability of $ur\tilde{n}_j$ is

$$P\left(ur\tilde{n}_j=0 \mid \prod_{X_k\in pa(\tilde{n}_j)} ur\tilde{n}_k=0\right)=1.$$

the failure rate of top node n_T

The failure rate of the network, which is based on Bayesian network inference, would be obtained after the conditional probability and prior probability. Assume the top node is n_T, then the failure rate of the whole system would be $Q=P(n_T=1)$

Based on Bayesian model, $P(n_T=1)$ could be gained directly by Bayesian causal reasoning. The complexity of Bayesian Network Reasoning method is closely linked with the number of the nodes. In the formula $Q=P(n_T=1)$, the reader only needs to pay attention to the state of n_i. The node n_i belongs to non-query node which could be blanked by merging its prior probability into child node's conditional probability. Therefore, the number of nodes in Bayesian Network and the complexity of the system could also be reduced.

After the child node of non-root node $\tilde{n}_j$ is blanked, its parent node set would be changed from $pa(n_i)$ to $pa'(n_i)$. Its conditional probability is

$$P(n_i \mid pa'(n_i))=\frac{P(n_i,pa'(n_i))}{P(pa'(n_i))}$$

Its total probability formula which is unfolded on the basis of $pa(n_i)$ is

$$\begin{aligned}
&=\frac{\sum_{\substack{\tilde{n}_j\in pa(n_i)\\ \tilde{n}_j\notin pa'(n_i)}} P(n_i,pa'(n_i),\tilde{n}_j)}{P(pa'(n_i))}\\
&=\frac{\sum_{\substack{\tilde{n}_j\in pa(n_i)\\ \tilde{n}_j\notin pa'(n_i)}} P(n_i \mid pa'(n_i),\tilde{n}_j)\bullet P(n_i,pa'(n_i),\tilde{n}_j)}{P(pa'(n_i))}\\
&=\frac{P(pa'(n_i))\sum_{\substack{\tilde{n}_j\in pa(n_i)\\ \tilde{n}_j\notin pa'(n_i)}} P(n_i \mid pa'(n_i),\tilde{n}_j)\bullet P(\tilde{n}_j)}{P(pa'(n_i))}\\
&=\sum_{\substack{\tilde{n}_j\in pa(n_i)\\ \tilde{n}_j\notin pa'(n_i)}} P(n_i \mid pa'(n_i)),\tilde{n}_j\bullet P(\tilde{n}_j)
\end{aligned}$$

When non-query node is blanked, the above-mentioned formula could be further unfolded on the basis of total probability formula according to $pa'(n_T)$:

$$Q=\sum_{pa'(n_T)} P(n_T=1,pa'(n_T))$$

Apply the formula of conditional probability:

$$=\sum_{pa'(n_T)} P(n_T=1 \mid pa'(n_T))P(pa'(n_T))$$

Mark $P\left(pa'\left(n_T\right)\right)=\left\{n_{T_i} \mid pa'\left(n_T\right)\right\},\left(i=1,2,\cdots\right)$ and unfold $P\left(pa'\left(n_T\right)\right)$ according to $\bigcup_{X_{T_i}\in pa'\left(n_T\right)} pa'\left(n_{T_i}\right)$:

$$P\left(pa'\left(n_T\right)\right)=\sum_{\bigcup_{X_{T_i}\in pa'\left(n_T\right)} pa'\left(n_{T_i}\right)} P\left(pa'\left(n_T\right), \bigcup_{X_{T_i}\in pa'\left(n_T\right)} pa'\left(n_{T_i}\right)\right)$$

Apply the formula of conditional probability:

$$=\sum_{\bigcup_{X_{T_i}\in pa'\left(n_T\right)} pa'\left(n_{T_i}\right)} P\left(pa'\left(n_T\right) \mid \bigcup_{n_{T_i}\in pa'\left(n_T\right)} pa'\left(n_{T_i}\right)\right)\cdot P\left(\bigcup_{n_{T_i}\in pa'\left(n_T\right)} pa'\left(n_{T_i}\right)\right)$$

Concerning the principle of conditional independence of Bayesian Network,

$$=\sum_{\bigcup_{n_{T_i}\in pa'\left(n_T\right)} pa'\left(n_{T_i}\right)} \prod_{n_{T_i}\in pa'\left(n_T\right)} P\left(n_{T_i} \mid pa'\left(n_{T_i}\right)\right) P\left(pa'\left(n_{T_i}\right)\right)$$ With the root node's prior probability applying to the formula, the number of parent nodes becomes fewer and fewer until is $P\left(n_T=1\right)$ obtained.

The Reliability of the EMU System

Repeat the above calculation process (1)~(4) and calculate the reliability value of R_i and R_e from BN_i and BN_e separately. Since these three Bayesian Networks are connected in series, the reliability of the EMU system is:

$$R = R_i * R_e * R_m$$

4 Examples

This paper has taken traction system of China Railways CRH5 EMU. The mechanical network model based on the system structure is displayed in Figure 2 and its node number's corresponding components is shown in Table 2.

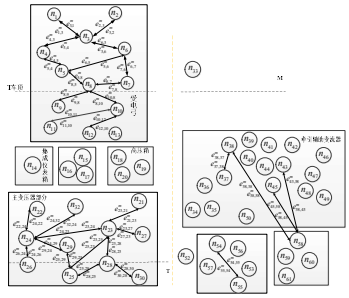

Figure 2 The Mechanical Network Model of the Traction System of China Railways CRH5 EMU

Table 2 The Correspondence Table between Serial Number and Components

Number	Components	Number	Components
1	Carbon Slider	31	Oil Temperature Analog Display
2	Pantograph Horn	32	Excess Pressure Valve
3	Pantograph Head	33	Braking Resistor
4	Composition of upper arm	34	Braking Chopper
5	Composition of upper arm	35	Braking Resistance and Current
			Converter TA1/2
6	Top Guide Bar	36	Secondary Winding Current Converter TA1/2
7	Bottom Guide Bar	37	Inverter(2 个)
8	Pantograph Lifting Devices	38	4QC1/2
9	Valve Plate	39	Capacitance
10	Pedestal	40	Voltage Transducer
11	Pantograph Assembly	41	KAUX
12	Insulator	42	Electric Reactor
13	Copper Row	43	High Frequency Transformer TR1/2
14	Voltage and Current Transformer	44	Current Converter Traction Motor TA2-MI (4)
15	Earthing Switch	45	Auxiliary Power Module
16	Main Circuit Breaker	46	Medium voltage panel
17	Lightning Arrester	47	Auxiliary Control Unit
18	Primary Winding Current Sensor	48	EMI Filter
19	Contactor SAZ (2)	49	Medium Voltage Output Switch
20	Module CLTA/B	50	Traction Control Unit (TCU)
21	Traction Transformer	51	Auxiliary Power Supply System
22	Oil Level Indicator	52	TCMS
23	Steel Tank	53	Speed Sensor
24	Oil Conservator	54	Traction Motor (2)
25	Oil Pump	55	Ventilator (2)
26	Moisture Absorber	56	PT10 Sensor 01
27	PT100 Temperature Sensor	57	PT100Sensor 2
28	Cooler	58	Cooling Fan of Traction Converter (2)
29	Oil Flowing Relay	59	Pressure Sensor
30	Cooling Motor	60	Traction Converter Cooling Pump

4.1 Remove weights remove directions

Take the mechanical network as an example. Below are the detailed steps of removing weights removing directions.

First, select one attribute of the node like failure rate λ_i and one attribute of the side like interaction intensity $g\left(e_{ij}^m\right)$.

Calculate the maximum and the minimum value of λ_i and $g\left(e_{ij}^m\right)$ separately.

$$\lambda_M = \max\left\{\lambda_1, \lambda_2, \cdots, \lambda_n\right\},$$

$$\lambda_m = \max\left\{\lambda_1, \lambda_2, \cdots, \lambda_n\right\},$$

$$g_M = \max\left\{g\left(e_{12}^m\right), g\left(e_{23}^m\right), \cdots, g\left(e_{56}^m\right)\right\},$$

$$g_m = \min\left\{g\left(e_{12}^m\right), g\left(e_{23}^m\right), \cdots, g\left(e_{56}^m\right)\right\};$$

Calculate the BPAs based on D-S evidence theory.

$$m_{di}(h) = \frac{|\lambda_i - \lambda_m|}{\sigma},$$

$$m_{di}(l) = \frac{|\lambda_i - \lambda_M|}{\sigma},$$

$$m_{\omega i}(h) = \frac{|g_i - g_m|}{\delta},$$

$$m_{\omega i}(l) = \frac{|g_i - g_M|}{\delta},$$

Then,

$$M_d(i) = \left(m_{di}(h), m_{di}(l), m_{di}(\theta)\right),$$

$$M_\omega(i) = \left(m_{\omega i}(h), m_{\omega i}(l), m_{\omega i}(\theta)\right);$$

According to the orthogonal sum, solve the following formula:

$$M(i) = \left(m_i(h), m_i(l), m_i(\theta)\right)$$

After merging, new node failure rate index $\tilde{\lambda}(i)$ could be gained:

$$\tilde{\lambda}(i) = M_i(h) - M_i(l) = m_i(h) - m_i(l)$$

Re-select the attribute of the node and repeat the above-mentioned steps until all nodes' attribute value have merged with all sides' attribute and formed the new set of node attribute, that is, $\tilde{X}_m = \left\{\tilde{\lambda}, \tilde{r}_t, \tilde{\eta}, \cdots\right\}$.

Based on the above-mentioned steps, removing weights removing directions could also be used to mechanical network, electronic network and informative network in the whole system.

Take the mechanical network model of the traction system of China Railways CRH5 EMU as an example shown in Figure 3-1. The node failure rate λ_i would be merged with side interaction intensity. Side interaction intensity should be calculated out first. Below are the detailed steps:

(1)The associated influence degree resulting from different connection ways between components. Every side belongs to one set or sets (mechanical set, electronic set or informative set) which can be quantified according to related statistical results and experts opinion. Connection intensity $0 < c\left(e_{ij}\right) \le 1$ embodies sides' influential degree as well as the importance degree during design and manufacture processes. What is more, non-detachable joint is the most stable connection way. Take the equipment unit connection method as an example. Below are the quantified and normalized results of $c\left(e_{ij}\right)$.

Table 3 The Quantified Results of $c\left(e_{ij}\right)$

Connection Method	Connection Intensity $c\left(e_{ij}\right)$
Press-fit Joints	0.3
Screw Joints	0.6
Rivet Joint	0.8
Welding Joint	1.0
Key Joint	1.0

(1)When the node fails, there is possibility that it would affect its neighbors. And this possibility is called fault propagation rate $\eta\left(e_{ij}\right)$. This fault propagation rate can be got form history fault data and system parameters. This paper offers one calculation method. If all needed data are available and there is a causal relationship between n_i and $\tilde{n}_j$, calculate the changing times of n_i first and then calculate the changing times of n_j resulting from n_i. These two results would be embodied by $\kappa(n_i)$ and $\kappa\left(n_j\right)$ separately. Therefore, the formula would be:

$$\eta\left(e_{ij}\right) = \frac{\kappa\left(n_j\right)}{\kappa(n_i)}$$

(3)The interaction relationship between nodes is shown in Figure 3. The direction of the side represents the association relationship of coupling effect. In weighted networks, the intensity of coupling effect plays an important role in failure evolution.

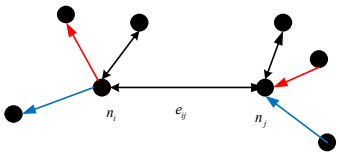

Figure 3 Graph of Sides Interaction Intensity

The interaction intensity of connection side comprehensively reflects the interaction intensity of nodes. Hence, connection strength and fault propagation rate should both taken into account. To simplify the reliability network model, $g\left(e_{ij}\right)$ is introduced to demonstrate the interaction intensity of connection side:

$$g\left(e_{ij}\right) = c\left(e_{ij}\right)\eta\left(e_{ij}\right)$$

According the above-mentioned steps, the interaction intensity of each connection side could be gained as

Side	Fault Propagation Rate	Intensity	Side	Fault Propagation Rate	Intensity
e_{13}	0.11	0.03	$e_{22,24}$	0.08	0.05
e_{23}	0.51	0.51	$e_{23,24}$	0.52	0.42
e_{34}	0.09	0.03	$e_{24,32}$	0.58	0.46
e_{36}	0.1	0.08	$e_{25,29}$	0.56	0.45
e_{45}	0.45	0.27	$e_{25,28}$	0.52	0.31
e_{56}	0.05	0.03	$e_{21,23}$	0.52	0.16
e_{58}	0.56	0.45	$e_{23,27}$	0.04	0.02
e_{67}	0.08	0.05	$e_{28,30}$	0.03	0.02
e_{78}	0.09	0.05	$e_{54,55}$	0.67	0.20
...	...	...	...	...	...

is shown in Table 4.

Node failure rate can be gained according to side attribute and the merging method between node attributes and side attributes based on D-S evidence theory. This is shown in Table 5.

Table 5 Node Failure Rate

Node	Failure Rate	Node	Failure Rate
1	0.0051	18	0.0168
2	0.0067	19	0.0131
3	0.0110	20	0.4010
4	0.0097	21	0.0761
5	0.0069	22	0.1583
6	0.0073	23	0.0775
7	0.0096	24	0.0906
8	0.0101	25	0.0668
9	0.0192	26	0.1469
10	0.0082	27	0.1775
11	0.0096	28	0.1721
12	0.0089	29	0.1195
13	0.0094	30	0.0757
14	0.0088	31	0.0802
15	0.0076	32	0.1015
16	0.0061	33	0.0603
17	0.0084	...	...

4.2 The Construction of Bayesian Network Model

CRH5 is drawn as an example and its network construction is shown in Figure 4. Number 7 is input node while number 8 is output node. With traversing method, the minimum cut sets would be $\{7\},\{1,5\},\{2,5\},\{3,5\},\{1,6\},\{2,6\},\{3,6\},\{8\}$ .And there are 24 minimum path sets. Since minimum cut sets are fewer than minimum path sets, it would be much easier to solve the problem by minimum cut sets.

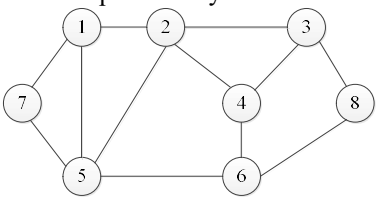

Figure 4 Graph of Network Construction

This paper builds the BN model by means of minimum cut sets and it is shown in Figure 5. Node $n_i\left(i=1,2,\cdots,8\right)$ represents 8 components in the redundant system. Node $sn_j\left(j=1,2,3,4\right)$ represents 4 sub-system, that is, 6 minimum cut sets $\{1,5\},\{2,5\},\{3,5\},\{1,6\},\{2,6\},\{3,6\}$. And node G represents the whole system. Build the conditional probability table based on the above-mentioned logical relationship, then list the conditional probability table between sub-system node sn_1 and system node G .

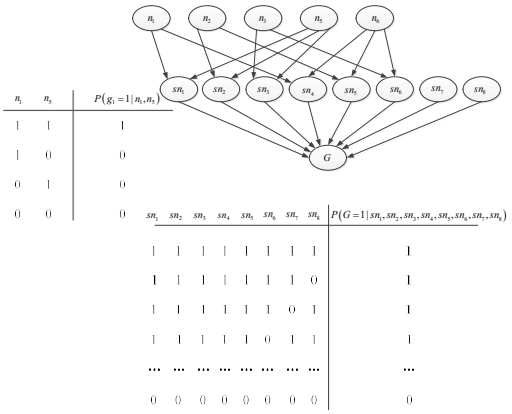

Figure 5 BN Model of the Network System

4.3 System Reliability Assessment Based on Bayesian Network Inference

This paper has got the system reliability $R_s=0.9778$ based on node failure rate in Table 6 and the method of system reliability assessment which is described in 3.2 part.

Assume that the system (Node G) fails during diagnosis reasoning, the conditional probability of components failure is shown in Table 6. This table has displayed the curve graph of conditional failure probability of 13 components in the system. Conclusion could be drawn that when the system fails that n_7 and n_8 correspond to the maximum value. And this maximum value is 0.450456, which means the weak parts in the whole system.

Table 6 Components' Failure Rate

Compone	Failure	Sub-sy	Failure

nt	Rate	stem of the Cut Set	Rate
n_1	0.0177498	sn_1	0.00450456
n_2	0.0177498	sn_2	0.00450456
n_3	0.1774980	sn_3	0.04504560
n_5	0.0177498	sn_4	0.00450456
n_6	0.0177498	sn_5	0.00450456
n_7	0.4504560	sn_6	0.04504560
n_8	0.4504560		

5. CONCLUSIONS

EMU system is becoming more and more perfect and its structure is more and more complicated. At the same time, EMU system's reliability should be improved as well. Therefore, this paper has put forward Bayesian Network Model which has combined the nodes' attributes with the system's functional characteristics. On the one hand, Bayesian Network Model can be used to describe the polymorphic, dynamic and uncertain system as well as the environment outside the system. On the other hand, Bayesian Network Model is free from the restriction of variables' states and distribution area. Examples have shown that Bayesian Network Model is very useful and can be a new method for assessing the reliability of EMU system's mechanical structure.

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Study on Data Mining Algorithm used in Big Data System

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Abstract. Aiming at data from different data sources were data preprocessing and the establishment of a common mathematical model to analyze how to improve in the face of massive high-dimensional data mining efficiency and quality of the methods of association rules, and the rules for existing association metrics prone to a lot of redundant and loop rule this situation put forward the corresponding solutions, while the paper applied the high-dimensional data clustering algorithm based on hypergraph. Research article on high-dimensional data mining methods of data analysis for large data era has a certain significance to explore the methods and tools of mathematical analysis of big data era.
Keywords: Big Data; Data Mining; Algorithm Design

1. INTRODUCTION

Data were obtained with the traditional method or tool difficult to handle or analyze data information. With the changing times, in addition to business data, we also record a variety of information about the location, temperature, web pages, they constitute a huge confused big data. Big Data is so complex, the need for sufficient imagination, so now there is no single definition. Big Data is both a surge in the amount of data (the beginning of the ERP / CRM data, and gradually expanded to increase Internet data, then the relevant information and data networking of sensors, etc.), but also the complexity of the data improved. Large-scale data can be said to be a qualitative change in the amount accumulated to a certain extent formation. Data type large variety of data, structured data and other information of the original database, there are text, video and other unstructured information like both, but the speed of data acquisition and processing requirements are also increasing rapidly. Using a variety of lightweight database to receive data sent from the client, and import it into a large, centralized or distributed databases, distributed storage clusters, and then use a distributed database for common centralized mass data storage therein of query and subtotals etc., in order to meet the most common analysis needs, while the data for the previous query-based data mining, to meet the needs of high-level data analysis.

2. THEORETICAL METHODS

Can be dynamically adjusted based on the fitness value of the value of the different stages of the evolution of the probability of crossover, crossover probability adjustment strategy used in this project is shown in Equation 1, adapted to their individual cross high probability should be small, low fitness individuals whose crossover probability should be larger.

$$Pc = \begin{cases} \dfrac{Pc\max - Pc\min}{1+\exp\left(\dfrac{2f'-2f}{f\max - f}\right)} + Pc\min \\ pc\max \end{cases} \quad \begin{matrix} f' \geq f \\ f' < f \end{matrix} \tag{1}$$

Wherein Pcmax and P cmin Pc denote the upper and lower limits, the value of the project were 0.9 and 0.3, fmax represents the maximum fitness value of the current population of individuals, f denotes the average fitness value of the current population, and f' is two cross greater fitness value of the individual. Fig.1 is a corresponding cross rate adaptive curve. It should be noted has a certain impact on solving Pcmax and Pcmin results and efficiency of genetic algorithms to solve, but there is no rational choice theory, based on their value in practical applications, we passed several tests determined in accordance with the curve in Fig.1 of these two parameters reasonable size.

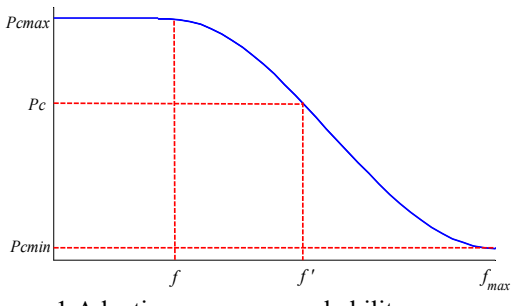

Figure 1 Adaptive crossover probability curve

Mutation Operator mutation probability is another important part of the design, which controls the frequency of the mutation operation is used. In practice, found: In the early evolution of the population, individual differences, selection and crossover effect is obvious, evolution faster mutation rate may be small; with the evolution of conduct,

individuals are subject to a higher fitness close, resulting in the population structure gradually single individual, if more successive generations of evolution does not occur, then rely on the current population may not find the optimal solution, then you can increase the mutation rate to expand your search; evolutionary stage, individuals in the population have good fitness, then I hope the mutation probability is small, so as not to destroy the fine mode. Used for this purpose by the project after the first cut of the mutation probability associated with the number of iterations, the formula is as follows:

$$Pm = Pm\min + \frac{t}{T\max} \tag{2}$$

When $0 \le \frac{t}{T\max} \le (Pm\max - Pm\min)$,

and

$$Pm = \frac{Pm\max}{Pm\max - Pm\min} \times \frac{t}{T\max} + \frac{Pm\max}{Pm\min + 1 - Pm\min} \tag{3}$$

When $(Pm\max - Pm\min) \le \frac{t}{T\max} \le 1$, so it should be noted that the results Pmmax and Pmmin solving and solution efficiency of genetic algorithm has some impact, but there is no rational choice theory, based on their value in practical applications, we passed several tests in accordance with Fig.2 mutation probability adaptively determine the values of these two parameters reasonable size.

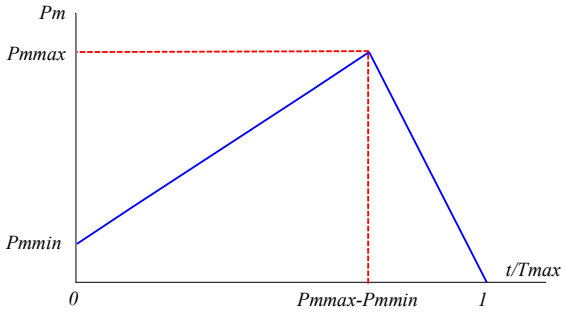

Figure 2 adaptive mutation probability curve

Individual genetic algorithm does not have a memory function, each individual can only reflect the current state of the evolution of the magnitude and direction of blindness, can cause damage to the stability of the population; and all individuals to share information with each other in the competition, so the entire population is evenly move to the optimal solution, so easily lead to the loss of population diversity. For this reason the introduction of the project PSO algorithm, PSO of individuals with memory function, based on historical information and current state to control the magnitude and direction of evolution, in most cases, can quickly converge to the optimal solution; the same particle swarm algorithm is through collaboration between individuals to find the optimal solution, only the best way to position groups to pass information to other particles, and does not directly share information between individuals, so that the whole search process is always followed by the current optimal update solution conducted, which is conducive to maintaining the diversity of population.

Similar undirected graphs and directed graphs, directed graph is super super undirected graph edge adds direction to indicate the order over the edge between vertices. On this basis, we will not to some properties hypergraph to have to make some necessary promotion, directed hypergraph also found unique properties. Of course, there is the main purpose of research is to solve the hypergraph practical application problems, this paper attempts to use a directed graph to represent association rules over and have to take advantage of nature hypergraph mining association rules that exist to solve the redundancy and ring road problems.

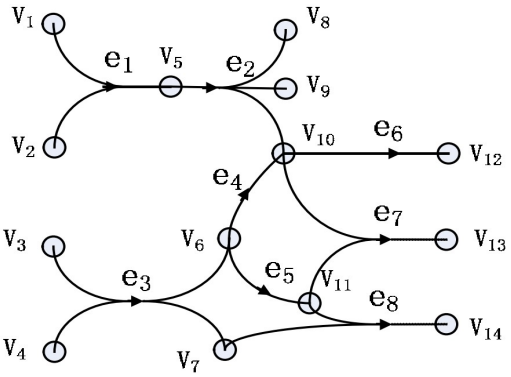

Figure 3 representation of H hypergraph

Directed hypergraph size and undirected hypergraph is defined the same as for the super edge of the base and, rank (lower rank) is also defined as the maximum (minimum) value of each super edge base. Directed adjacency matrix and other matrix hypergraph, due to the nature of existence itself hypergraph clusters, it is difficult in a directed graph and its adjacency matrix between ultra-establish one relationship. We will have to be achieved over a diagram corresponding to the adjacency matrix, but not only have to restore the original hypergraph by the adjacency matrix.

3. RESULTS AND ANALYSIS

The co-evolutionary algorithms in the Windows XP operating system with Matlab7.6 (R2008a) programming, genetic algorithms, particle swarm optimization algorithm and coevolutionary average fitness value and the run-time tracking evolutionary process applied separately to compare populations performance advantages and disadvantages when mining association rules. Experimental parameters for solving the coevolution results and computational efficiency of the algorithm has a certain influence,

but there is no rational choice theory its worth in practical applications, it is necessary after several tests to determine the values of these parameters is reasonable size. As can be seen from Fig.3, in the early evolution of coevolution algorithm convergence speed and quality of the individual are slightly better than the other two algorithms. With the increasing number of iterations, each of the three algorithms are convergent. From the experimental results, when mining association rules on low-dimensional data sets, three mining quality difference is not large, co-evolutionary algorithm is slightly better than genetic algorithm and particle swarm optimization.

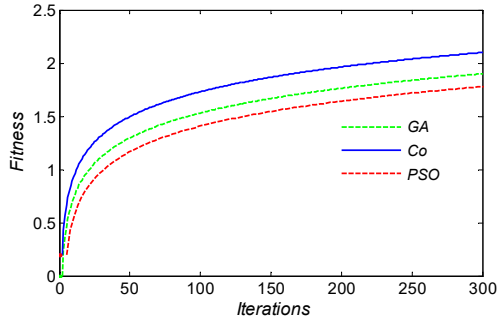

Figure 4 Comparison schematic dataset when applied to Chess

With the increasing number of iterations, the genetic algorithm after 40 iterations after the premature convergence has been caught and can not jump. Compared with the genetic particle swarm optimization algorithm, its convergence speed and quality are improved in, but the same can not jump out of the dilemma faced by local optima. The co-evolutionary algorithm in an iterative process, although there were also premature convergence phenomenon, but at the first 180 iterations there is a clear inflection point, show that the algorithm in this guide have been caught here individual values deviate from the original local optimal local the most advantage of the greater probability is close to the global optimum.

4. CONCLUSIONS

Analyzes the main features of high-dimensional data, as well as a large cause of these features were the main issues arising when mining association rules, to address these issues, we have adopted a co-evolutionary algorithm, which resolves genetic search strategy, and PSO search strategy, respectively improved Genetic Algorithm and Particle Swarm algorithm iterates two populations at the same time, and the introduction of an information exchange mechanism between the populations of the two populations co-evolution, trying to make up for the shortcomings of traditional genetic algorithm is applied when mining association rules. Through experimental verification, analysis and application, proved that the algorithm at an acceptable computational complexity of the premise, it is not required to produce not only inherited when using traditional genetic algorithm for mining association rules massive advantage of candidate sets and multiple scans of the database and more to make up for their premature convergence and slow convergence late defects, which can effectively search the database of high-quality association rules and, when applied to high-dimensional data set is particularly significant.

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