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CONTENTS

The Study on the Optimization Algorithm of the Nurse Scheduling Problem

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Abstract: the nursing work is one of the most important work contents of the medical institutions. The nurse scheduling problem is restricted by many constraints due to the particularity of nursing work. Good nurse scheduling method can not only help motivate nurses' work, but also improve the quality of nursing work to ensure patients' life and health. In this paper, the problem of nurse scheduling is analyzed, and the mathematical model of the problem is given, and the two stage algorithm is used to solve the problem of nurse scheduling. First, a feasible white night shift allocation scheme is selected by branch and bound algorithm, and then the simulated annealing algorithm is used to optimize the design of the selected scheme. Through the optimization algorithm, the complex nurse scheduling problem can be effectively solved.

Keywords: nurse scheduling; branch and bound algorithm; simulated annealing algorithm.

1. INTRODUCTION

In modern society, there are many problems of scheduling in the process of production, life and study, such as the school scheduling problem, the factory scheduling problem and the nurse's scheduling problem and so on, [1, 2]. Among them, the problem of the nurse scheduling is complicated and challenging because of the special work of medical institutions. It is difficult to ensure the rationality and efficiency of the scheduling of nurses in most medical institutions with the possibility of long time, low efficiency, waste of human resources and personal subjective assumption[5-8].

Many researches have been done on nurses' scheduling problems. Many literatures are looking for appropriate mathematical models to solve this scheduling problem, [3-6]. Warner et al. First proposed a single choice algorithm, which uses two steps to solve the possible work arrangement of each nurse and optimize the selection of the target value [7]. Burke and others chose the nurse scheduling problem in Belgian hospital as an example, and also used two stages of solution. First, a large number of local optimal solutions are obtained by multi domain search. Then tabu search is used to solve the final result [8]. The methods of artificial intelligence have also been used in nurses' scheduling problems. Beddoe et al. Used the method of case reasoning (CBR) to introduce the constraints and repair records that are not in practice in the optimization of [9]. Dowsland et al. Is the three stage solution method, the first stage to judge the resource conditions of nursing work, the second stage using tabu search algorithm, and the third stage using the network flow model [10]. Genetic algorithm and heuristic algorithm are also the main algorithms used by scholars to solve nurse scheduling problems.

Most of the previous nurses' scheduling problems have been solved in many stages, and the results of the final solution are remarkable. This paper studies and absorbs the achievements of predecessors, analyzes the problem of nurse scheduling, gives the mathematical model of the problem, and uses the two stage algorithm to solve the problem of nurse scheduling. First, the branch and bound algorithm is used to select the feasible white night shift allocation scheme, and then the simulated annealing algorithm is used to optimize the design of the selected scheme. Through the optimization algorithm, the complex nurse scheduling problem can be effectively solved.

2. ANALYSIS OF THE NURSE SCHEDULING PROBLEMS

The nurse scheduling problem is to arrange each nurse's daily work situation. According to one week's nursing work arrangement, the daily working condition is divided into three kinds, namely, the white shift, the evening shift and the vacation. Therefore, according to the permutation and combination, there are probably 2187 kinds of work arrangements for a nurse in a week. In this paper, each work arrangement is defined as a situation, using 14 bit binary number to replace the nurse scheduling problem. The first seven numbers represent the white shift and the later seven figures for the late shift, and the 1 represents the schedule, and the 0 is not scheduled for the shift[9-10].

There are many related factors affecting the effect of nurse scheduling. The joint effect of various factors makes the scheduling problem become a major problem in the work of medical institutions. Some hospitals even waste a lot of manpower and financial resources on the scheduling problem, even after investing a lot of resources, they still fail to solve the problem. Among them, the main influencing factors

are the number of nurses, the grade of nurses, the white evening shift and the individual needs. It is necessary to make the teaching work smoothly and orderly through the optimal arrangement according to the rules of different constraints, and then expect to improve the teaching quality.

In order to get the optimal solution of the combination, enough constraints do bring better solutions. However, the more constraints are required for the solution process, the more difficult the solution process is to be realized, which brings great computing time and waste calculation resources, so it is very important to select the appropriate conditions. In view of the factors affecting the effect of nurse scheduling, we can choose the following constraints, which can be divided into two categories: important constraints and secondary constraints. Among them, the important constraint condition is the constraint that has great and direct influence on nurse scheduling. The secondary constraint is a type of constraint that has little effect on the scheduling problem, but it can not be ignored. In this paper, several typical constraint conditions are mainly considered. There are several important constraints and minor constraints.

Table 1 .The constraint condition table

The important constraint conditions	
1	The number of nurses per day meets the needs of each week
2	On the same day, the same nurse can only be assigned one job.
The secondary constraint conditions	
1	To meet the special needs of individual nurses as far as possible
2	Limit the maximum and minimum number of working days per nurse and the number of consecutive working days.
3	There should be two days of rest after the night shift
4	Limit the number of consecutive weekends of overtime

Here, for each scenario given a weight value w to judge the popularity of the situation, there are three main factors affecting the W value: (1) the intrinsic property of the situation itself, that is, the attitude of most people to the situation; (2) the difference between the personal feelings and needs of the nurses, each person is different; (3) the influence of the arrangement of the historical work, the distribution of the night shift and the evening shift should consider the rest of the body reasonably.

3. THE PROBLEM MODEL

In fact, the problem of nurse scheduling is to assign every day to each nurse, and make the defaults of each constraint as small as possible. Because the constraints of the scheduling problem are very complex and numerous, this paper transforms it into a single objective problem to simplify the solution to the multi-objective problem. The given problem model is shown as follows:

$$\min\left(f(\chi)\right)=\min\left(\sum_{S=1}^{S}\sum_{i=1}^{18}w_{s,i},f_{s,i}\right)$$

$$s,\mathrm{t}\begin{cases}\text{the number of nurses on every day meets the needs}\\ \text{The same nurse can only work in one class every day}\end{cases} \quad (1)$$

Among them, the w_{si} is the weight of the i constraint condition of the s nurses, and the f_{si} is the fitness value of the i constraint condition of the s nurses.

4. THE OPTIMAL SOLUTION ALGORITHM

(1) The overall overview of the algorithm

In this paper, the technical route of the optimization algorithm is to determine the total workload of each nurse in one cycle, that is, to determine the allocation scheme for the white and late classes. This step will get many feasible allocation schemes and need to find the best one in these feasible schemes, so it is necessary to further optimize the selection process. These two stages can be separated step by step, or the two stages can be combined. When an optimal selection is carried out in a white and late class assignment scheme, the method is beneficial to find the optimal solution more quickly, reduce the unnecessary process of solving and improve the efficiency of calculation. It can be said that these two stages are mutual auxiliary relations, the branch boundary algorithm can reduce the use of simulated annealing algorithm, the simulated annealing algorithm can provide a lower upper limit of the branch boundary algorithm. The steps for solving the two stage nurse scheduling problem in this paper are shown in the following diagram:

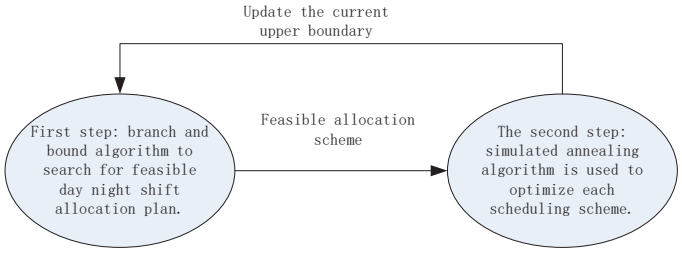

Fig. 1.The Schematic diagram of the algorithm for solving the nurse scheduling problem in the two stage

(2) The branch and bound algorithm

Branch and bound algorithm is a widely used

optimization problem search method. This method takes the current optimal solution as the upper bound, and finds the lower bounds of the problem by the relaxation method. If the lower bound is greater than the upper bound of the current setting, then prune the branch of the subtree which is the root of the node, and through such a process the efficiency of the search is realized. The two factors that affect the efficiency of the branch and limiting algorithm are the method and strategy of branching and pruning. The branch strategy uses the method of depth optimization, and the pruning strategy uses the method of feasibility pruning.

(3) The simulated annealing algorithm

The simulated annealing algorithm was first proposed by Mr. Metropolis, and Kirkpatrick applied it to solve the optimal solution problem. It is an algorithm based on the principle of physical annealing. When the metal is heated, the molecule is in a free motion state. At this time the temperature can be lowered to make the metal molecules stay in different states. The simulated annealing method is analogous to the process of optimization as the annealing process of metal, and the optimal solution is regarded as a state of the lowest energy.The simulated annealing algorithm mainly determines the initial temperature, the drop temperature function, the stopping criterion and termination rule at a certain temperature.

5. CONCLUSION

Nursing is one of the most important tasks in medical institutions. The nurse scheduling problem is restricted by many constraints due to the particularity of nursing work. Many scholars have done many research results on nurse scheduling problems, and many literatures are seeking suitable mathematical models to solve this scheduling problem. Most of the previous nurses' scheduling problems were solved by multi-stage solutions, and the final solution was effective.

This paper studies and absorbs the research results of the predecessors, analyzes the nurse scheduling problem deeply, gives the mathematical model of the problem, and uses the two stage algorithm to solve the nurse scheduling problem.First, a feasible white night shift allocation scheme is selected by branch and bound algorithm, and then the simulated annealing algorithm is used to optimize the design of the selected scheme. Through the optimization algorithm, the complex nurse scheduling problem can be effectively solved. Good nurse scheduling can not only help motivate nurses' work, but also improve the quality of nursing work to ensure patients' life and health.

ACKNOWLEDGMENT

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Research on the Improvement of Intelligent Algorithm for Wireless Sensor

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Abstract: With the rapid development of science and technology, the application of wireless router is becoming more and more common. It has become an important component in people's daily life. Wireless sensor integrates many kinds of Frontier Science and technology, and has high theoretical research value. In this respect, there are many research results. In the communication technology of wireless sensor networks, the existing routing algorithms are divided into two most commonly used algorithms, such as clustering algorithm and directional diffusion algorithm, but there are some limitations. In this paper, combining the advantages of clustering algorithm and directional diffusion algorithm and avoiding its shortcomings, the two methods are combined to form an optimized algorithm. The improved algorithm can make the energy consumption of wireless sensor nodes balanced, and the life cycle of wireless sensor networks is greatly extended.
Key words: wireless sensor; energy loss; directed diffusion algorithm;

1. INTRODUCTION

Wireless sensor network technology has been praised as one of the most useful and critical science and technology since twenty-first Century. It has brought unprecedented impact and change to the production and life of people. It has a wide range of influence, from national defense to industrial production, from daily home to transportation, from environmental protection to health management. As one of the hottest research areas, wireless sensor technology is a multi-disciplinary overlapping and highly integrated technology. It broadens the traditional sensors only as the functional constraints of the sensing unit, and realizes the combination of information exchange and coordinated control on the basis of perception, and interconnects objects and objects through the perceptive probes all over the place[5-6].

Because of its high scientific value and practical application value, wireless sensor networks have attracted the attention and attention of many scholars and experts at home and abroad, and a large number of relevant research results have been born. The University of California at Berkeley in the United States has studied a distributed node location algorithm in WSN and a node related location reconstruction algorithm and developed a Tiny OS operating system. The Massachusetts Institute of Technology has proposed a special method and technology for the in-depth study of ultra low energy wireless sensor networks. The research on wireless sensor networks in China started mainly in the Shanghai micro system of the Chinese Academy of Sciences. Later, the Ningbo Institute of Chinese Academy of Sciences developed a graphical interface platform for quantitative quantitative analysis and research of WSN. Nanjing University of Posts and Telecommunications has further realized visual management of wireless sensor networks, and developed an open platform to provide users with visual development means. In the process of wireless sensor network communication, the problem of fast energy consumption of nodes is the most difficult problem to be solved. Scholars have long been working to find a best algorithm that can make the energy consumption of wireless sensor nodes balanced, and can prolong the lifetime of wireless sensor networks.

Although there has been a great deal of research on wireless sensor networks, there are still many shortcomings and problems that need to be further analyzed and improved. In the communication technology of wireless sensor networks, the existing routing algorithms are divided into two most commonly used algorithms, such as clustering algorithm and directional diffusion algorithm, but there are some limitations. In this paper, combining the advantages of the two algorithms and the advantages of the clustering algorithm and the directional diffusion algorithm, we combine the two methods to form an optimized algorithm. This algorithm can make the energy consumption of the wireless sensor nodes balanced, and the life cycle of the wireless sensor network is greatly extended[7-10].

2. THE WIRELESS SENSOR NETWORK

Today, wireless sensor network technology has gone through four stages, now in the era of WSN network, that is, the age of sensor networks formed by a large number of multi-functional sensors which are combined through a large number of self organized introduction. Wireless sensor networks (WSN) distribute a large number of sensor nodes in a certain interval in a different manner, and these nodes form a network by self organized introduction. Each node contains many different types of sensors, and the

sensor sends various information in the area it gets to the data processing center in the form of multi hop routing. Such a process enables the communication and exchange between the real world and the network information world, thus realizing the communication between human beings and computers. Figure 1 is a schematic diagram of WSN's network system structure.

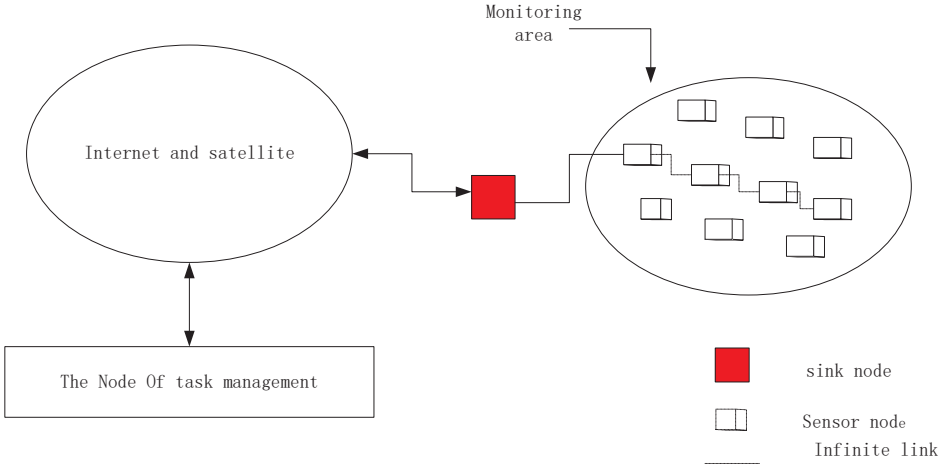

Figure 1. The system structure of WSN

3. THE CLUSTERING ALGORITHM AND DIRECTIONAL DIFFUSION ALGORITHM

The algorithm applied to wireless sensor networks is obviously different from traditional wireless networks because of the special energy requirements of nodes. The main point of the algorithm is to reduce the energy loss rate of nodes and prolong the lifetime of networks, rather than focusing on some non energy elements. At present, there are two commonly used intelligent algorithms for wireless sensor networks, namely clustering algorithm and directional diffusion algorithm.

The Clustering algorithm is to establish and maintain data transmission path and control network topology. The basic process is divided into three parts: cluster head generation, cluster formation and data transmission. The algorithm can effectively eliminate data redundancy and effectively promote data combination, which can not only reduce load but also reduce energy consumption. There are three kinds of clustering algorithms: routing, coding and fusion. The basic idea of clustering algorithm is simply expressed as shown in the following figure.

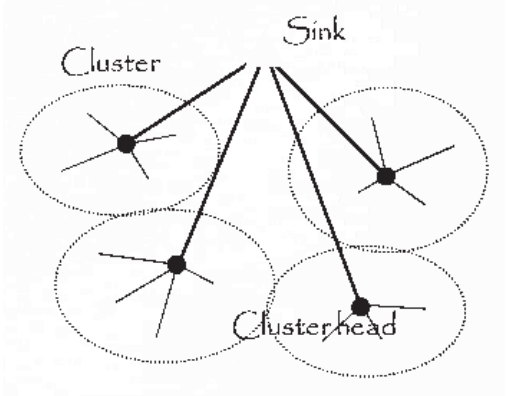

Figure 2. The Basic idea of clustering algorithm

The directed diffusion algorithm is a key achievement in the development of network routing protocols, and it is an active search algorithm initiated by pooling nodes. It consists of three stages: interest broadcast, gradient establishment and data transmission, and its transmission mode is based on data. What is quite different from other routing protocols is the gradient method to define the probability that an intermediate node will continue to search for available data in a certain direction. Dependent on the most basic directed diffusion algorithm, many related improved derivative algorithms, such as Rumor algorithm, EAR algorithm and GBR algorithm, have been generated.

4. THE IDEAS OF IMPROVED ALGORITHM

4.1 The improved strategy of algorithm

Node is the key point of wireless sensor network. Because nodes are generally powered by chemical batteries, when the nodes are fixed, they will not be recharged to each node, so reducing the energy loss of the nodes is the core problem that the wireless sensor network needs to solve. In the main elements of the node, the sensor is the main body of energy consumption, and the data processing module and the information module are also the main source of energy consumption. Thanks to the rapid development and breakthrough of integrated circuit technology, the energy consumption of sensor and data processing modules gradually decreases, and the process of wireless receiving and sending has become the main energy consumption body. However, there are a lot of data transmission and receiving processes in the directed diffusion algorithm, which requires a lot of energy consumption and a lot of resources. In order to reduce the number of data transmission and reception in the algorithm, the clustering idea is applied to the directional diffusion algorithm, and an optimization algorithm is proposed.

4.3 The improved algorithm

In wireless sensor networks, this paper proposes an

improved method based on the directional diffusion algorithm. The specific operation is that after the node is arranged, the cluster is first divided, and an external node sends out a limit value information. Each node compares the remaining energy of the node with the limit value to determine whether it can be a preparatory cluster head. Then, with the largest residual energy as the cluster head, data transmission between nodes is accomplished and realized through inter cluster and intra cluster communication. Finally, the rotation of cluster heads is used to ensure the effective prolongation of the life cycle of WSN.

5. CONCLUSION

Known as the most prominent and dazzling science and technology since twenty-first Century, it has brought unprecedented influence and change to people's production and life. Wireless sensor technology is a technology of multi-disciplinary overlapping and highly integrated theory. It broadens the traditional sensors only as the functional constraints of the sensing unit, and realizes the combination of information exchange and coordinated control on the basis of perception. Finally, the objects and objects are connected directly through the perceptual probes all over the area. Because of its high scientific value and practical application value, WSN has attracted the attention and attention of a large number of scholars and experts at home and abroad. Although there have been a lot of scientific research on wireless sensor network technology, there are still a lot of shortcomings and problems, which need to be further studied and improved. In wireless sensor network communication technology, the existing routing algorithms are divided into two most commonly used algorithms, such as cluster algorithm and directional diffusion algorithm, but there are some limitations. In this paper, combining the advantages of the two algorithms and the advantages of the clustering algorithm and the directional diffusion algorithm, we combine the two methods to form an optimized algorithm. This algorithm can make the energy consumption of the wireless sensor nodes balanced, and the life cycle of the wireless sensor network is greatly extended.

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Attitude Estimation Based on Algorithm of Extend Kalman Filter Quaternion

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Abstract: Due to the accumulated error caused by the drift of gyroscope, attitude estimation based on gyroscope cannot complete accurate measurement for a long time. The accelerometer is affected by the vibration seriously, it also cannot finish the measurement independently. So the usual approach is to fuse the data. The quaternion fusion algorithm based on extended kalman filtering(EKF) is proposed by this paper. Take the quaternion updated by gyroscope angular velocity as state variable and the quaternion updated by acceleration as observation variable to establish EKF model, attitude angle is calculated with the fused quaternion. The experiments' results show that the drift of attitude can be suppressed effectively in stationary, and it can response the change of attitude quickly in motion.

Keywords: Attitude estimation; Quaternion; Gyroscope; Accelerometer; EKF

1. INTRODUCTION

In recent years, attitude estimation has been applied to many fields such as aircraft, robot indoor positioning, virtual reality and wearable devices. It has become a hotspot to improve the accuracy of attitude angle. The measurement of attitude angle is usually finishied by the inertial measurement unit(IMU) and it consists of a three-axis gyroscope and a three-axis accelerometer. In the process of acquiring the attitude angle, the gyroscope will generate accumulated errors due to the drift and the accelerometer is affected by the vibration of the carrier seriously[1-2]. Single sensor's data often cannot obtain accurate attitude information, so the common approach is to fuse the data.

Current methods of data fusion include complementary filtering, extended kalman filtering (EKF) and unscented kalman filtering (UKF). The complementary filtering has low precision because it's not easy to determine the cutoff frequency[3]. EKF applies kalman filtering to nonlinear systems by linearizing nonlinear problems, which lead to a truncation error, yet it has little influence on general nonlinear systems[4]. UKF is based on UT transform and the method of linearizing the function is abandoned. UKF is superior to EKF in convergence speed and calculation precision, but it's more intensive computationally. The system noise and observation noise are also not easy to determine and calculation process is susceptible to noise interference[5]. Euler angles method and quaternion are commonly used in attitude estimation. It's simple by using the Euler angles to describe the attitude, but the method will create singular values and there exists problem of large calculation[6]. The quaternion method is a mainstream attitude algorithm at present, because quaternion can describe the fixed point rotation of rigid body, and it can avoid the singularity problem of Euler angles method.

The paper is organized as follow: section II gives the definition of Euler angle and quaternion, and describes the relationship between them. Section III introduces how to construct and update quaternion model use the original data of gyroscope and accelerometer. The construction of EKF filters is shown in section IV. Experiments and results are provided in Section V. Finally, conclusions of this work are given in Section VI.

2. FUNDAMENTAL

(1)Euler angle and Direction Cosine Matrix

Euler angle is a set of angular parameters that can describe the rotation of an object in space, including pitch, roll and yaw, represented by φ, θ, γ respectively. The changes of these angle are the basis for measuring the attitude of the carrier. The paper defines the carrier coordinate system as b and the reference coordinate system is n. IMU is fixed to the carrier, so it is necessary to convert the attitude vector measured by IMU to reference coordinate system[7-8]. The conversion matrix C_n^b is called Direction Cosine Matrix.

Finite rotations of rigid body in space are not interchangeable that you get different conversion matrices in different rotation order[9]. ENU(East North Up) coordinate system was selected as reference coordinate system n, as is shown in Fig.1, rotate the reference coordinate n to the carrier coordinate system b use the order of -Zn→X1→Y2 , each time the rotational angle of the order is φ→θ→γ , then through the three coordinate transformations matrix obtained the Direction Cosine Matrix

$$C_n^b = C_2^b C_1^2 C_n^1 = \begin{bmatrix} \cos\gamma & 0 & -\sin\gamma \\ 0 & 1 & 0 \\ \sin\gamma & 0 & \cos\gamma \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & -\sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} \cos\psi & \sin\psi & 0 \\ -\sin\psi & \cos\psi & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad (1)$$

$$= \begin{bmatrix} \cos\gamma\cos\psi + \sin\gamma\sin\psi\sin\theta & \sin\gamma\cos\psi\sin\theta - \cos\gamma\sin\psi & -\sin\gamma\cos\theta \\ \sin\psi\cos\theta & \cos\psi\cos\theta & \sin\theta \\ \sin\gamma\cos\psi - \cos\gamma\sin\psi\sin\theta & -\sin\gamma\sin\psi - \cos\gamma\cos\psi\sin\theta & \cos\gamma\cos\theta \end{bmatrix}$$

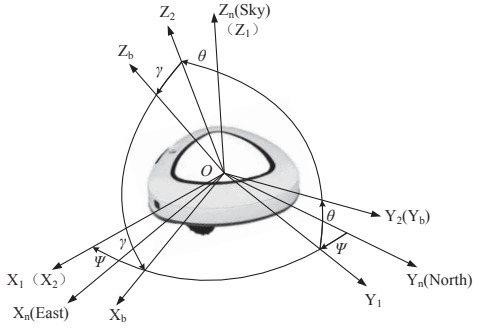

Figure 1. The rotation of carrier in space

(2) Attitude represented by Quaternions

The quaternion is defined as $Q = q_0 + q_1 i + q_2 j + q_3 k$. The trigonometric form of quaternions is shown by (2). It contains all the information about the rotation of the rigid body at a fixed point.

$$Q = \cos\frac{\theta}{2} + u^R \sin\frac{\theta}{2} \quad (2)$$

uR represents the axis and the direction of rotation, and θ stands for the angle of rotation. Then the Direction Cosine Matrix in quaternion form is given by

$$C_n^b = \begin{bmatrix} q_0^2 + q_1^2 - q_2^2 - q_3^2 & 2(q_1q_2 + q_0q_3) & 2(q_1q_3 - q_0q_2) \\ 2(q_1q_2 - q_0q_3) & q_0^2 - q_1^2 + q_2^2 - q_3^2 & 2(q_2q_3 + q_0q_1) \\ 2(q_1q_3 + q_0q_2) & 2(q_0q_1 - q_2q_3) & q_0^2 - q_1^2 - q_2^2 + q_3^2 \end{bmatrix} \quad (3)$$

So the relationship between quaternion and Euler angles is:

$$\begin{cases} \psi = 2\arctan\dfrac{q_1q_2 - q_0q_3}{q_0^2 - q_1^2 + q_2^2 - q_3^2} \\ \theta = 2\arcsin(q_2q_3 + q_0q_1) \\ \gamma = 2\arctan\dfrac{q_0q_2 - q_1q_3}{q_0^2 - q_1^2 - q_2^2 + q_3^2} \end{cases}$$

3. UPDATE QUATERNION

(1) Quaternion Update by Gyroscope

The original output of the gyroscope is rotation angular velocity of three axes, represented by ωx , ωy and ωz . To establish the relationship between the quaternion and the original data of gyroscope, the quaternion differential equation needs to be solved. Take the derivative of both sides of (2) and the result is as follow:

$$\frac{dQ}{dt} = \frac{1}{2}\omega_b \cdot Q \quad (4)$$

$$\omega_b = \begin{bmatrix} 0 & -\omega_x & -\omega_y & -\omega_z \\ \omega_x & 0 & \omega_z & -\omega_y \\ \omega_y & -\omega_z & 0 & \omega_x \\ \omega_z & \omega_y & -\omega_x & 0 \end{bmatrix}$$

Update the quaternion by the first-order Runge-Kutta method and the updated equation was obtained:

$$Q(t + \Delta t) = Q(t) + \frac{\Delta t}{2}\omega_b \cdot Q(t) \quad (5)$$

(2) Quaternion Update by Accelerometer

In the ideal situation of static or uniform motion, the acceleration vector of the carrier in reference coordinate n is the gravitational acceleration g. Then normalized acceleration vector output is $a^n = [0 \quad 0 \quad 1]^T$. The vector of acceleration in carrier coordinate system is $a^b = [a_x \quad a_y \quad a_z]^T$. ax , ay and az are the accelerometer measured values. The relationship between them is $a^b = C_n^b \cdot a^n$, substitute (3) into the equation

$$a^b = C_n^b \cdot a^n = \begin{bmatrix} 2(q_1q_3 - q_0q_2) \\ 2(q_2q_3 + q_0q_1) \\ q_0^2 - q_1^2 - q_2^2 + q_3^2 \end{bmatrix}$$

$$= \begin{bmatrix} -q_2 & q_3 & -q_0 & q_1 \\ q_1 & q_0 & q_3 & q_2 \\ q_0 & -q_1 & -q_2 & q_3 \end{bmatrix} \begin{bmatrix} q_0 \\ q_1 \\ q_2 \\ q_3 \end{bmatrix}$$

That is

$$a^b = M \cdot Q_a \quad (6)$$

The quaternion is normalized quaternion, so $MM^T = I$, then

$$Q_a = M^T \cdot a^b = \begin{bmatrix} -a_xq_2 + a_yq_1 + a_zq_0 \\ a_xq_3 + a_yq_0 - a_zq_1 \\ -a_xq_0 + a_yq_3 - a_zq_2 \\ a_xq_1 + a_yq_2 + a_zq_3 \end{bmatrix}$$

Thus, the quaternion update by acceleration is obtained:

$$Q_a(t + \Delta t) = a_c \cdot Q_a(t) \quad (7)$$

$$a_c = \begin{bmatrix} a_z & a_y & -a_x & 0 \\ a_y & -a_z & 0 & a_x \\ -a_x & 0 & -a_z & a_y \\ 0 & a_x & a_y & a_z \end{bmatrix}$$

4.EKF FILTER DESIGN

Kalman filtering has made great contributions to the connection between control theory and information theory since it was proposed. It is widely used in attitude estimation and path planning. The core idea of the algorithm is to combine the prediction and feedback measurement of the system to make the state estimation for the next time is approximate to the accurate true value infinitely.

Kalman filtering algorithm cannot solve nonlinear problems. EKF expands the nonlinear function by Taylor formula and linearize it by first order truncation. Then transform nonlinear problems into linear ones and apply the kalman filtering algorithm into nonlinear system.

(1) Kalman Filter Establishment

The EKF model includes state equation, measurement

equation, process noise and observation noise. Assume that noises are all zero mean gaussian white noises:

$$\begin{cases} x_k = f_{k-1}(x_{k-1}, u_{k-1}, w_{k-1}) \\ y_k = h_k(x_k, v_k) \\ w_k \sim (0, Q_k) \\ v_k \sim (0, R_k) \end{cases}$$

The quaternion updated by gyroscope is taken as the state variable of the model.

$$x_k = [q_0 \quad q_1 \quad q_2 \quad q_3]^T$$

The state equation is derived from the update equation of angular velocity quaternions by (5). The variable T is the sampling period of IMU.

$$\begin{bmatrix} q_0 \\ q_1 \\ q_2 \\ q_3 \end{bmatrix}_{(k)} = \begin{bmatrix} q_0 \\ q_1 \\ q_2 \\ q_3 \end{bmatrix}_{(k-1)} + \frac{T}{2} \begin{bmatrix} 0 & -\omega_x & -\omega_y & -\omega_z \\ \omega_x & 0 & \omega_z & -\omega_y \\ \omega_y & -\omega_z & 0 & \omega_x \\ \omega_z & \omega_y & -\omega_x & 0 \end{bmatrix} \begin{bmatrix} q_0 \\ q_1 \\ q_2 \\ q_3 \end{bmatrix}_{(k-1)} + \begin{bmatrix} w_{q_0} \\ w_{q_1} \\ w_{q_2} \\ w_{q_3} \end{bmatrix}_{(k-1)}$$

The process noise is $[w_{q_0} \quad w_{q_1} \quad w_{q_2} \quad w_{q_3}]^T_{(k-1)}$.

The quaternion updated by accelerometer is taken as the observation variable.

$$y_k = [q_{a_0} \quad q_{a_1} \quad q_{a_2} \quad q_{a_3}]^T$$

The measurement equation is obtained from the updating equation of acceleration quaternion by (7).

$$\begin{bmatrix} q_{a_0} \\ q_{a_1} \\ q_{a_2} \\ q_{a_3} \end{bmatrix}_{(k)} = \begin{bmatrix} a_z & a_y & -a_x & 0 \\ a_y & -a_z & 0 & a_x \\ -a_x & 0 & -a_z & a_y \\ 0 & a_x & a_y & a_z \end{bmatrix} \begin{bmatrix} q_0 \\ q_1 \\ q_2 \\ q_3 \end{bmatrix}_{(k)} + \begin{bmatrix} v_{q_0} \\ v_{q_1} \\ v_{q_2} \\ v_{q_3} \end{bmatrix}_{(k)}$$

The observation noise is $[v_{q_0} \quad v_{q_1} \quad v_{q_2} \quad v_{q_3}]^T_{(k)}$.

(2) Model Linearization

The linearization process is expand the state equation at point $x_{k-1} = \hat{x}^+_{k-1}$ and $w_{k-1} = 0$, ignore the higher order term and get the result:

$$x_k = F_{k-1} x_{k-1} + \tilde{u}_{k-1} + L_{k-1} w_{k-1}$$

In this equation

$$F_{k-1} = \frac{\partial f_{k-1}}{\partial x}, \quad L_{k-1} = \frac{\partial f_{k-1}}{\partial w}$$

Process noise satisfies the condition:

$$\tilde{w}_k = L_{k-1} w_{k-1} \sim (0, L_k Q_k L_k^T)$$

Then linearize the measurement equation at point $x_k = \hat{x}^-_k$ and $v_k = 0$, get the result:

$$y_k = H_k x_k + z_k + M_k v_k$$

In the equation

$$H_k = \frac{\partial h_k}{\partial x}, \quad M_k = \frac{\partial h_k}{\partial v}$$

Observation noise satisfies the condition:

$$\tilde{v}_k = M_k v_k \sim (0, M_k R_k M_k^T)$$

(3)The EKF Procedure

The filtering process of EKF algorithm is a continuous updating process of state estimation essentially. The specific processes are as follows:

Calculate the initial state

Initial state vector

$$\hat{x}_0 = E(x_0)$$

Initial covariance matrix

$$P_0 = E[(x_0 - \hat{x}_0)(x_0 - \hat{x}_0)^T]$$

Update state estimation for time and the covariance of error

$$\hat{x}^-_k = f_{k-1}(\hat{x}^+_{k-1}, u_{k-1}, 0)$$

$$P^-_k = F_{k-1} P^+_{k-1} F^T_{k-1} + L_{k-1} Q_{k-1} L^T_{k-1}$$

Calculate kalman gain

$$K_k = P^-_k H^T_k (H_k P^-_k H^T_k + M_k R_k M^T_k)^{-1}$$

Update state estimation for measurement and the covariance of error

$$\hat{x}^+_k = \hat{x}^-_k + K_k [y_k - h_k(\hat{x}^-_k, 0)]$$

$$P^+_k = (I - K_k H_k) P^-_k$$

5. EXPERIMENTS AND RESULTS

In order to verify the validity of the algorithm, two kinds of experiments were designed to observe the attitude output performances of IMU both in static and in dynamic.

(1) Experiment in Static

The IMU is placed on a horizontal table, collect the attitude output for 150 seconds. The result is shown in Figure 2. It can be seen that pitch, roll and yaw all had drift at the initial time, but it was suppressed immediately. In addition, three angles are always in a stable convergence state for the rest of the time.

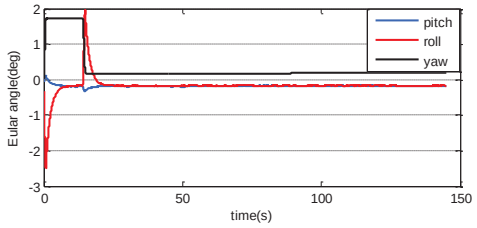

Figure 2. Static result of Eular angle

(2) Experiment in Dynamic

There are many situations of rotation for IMU in the state of motion. Two experiments based on yaw angle are designed to prove the dynamic performance of the algorithm. The experimental equipment is based on high precision turntable, and the IMU is attached to the center of it.

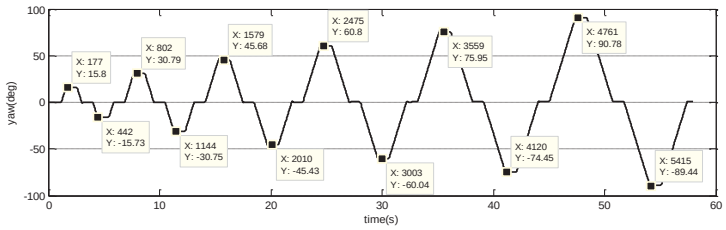

Figure 3. The result of changing angle

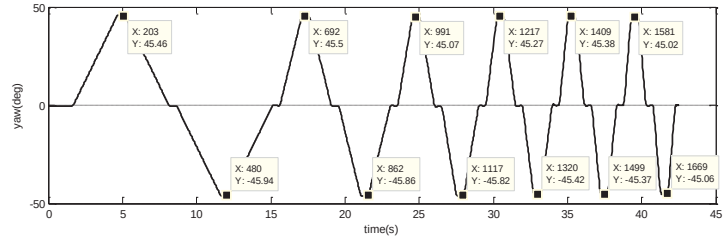

Figure 4. The result of changing speed

Firstly, the speed of rotation remains unchanged, and the rotation angle is increased by 15 degrees each time. The result is shown in Figure 3. Secondly, keep the rotation angle from changing to 45 degrees and increase the speed by 1 rad/s each time, shown in Figure 4. A conclusion can be drawn from the results that the yaw calculated by the algorithm can response the change of attitude quickly and accurately.

6. CONCLUSION

The paper introduces an attitude estimation algorithm based on extended kalman filtering quaternion. Quaternions updated by gyroscope and accelerometer is fused by EKF to calculate the attitude angle. The experiment results proves its validity that the drift of the three attitude angles can be suppressed effectively and the static error is less than 0.1 degree. In the dynamic situation, the error of yaw angle is less than 1 degree.

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Study on Polarization Effect and Depolarization of Lithium Battery

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Abstract: The polarization effect exists in the process of charging lithium battery. The temperature and the volume of gas are increased because of it. In addition, many negative impacts are brought, such as the reduction of charging rate, the attenuation of available capacity, the decrease of service life and so on. At present, the polarization effect is not taken into account in most of the charging methods, or some effective measures of depolarization are not taken. The battery is damaged in the charging process. In this paper, the cause and characteristic of polarization effect are analyzed, some kinds of depolarization methods are summarized; the flexible charging methods is put forward. Experiment shows that the depolarization effect is obvious, and it can help to improve the battery charging rate, available capacity and service life.
Keywords: Lithium battery; Polarization effect; Depolarization; Flexible charging

1. INTRODUCTION

As a secondary non-aqueous battery, lithium battery has many advantages such as high specific power, high specific energy, long cycle life, high output voltage [1], green environment and so on. It has been widely used in various fields. Improving battery capacity, service life and charging rate has become the focus of current research. At present, there are many charging methods of lithium battery, the more mature charging methods are constant voltage and constant current charging, followed by stage variable current charging, pulse charging, intelligent charging and so on[2-3]. The charging and discharging process of lithium battery is actually the process of electrochemical reaction. In theory, to achieve the fast charging effect, we can charge with high current, but the polarization effect during charging will limit the increase of charging current and affect the charging speed. In severe cases, it will increase the amount of gas evolution [4], increase the internal temperature of the battery and shorten its service life. In extreme cases, it may cause the battery to explode. The polarization effect reflects the electrochemical reaction state of the battery, which is related to the battery capacity and service life [5]. Therefore, the polarization effect of lithium battery during charging process cannot be ignored, it is necessary to take appropriate depolarization measures.

2. POLARIZATION EFFECT

In the process of charging and discharging, the phenomenon that the terminal voltage of the battery is in consistent with the actual open circuit voltage due to the existence of current is called polarization phenomenon [6]. For the lithium battery, the actual EMF of the battery is smaller than the terminal voltage of the battery when charged, but the actual EMF of the battery is larger than the terminal voltage of the battery during discharge, and there is a potential difference ΔU in the internal resistance of the battery. As a result, the terminal voltage varies by $2\Delta U$ during charging and discharging, which has a great effect on the state of the battery.

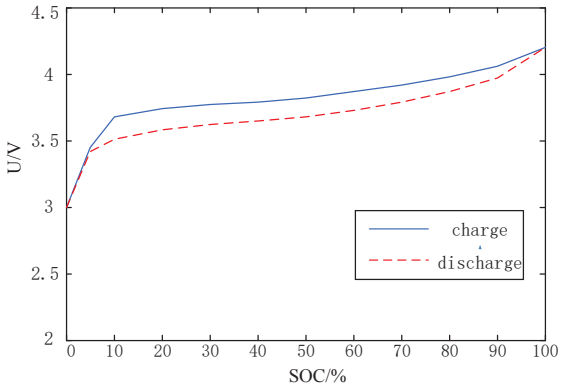

Figure1 Charge discharge curve of lithium iron phosphate battery

As shown in Fig.1, the battery capacity ranges from 10% to 90%, and the charge and discharge voltage of the battery changes smoothly, which is called the platform period. The platform stage is the main working area of lithium battery, the polarization phenomenon is weak, the charge and discharge current of high rate can be accepted, and the polarization effect is obvious at both ends of the battery capacity. After the over-discharge of lithium battery, the polarization effect is serious, so trickle charge should be carried out in the early stage of charging to restore the battery activity, after the battery voltage is greater than the threshold voltage, large current charge should be carried out. At the end of charging, the polarization effect of the battery is aggravated, the polarization resistance changes greatly, and the terminal voltage of the battery rises sharply. The overvoltage caused by the polarization effect will

limit the increase of the charging current, which will affect the battery capacity and charging speed.

3. CHARACTERISTICS OF POLARIZATION EFFECT

(1) Polarization dependence

There are many nonlinear relationships in charge and discharge process of lithium battery, which is related to many variables, and the state of the battery is discrete. Therefore, it is difficult to establish an accurate mathematical model to describe the characteristics of lithium battery.

The charge and discharge process of lithium battery is actually an electrochemical reaction process, which is affected by electrolyte concentration and electrode plate, electrochemical reaction rate, ion and electron moving rate, etc. The polarization effects can be divided into ohm polarization, electrochemical polarization and concentration difference polarization.

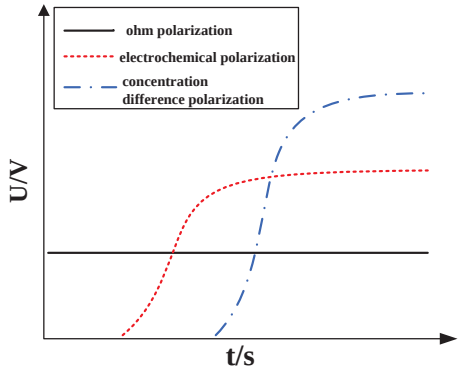

Figure2 Polarization process curve of lithium iron phosphate battery

During the charging process of lithium battery, the effects of the three polarization effects are different. As shown in Fig.2, in the early stage of charging, the polarization effect of the battery is small, mainly the ohm polarization. In the middle of charging, three kinds of polarization phenomena exist and the electrochemical polarization changes greatly. At the later stage of charging, the polarization phenomenon of the battery is serious, mainly the concentration difference polarization. During the whole charging process, the ohm polarization exists and changes little, and then increases slightly, the concentration difference polarization changes obviously in the later period, and the degree of electrochemical polarization effect is between the two kinds of polarization phenomena. The above phenomena are often ignored in the research of lithium-ion battery charging technology, which is not conducive to battery protection and prolongation of battery life.

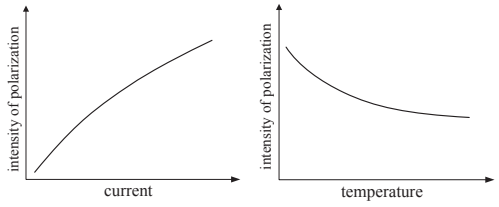

Figure3.relationship between polarization intensity and current and temperature

As shown in Fig.3, with the increase of charging current, the polarization of the cell becomes more and more serious, and the two are almost in direct proportion. In general safety considerations, the charging rate of lithium battery is between 0.5 C and 1 C. When the temperature of lithium battery is low, the activity of internal ion is low, the electrochemical reaction is passivation and the polarization effect is obvious. When the temperature rises, the activity of the battery increases and the polarization effect weakens. In addition, polarization phenomenon is also related to battery materials, health status and the number of times of use.

(2) Polarization parameters

The polarization effect causes the change of battery electrical characteristics, including the change of ohm internal resistance, polarization resistance and polarization capacitance. The ohm internal resistance can be obtained by using the initial charge voltage and the variation of current. The polarization resistance is calculated by the variation of voltage and current at the stop charging stage. Polarization effect induces the change of polarization voltage which directly reflects the state of electrochemical reaction in the battery. It is obtained by the potential difference in the static stage of the charging process and it is an important parameter to judge the capacity and health of the battery.

There are many equivalent circuit models for lithium-ion batteries. PNGV (the Partnership for a New Generation of Vehicles) model is a standard battery model proposed in the 2001 《PNGV Battery Test Manual》 [7]. It belongs to a second-order RC model. The simulation accuracy of the model is higher than that of the first-order RC model, and the computational complexity is lower than that of the high-order RC model, which can better reflect the dynamic characteristics of the lithium battery.

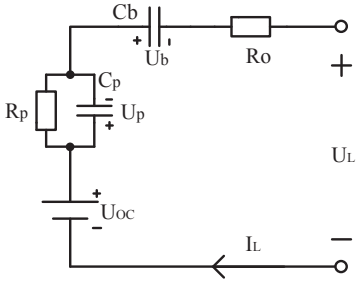

Figure 4 PNGV equivalent circuit model

Fig.4: U_{OC} is the open circuit voltage of the battery, U_L is the terminal voltage of the battery, R_o is the ohm internal resistance, reflecting the abrupt change of the terminal voltage of the battery; R_P is the polarization resistance , C_P is the polarized capacitance, which can better reflect the gradual variation of the terminal voltage of the battery ; C_b is the equivalent capacitance of the battery， it is used to describe the

open circuit voltage change caused by accumulative load current, which is influenced by charge discharge rate and temperature factor.

The state equation of PNGV model is established:

$$\begin{cases} \begin{bmatrix} \dot{U}_b \\ \dot{U}_p \end{bmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & -\dfrac{1}{C_p R_p} \end{pmatrix} \begin{bmatrix} U_b \\ U_p \end{bmatrix} + \begin{bmatrix} \dfrac{1}{C_b} \\ \dfrac{1}{C_p} \end{bmatrix} [I_L] \\ [U_L] = [-1 \quad -1] \begin{bmatrix} U_b \\ U_p \end{bmatrix} + [-R_o][I_L] + [U_{OC}] \end{cases} \tag{1}$$

The mathematical expressions of the open circuit voltage and the terminal voltage of the battery are as follows:

$$\begin{cases} U_{OC} = U_L + \dfrac{1}{C_b}(\int I_L dt) + R_P I_P + R_O I_L \\ \dfrac{dI_P}{dt} = \dfrac{I_L - I_P}{\tau} \\ \tau = C_P R_P \\ C_b = \dfrac{AC \times U_{OC}}{\dfrac{1}{2}(U^2{}_{100\%SOC} - U^2{}_{0\%SOC})} \end{cases} \tag{2}$$

In equation（2）: τ is the polarization time constant, AC is the rated capacity of the battery.

The PNGV model is suitable for the parameter identification of the battery model, which is helpful to study the charging state and characteristics of the lithium battery.

(3) Effects of polarization

Polarization effect will affect the charging effect of lithium battery. Polarization slows down the electrochemical reaction rate and reduces the charging efficiency. The polarization of the battery also increases the amount of gas evolution, consumes electricity, emits a large amount of heat to raise the internal temperature of the battery, with negative consequences, such as shortened battery life, surface expansion, deformation or leakage. In extreme cases, batteries may burn or explode.

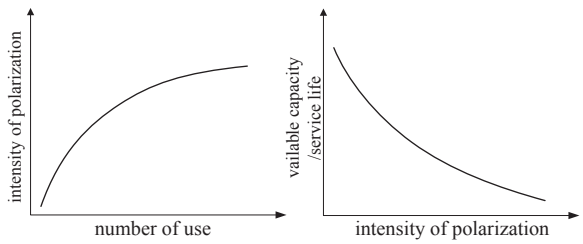

Figure 5. Relationship between polarization intensity, number of use and available capacity of Lithium Battery

As shown in Fig.5, as the number of lithium batteries increases, polarization increases and battery life decreases. During charging, the polarization effect reduces the rechargeable capacity of the battery. During discharge, the polarization effect reduces the actual discharge capacity of the battery. When the polarization effect is serious, the metal lithium will be precipitated near the negative electrode, which will destroy the internal chemical structure, produce irreversible changes, accelerate the aging and capacity attenuation of the battery, and cause a great loss to the battery.

In theory, the charge rate can be increased by high current charge, but the polarization effect will weaken the chemical reaction and limit the charge capacity, which can not achieve the effect of fast charging. Therefore, depolarization measures should be taken into account in the charging process of lithium batteries. The reasonable charging methods should be adopted in order to speed up the charging rate, increase the available capacity and service life of the batteries.

4. DEPOLARIZING MEASURE

Ohm polarization is a process in which ions are blocked by electrolyte solutions and plates during charge and discharge. This phenomenon can be produced as long as the current flows through, and can not be completely eliminated. Voltage drop compensation charge usually reduces ohm polarization by improving battery material and production process. Therefore, the main consideration in the charging process is to eliminate the electrochemical polarization and concentration difference polarization.

Electrochemical polarization is a phenomenon that electrode potential deviates from equilibrium potential because electrochemical reaction rate is less than electron transfer rate, which is mainly related to electrode activity. Concentration difference polarization is that the transfer rate of lithium ion is smaller than the electrochemical reaction rate, which results in the aggregation of reactants in the attachment of the pole column and limits the charging rate.

The negative effect of polarization effect on Lithium Battery increases with the increase of charging current. In order to improve the situation of charging with small current most of the time, and to achieve the goal of shortening charging time by high current charging, depolarization and polarization mitigation methods should be designed. The current method of depolarization is:

(1)Static charging: As shown in Fig.6, pulse charging technology is used to charge intermittently. When the charge is stopped, the chemical reaction stops, the ion concentration decreases, the polarization effect is weakened, and then the charge is continued. This approach is called natural elimination of depolarization. Although the charging time may be prolonged, the literature [8] the pulse charging time is less than the traditional charging time, and the pulse charging can improve the charging rate.

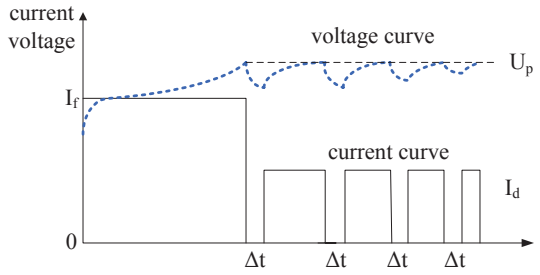

Figure 6 Pulse intermittent charging method

(2)Forced depolarization discharge: As shown in Fig.7, the polarization effect of lithium battery is obvious when it is charged positively with high current. At the later stage of charging, adding an instantaneous negative pulse to the battery and discharging to a certain extent can accelerate the elimination of polarization effect, also known as forced depolarization. Literature [9] It is pointed out that this method can improve the acceptance rate of charging current and shorten the charging time.

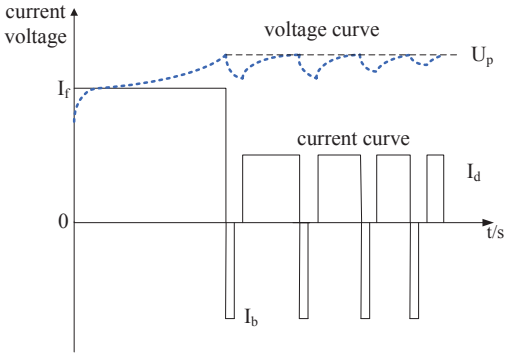

Figure 7 Negative pulse charging method

(3)Segmented constant current charging: As shown in Fig. 8, in the process of charging, the charge current is reduced step by step according to the capacity of the battery, which makes the charge current approach to the optimal charging curve proposed by Mas [10]. It reduces the influence on the battery damage and polarization effect, and speeds up the charging speed.

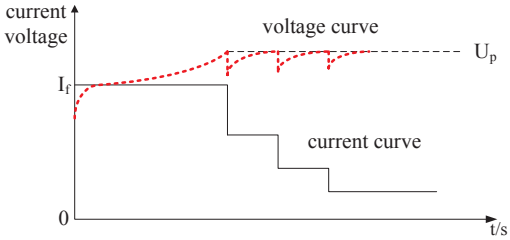

Figure 8 Segmented constant current charging method

(4) Flexible charging: Based on the analysis of the above methods, this paper combines the pulse intermittent charging method with the segmented constant current charging method to achieve the purpose of rapid charging of lithium batteries. At the same time, the internal polarization of the battery is weakened by adding a short time stop in the process of pulse charging, and the experimental results are verified by simulation.

The control method of pulse charging is relatively perfect and it is a common method in depolarization. The control of negative pulse charging is relatively complex and the cost of realization is high. The two depolarization methods are used in the later stage of charging, and the polarization degree of the battery is not measured in real time. But the period of polarization effect is different. Segmented constant current charging has certain depolarization effect, but it does not control the time of depolarization, and needs to measure the capacity of the battery. Flexible charging can reduce the effect of polarization by pulse intermittent and piecewise constant current method, and then improve the charging rate, available capacity and service life of the battery.

5. SIMULATION STUDY

(1) Model building

Use MATLAB/Simulink environment to build simulation model as shown in Fig9. It is shown that the battery model is based on the PNGV equivalent circuit model mentioned in section 2.2 of this paper. The battery is tested by controlling the controlled current source by switching on the charging current with a multi-channel selector. The control program written by S-function is used to control the charging process of the whole model.

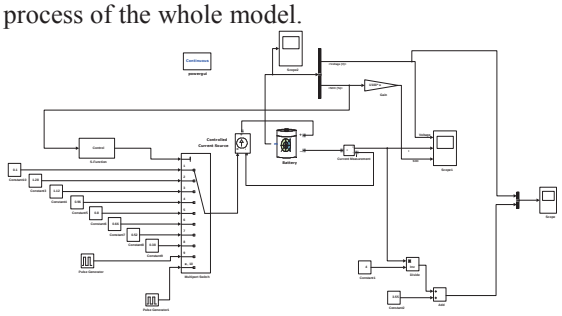

Figure 9 Simulink model

(2) Waveform analysis

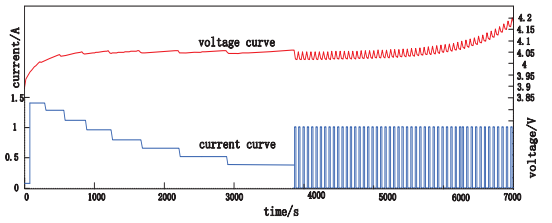

Figure 10.variation curve of voltage and current during flexible charging

Fig.10 shows the curve of voltage and current variation during flexible charging, before the constant current charge is pretreated with 0.1C small current, and then the constant current charge is carried out at a time of about 3500s. The battery voltage is slowly rising in this stage and the battery power reaches about 80%, and then it enters the pulse charging stage. From the diagram, we can see that the end voltage of charging can reach 4.2 v.

6. CONCLUDING REMARKS

There is polarization effect in the charging process of lithium battery, which will affect the charging effect, available capacity and service life of the battery. Therefore, it is necessary to take effective depolarization measures. Polarization phenomenon cannot be completely eliminated, but reasonable charging method can mitigate the effect of polarization effect. Pulse charging, negative pulse charging, segmented constant current charging and flexible charging are all effective depolarization methods. Flexible charging combined with the advantages and disadvantages of the above methods can weaken the polarization effect of lithium battery under the premise of safe charging. It is an effective depolarization charging method.

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Granary Temperature Prediction Based on BP Neural Network Based on Grey Relational Analysis

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Abstract: Aiming at the problems of large nonlinearity, complicated input variables, and low precision in traditional grain temperature prediction methods, an optimization algorithm based on BP neural network algorithm and grey correlation analysis method is proposed. Firstly, the grey relational analysis method is used to simplify the model input variables, and then the grey GM (1, N) model is combined with the improved neural network to improve the accuracy. The results show that the new model can fully and extensively process a large number of input variables through the calculation of the grey relational degree, without subjective selection, thereby enhancing the adaptability of the BP network and obtaining better prediction accuracy and stability.

Keywords: BP neural network; grey relational analysis; grey GM(1, N) algorithm; granary temperature prediction

1. INTRODUCTION

Food is a special strategic commodity. China is a large food country [1]. Grain quality directly affects national health and national security. Real-time and accurate monitoring of changes in food conditions can provide important data support for our government to handle international and domestic issues and formulate policies. Grain storage security is an important part of food security. During grain storage, changes in its temperature directly affect the quantity, quality, and safety of stored grains.

Traditional granary temperature prediction methods have many drawbacks. First, the forecasting algorithm is single and the BP neural network algorithm is commonly used. The disadvantages are obvious. Second, there are many factors affecting the temperature of the granary, and the input variables to simplify the prediction model according to the degree of influence are not considered, resulting in a complex model input. Aiming at the above problems, this paper proposes a granary temperature prediction method based on the neural network of gray correlation analysis. A grey correlation analysis was performed on various factors affecting the temperature in the granary, and the six most relevant to the temperature in the granary were identified as the input variable of the multi-dimensional gray model GM(1, N). The temperature prediction value and residual were calculated, and the BP was used again. The neural network corrects the residuals to make the prediction more accurate. In order to verify the accuracy of the prediction method, the experimental results were compared with the prediction results of a single GM (1, N) model and a single neural network model.

2. PREDICTION MODEL INPUT VARIABLE SELECTION

(1) Overview of Grey System Modeling Methods

The object of the study and research of the grey system theory is the system with incomplete information. Through the known information, we can study and predict the unknown field so as to understand the purpose of the entire system. Having the good characteristics of being able to use "less data" modeling to find realistic laws can effectively overcome the contradiction of insufficient data or short system cycles. Gray forecasting is an important aspect of the application of grey systems. The commonly used grey forecasting models are GM (1, 1), GM (2, 1) and GM (1, N). In this paper, the GM (1, N) model was calculated as a comparative test model.

(2) Grey Relational Analysis Principle

Correlation is a measure of the relevance of two sequences. Grey system theory is a method of correlation analysis. It is the basis of gray system analysis, prediction, and decision-making. It can reveal the characteristics and degree of dynamic correlation of things. It has a small sample size and does not require Typical distribution rules, less calculations, etc., and there will be no inconsistency between quantitative results and qualitative analysis. The basic principles and calculation steps are as follows:

There are m time series groups $\{ X_1^{(0)}(t) \},\{ X_2^{(0)}(t) \},\cdots,\{ X_m^{(0)}(t) \},(t = 1,2,\mathrm{L}\ ,N)$. Set another time series $\{ X_0^{(0)}(t) \}(t = 1,2,\mathrm{L}\ ,N)$. The grey correlation analysis of the front and rear generally includes the following calculations and steps.

a. Raw data standardization transformation.

b. Calculate the correlation coefficient. The correlation coefficient of input sequence $\{X_0(k)\}$ and output sequence $\{Xi(k)\}$ at time $t=k$ can be calculated by the following formula:

$$L_{0i}(k)=\frac{\Delta_{\min}+\Delta_{\max}}{\Delta_{0i}(k)+\rho\Delta_{\max}} \quad (1)$$

Where $\Delta_{0i}(k)=\left|x_0(k)-x_i(k)\right|$, $(1\le i\le m)$ and $\Delta_{\min}$ represent the maximum and minimum values, respectively, of the absolute difference at each moment in all comparison sequences. ρ is the resolution coefficient;

c. Relation degree

$$r_{0i}=\frac{1}{N}\sum_{k=1}^{N}L_{0i}(k) \quad (2)$$

r_{0i} is the degree of correlation between the input sequence and the output sequence, N is the length of the comparison sequence; in general, the degree of association also satisfies the three axioms of the equivalent "relationship", namely: (1) reflexivity: $r_{00}=1$; (2) symmetry : $r_{0i}=r_{i0}$; (3) transitivity: $r_{0a}>r_{0b}, r_{0b}>r_{0c},$, then $r_{0a}>r_{0c}$;

d. Seeking relevance $r(x_0, x_i)$

$$r(x_0, x_i)=\frac{1}{N}\sum_{k=1}^{N}r_{0,i}(k) \quad (3)$$

(3) Prediction Model Input Variable Selection

The factors affecting the temperature of the granary usually include outside temperature (x_1), outside humidity (x_2), humidity inside the bin (x_3), concentration of oxygen inside the bin (x_4), concentration of carbon dioxide in the bin (x_5), intensity of light radiation (x_6), size of wind outside the bin (x_7), granary ventilation (x_8), grain volume (x_9), granary floor material (x_{10}), warehouse type characteristics (x_{11}), altitude (x_{12}), grain purchase conditions (x_{13}), seasonal changes (x_{14}) .

The correlation of the sample data is calculated, and the correlation degree between each influencing factor and the temperature in the bin can be obtained:

$r(x_0, x_1)$ =0.5002, $r(x_0, x_2)$ =0.4441, $r(x_0, x_3)$ =0.5977, $r(x_0, x_4)$ =0.1995, $r(x_0, x_5)$ =0.4815, $r(x_0, x_6)$ =0.2400, $r(x_0, x_7)$ =0.4371, $r(x_0, x_8)$ =0.5180; $r(x_0, x_9)$ =0.2760, $r(x_0, x_{10})$ =0.0290, $r(x_0, x_{11})$ =0.1742, $r(x_0, x_{12})$ =0.1742, $r(x_0, x_{13})$ =0.0611, $r(x_0, x_{14})$ =0.0200.

3. COMBINATION FORECASTING MODEL ESTABLISHMENT

(1) GM(1,N) Model

The GM(1,N) model is a multivariate (multivariable) first-order linear dynamic model. It is mainly used for dynamic analysis of systems and can analyze multivariate complex systems. The steps and principles for building a GM(1,N) model are as follows:

For a raw data matrix $X_N^{(0)}$ with a sequence of N columns and a length of M columns.

Step 1: Calculate the cumulatively generated data matrix $X_N^{(1)}$ at a time. Calculate the first time a series of worse data $\{\alpha^{(1)}(x_1^{(1)}, i)\}$;

Step 2: Construct the Matrix $X(A,B)=B$;

Step 3: Using the least square method to solve the gray parameters $a=(B^T, B)^{-1}B^T Y_M$;

Step 4: Substituting gray parameters into time functions:

$$\hat{x}^{(1)}(t+1)=\left[x_1^{(0)}(1)-\sum_{i=2}^{N}\frac{b_{i-1}}{a}x_i^{(1)}(t+1)\right]e^{-at}+\sum_{i=2}^{N}\frac{b_{i-1}}{a}x_i^{(1)}(t+1) \quad (4)$$

Step 5: Substituting the gray parameters into the time function, calculate the calculated value $\hat{x}^{(1)}(t+1)$ of the data sequence, and then obtain the $\hat{x}^{(0)}(t)$ by deriving the derivative of $\hat{x}^{(1)}$, and calculate the difference $\varepsilon^{(0)}(t)$ and the relative error $e(t)$ between $x^{(0)}(t)$ and $\hat{x}^{(0)}(t)$.

Step 6: At the same time when the model is established, the parameters of the GM(1,N) model are Laplaced, and the transfer function $w_i(s)$ of the dynamic link of the i-th influence factor to its active object under zero initial conditions is given.

(2) BP neural network

The BP neural network can realize arbitrary nonlinear mapping of input and output. It has a high degree of nonlinearity and strong adaptive learning ability. Therefore, it is widely used in function approximation, pattern recognition, and data compression. The guiding principle of BP network learning rules is that the correction of network weights and thresholds should be along the direction in which the performance function declines fastest—the negative gradient direction. The mathematical expression is as follows:

$$x_{k+1}=x_k-a_k g_k \quad (5)$$

The basic principles and calculation process of the three-layer BP neural network model used in this paper are as follows:

For the two discrete time series of N sample sets $\{(x_k, y_k)\,|\,x\in R^m, y\in R^n\}$, $(k=1,2,\mathrm{L}\ ,N)$, the total sample is divided into training sample φ_1 and

test sample φ_2 .

First, the training samples are trained to establish the mapping relationship, and then the test sample is used to test whether the network can give the correct input-output relationship. Using a three-layer BP neural network with input node m, output node n, and hidden node number p, the activation function from the input layer to the hidden layer adopts the Sigmoid type, and the activation function from the hidden layer to the output layer adopts a linear function. The relationship between the input and output of the available network is as follows:

$$y_k(t) = \sum_{j=1}^{P} v_{jk} \cdot f\left[\sum_{i=1}^{m} w_{ij} \cdot x_i(t) + \theta_j\right] + r_k \qquad (6)$$

Among them, $f(x) = \frac{1}{1+e^{-x}}, k = 1,2,\mathrm{L}\ , N_1$, x_1 is the input of the network, $y_k(t)$ is the expected output of the network, y_t is the actual output, w_{ij} is the network weight between the input node and the hidden layer node, v_{ij} is the network weight value between the hidden layer node and the output node, θ_j is the threshold of the hidden layer node and r_k is the threshold at the output node. Set the total network error is less than ε_1 , then the output node error is: J

$$E_1 = \frac{1}{2}\sum_{k=1}^{N_1}\sum_{t=1}^{n}\left[y_k(t) - y_k(t)\right]^2 \le \varepsilon_1 \qquad (7)$$

If the mean square error of the test sample is less than ε_2 , then there are:

$$E_2 = \frac{1}{N - N_1}\sum_{k=N_1}^{N}\sum_{t=1}^{n}\left[y_k(t) - y_k(t)\right]^2 \le \varepsilon_2 \qquad (8)$$

(3) Model Combination

The two predictive models are combined as follows:

a. The six influencing factors selected from the grey correlation analysis are used as the input variables of GM(1, N). After the calculation, the predicted temperature t is obtained. The residual e1 is the difference between the predicted value and the real value;

b. Using BP neural network to correct the residual value, the result is recorded as e;

c. Add the prediction results of the two models to get the final temperature prediction value T=t+e.

The algorithm combination process is shown in Figure 1:

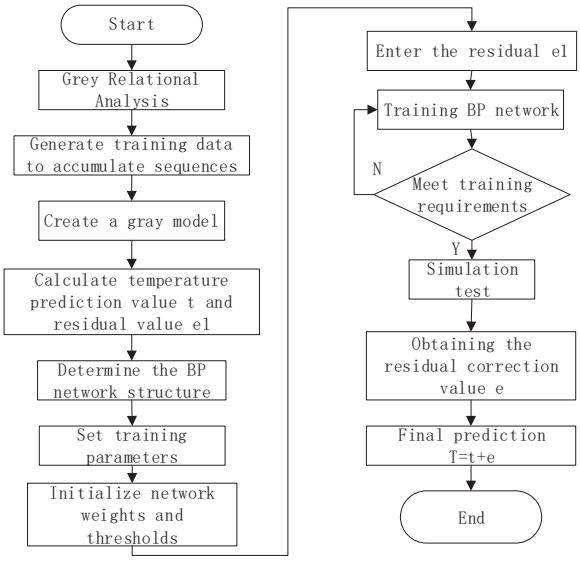

Figure 1 algorithm combination flow chart

4. EXPERIMENTS AND RESULTS ANALYSIS

To evaluate the performance of the combined prediction model, the experimental results were compared with a single GM (1, N), single BP neural network algorithm. In order to make the comparison more scientific, the model was evaluated using four kinds of error evaluation indicators: Mean Square Error (MSE), Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE).

When training the grey GM (1, N) model, the maximum number of network training sessions is 400 and the minimum mean square error is 0.01. When training the BP network, the number of hidden neurons in the network is determined to be 10 after repeated experiments. After the weights and thresholds are initialized, BP network training is performed. Select the spring environmental data of a granary as experimental data, and select 50 groups from 500 experimental data for testing. The remaining data are used as training samples.

The experimental prediction results of the combined model, single gray GM (1, N) model and single BP neural network model are shown in Figures 2, 3, and The error evaluation results of the three models are shown in Table 1.

Table 1 Comparison of results of three model error evaluation indicators

Model	MSE	RMSE	MAE	MAPE
Single GM(1,N)	0.9026	0.9501	0.7980	0.0425
Single BP Neural Networks	0.6456	0.8035	0.6720	0.0340
Combination model	0.4210	0.6488	0.5540	0.0283

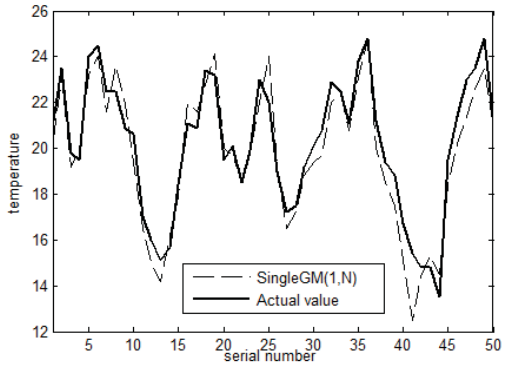

Figure 2 Single GM (1, N) Forecast Results

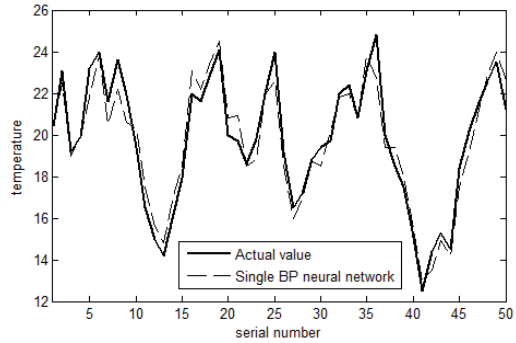

Figure 3 Single BP neural network prediction result

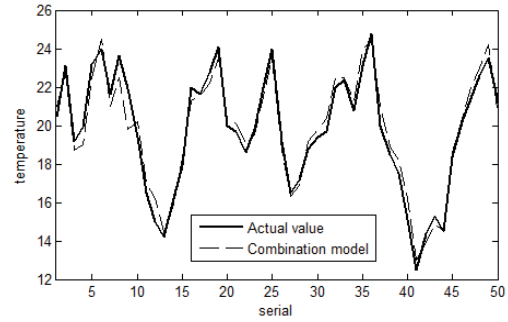

Figure 4 Forecast results of combination model

Combining with the experimental prediction result graph and the error evaluation results, the prediction performance of the combined forecasting model is stronger than that of a single gray GM (1, N) model and a single BP neural network model, and the stability is higher and the prediction error is the least. The experimental results show that the granary temperature prediction model based on BP neural network based on grey relational analysis is a high accuracy, scientific and reliable granary temperature prediction model.

5. CONCLUSION

Granary temperature as an important detection index in the grain condition monitoring system, its change will directly affect the environmental conditions inside the warehouse and the quality of stored grain, so it is very important to accurately predict the temperature of the grain warehouse in the grain warehouse. Because the temperature in the granary is influenced by many factors and the nonlinearity is high, the six influencing factors are selected as the input variables of the prediction model by the gray correlation analysis method, which greatly reduces the nonlinearity of the model. At the same time, the traditional linear model or single predictive model cannot fully and accurately describe the change rule of the granary temperature, leading to unsatisfactory prediction accuracy. It is achieved through the combination of multi-dimensional grey prediction model with strong trend prediction capability and BP neural network with strong nonlinear prediction ability. The effect of complementary advantages. The experimental results show that, compared with the single prediction method, the granule temperature prediction method based on the BP neural network of gray correlation analysis improves the accuracy of the granary temperature prediction, and has certain research value in the field of grain condition monitoring.

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Application of Petroglyph Element in Course of Visual Communication Design

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Abstract: Since character was not invented in the period of primitive society, the wise ancient human beings conveyed information and expressed inner feelings through pictures. Thus, petroglyph appeared. Although the concise lines in the petroglyph are single, various images are very vivid, embody the awe and love of ancient human beings for nature and also reflect mysterious wisdom of ancient human beings. The era develops and changes continuously. Nowadays, the resources are rich and appear in a diversified way. The resources of visual communication design also increase a lot. The popularization of electronic products and high technologies makes presentation and exhibition of petroglyph elements have more flexible forms. In particular, the application of petroglyph element in modern visual communication design can show its ancient and mysterious peculiarity and embody the design value with more connotations.

Key words: Petroglyph element; visual communication design; course

1. INTRODUCTION

The 5000-year brilliant historical civilization of China has bred extensive, profound and long-standing Chinese culture. Mysterious and ancient petroglyph is an important branch of Chinese splendid culture. Petroglyph is the representative work of ancient human beings and also important literature for us to understand ancestors. The contents of petroglyph express each aspect of ancient human life. Petroglyph element is an important part of ancient culture. Based on existing understanding, petroglyph element exerts the unique functional value in modern design activities if it is improved and extracted [1]. The deep understanding and research of the relation between petroglyph element and visual communication design, exploitation of extensive application of petroglyph element in visual communication design and enriching diversity of visual communication design course can make visual communication design own more ancient and mysterious charm, improve communication of ancient culture and enhance cohesive force of national culture. Thus, researching and discussing application of petroglyph element in visual communication design course has important significance.

2. CHARACTERISTICS OF PETROGLYPH ELEMENT

Rock is a very common thing, but it is an essential object in the eyes of ancient people. Rock was deemed as the instrument of labor or article of daily use in ancient times [2]. Just because of the close relation between rick and ancient people, petroglyph appeared. In the normal sense, petroglyph includes line carving, embossment and color painting on inner wall of grotto, dilapidated wall and independent rock. Ancient people recorded and described the life, imagination and wish through petroglyph in ancient times. Therefore, petroglyph was involved in most ancient human activities.

The most outstanding feature of ancient petroglyph is simple and pure, but this feature further reflects the emotional sustenance and fine visions of ancient people. Petroglyph adopts 2D modeling method and pursues front view of object. Petroglyph elements are rich and diversified. Animals and people are the main objects [3]. For petroglyph pattern, ancient people did not depict the details in the modeling process. They basically depicted the rough shapes of objects, and the petroglyph elements are very simple. But it is these rough petroglyph elements that describe the real life in ancient period.

Petroglyph element can be applied in the course of modern visual communication design, because of the following four characteristics: visuality, attention, analyticity and memory [4].

(1) Visuality

Visuality means petroglyph element is a kind of visual information which can be understood and read. Because the essence of visual communication design is to convey visual information, such characteristic of petroglyph element can easily make people make quick understanding and judgment of the visual information in their mind, unlike elusive ancient characters. Visuality embodies perceptual intuition and conciseness, and can reach the better visual effect [5].

(2) Attention

Attention means petroglyph element has very strong visual charm. Simply speaking, the appearance of visual element owns the ability to attract the eyes of receivers fast. The modern society contains immeasurable amount of information. Visual communication design aims to solve how to attract visual information receivers in the huge information stream. Petroglyph element has the unique and mysterious patterns, abstract and simple style, and

intriguing meanings. Because of the unique attention feature, the effect of attracting people can be reached, and thus the purpose of visual information communication can be reached [6].

(3) Analyticity

The information contained and conveyed in petroglyph element has important connotation and significance. The petroglyph really describes the life of ancient people. More importantly, it embodies the breeding process of human civilization. The information conveyed in petroglyph element is not just the simple pattern that children can understand, but also the ancient art creation deserves deep research by scholars. So, it is very important to deem petroglyph element as the important content of visual communication design, discuss and study the application of visual communication design, and innovate [7].

(4) Memory

Memory means visual information receivers can actively establish long and effective memory for the content conveyed by petroglyph element, so memory is a key scale to measure communication effect. In the era of information, information communication becomes increasingly extensive, and the problems also become more and more complex. Thus, for information receivers, how to choose such complex information becomes a big problem. For information communicators, how to let the information enter the receiver's memory library also becomes a big problem. The ultimate aim of visual information conveying is to let the conveyed information can leave a deep impression in the memory library of most receivers and let them remember the conveyed information. The visual feature of petroglyph element enhances people's memory of visual communication information and makes information enter the memory library in the mind.

3. COURSE OF VISUAL COMMUNICATION DESIGN

Visual communication design mainly refers to visual graphic design, and expresses epical connotations through rich visual symbols. Then, they are conveyed to people's eyes through various communication media. Generally speaking, all manually-designed things that people see are related to visual communication design more or less. Therefore, the course of visual communication design involves a wide range, including logo design, package design, font design, image design, book design, advertisement design and costume design, etc. With social development, visual communication design is applied more and more widely. People's aesthetic needs become richer. Their aesthetic quantity improves and aesthetic elements become diversified. The course of visual communication design cannot totally meet market demand. In recent years, media industry has advanced rapidly with economic development. Media industry and visual communication design have an indispensable relation. Visual communication design is faced with a new opportunity. So, it is required to improve the course and cultivate the real professional, applied and comprehensive visual communication design talents in order to really make visual communication design adapt to the demand of social market.

In the course of visual communication design, it is necessary to scientifically and reasonably apply petroglyph element in the teaching system, take archaeology background of petroglyph element as the course foundation, highlight art and culture features of visual communication design and make modern visual communication design better meet the demand of market and visual design and be closer to the market. The addition of petroglyph element design philosophy in the teaching content of visual communication design can get rid of limitation of formalism to creative thinking education of modern visual communication design course.

4. APPLICATION OF PETROGLYPH ELEMENT IN THE COURSE OF VISUAL COMMUNICATION DESIGN

To study and discuss the application of petroglyph element in the course of visual communication design, it is required to take petroglyph element as the center, link and integrate theoretical knowledge, market survey, theme design, draft design, work making and course exhibition, pay attention to students' experience in the design process and encourage interaction and discussion in the course.

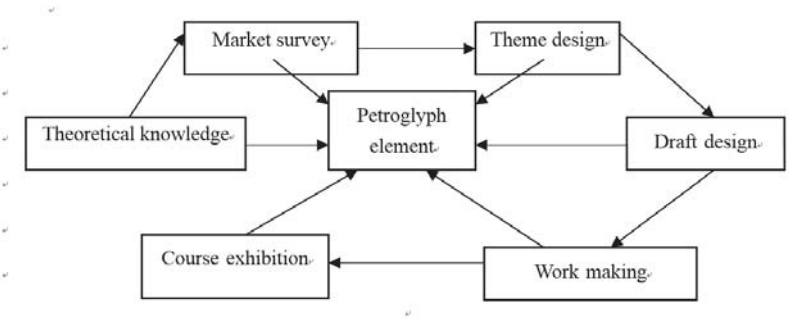

Fig.1: Application of petroglyph element in the course of visual communication design

To apply petroglyph element in the course of visual communication design and deeply reflect the

profound connotation conveyed by petroglyph element, it is required to pay attention to teaching and reasonable teaching method.

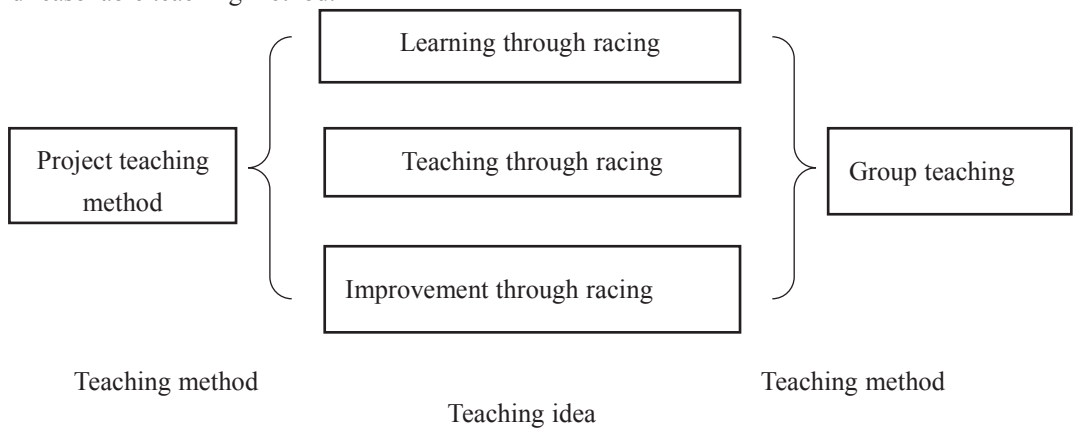

Fig.2: Teaching principles and method of visual communication design

(1) To deem learning through racing, teaching through racing and improvement through racing as the teaching idea

The teacher provides the competition theme. Then, students can choose the topics they are interested in, and integrate petroglyph element in the selected theme to complete the work through their specialty accomplishment and teacher's guidance. Finally, they may compete with the works. Since the competition is an open platform, it can provide diversified communications, improve students' specialty accomplishment and psychological quality and enhance teacher's teaching level. Based on the competition, the initiative is given back to students, which can greatly motivate students' learning enthusiasm and creation passion.

(2) To combine project teaching method with group teaching method

Visual communication design project aims to cultivate students' professional ability. The project may be the teaching content organized by the teacher, scientific research project or real enterprise project. Students choose projects by themselves, and gradually complete conception, first draft design and final work. In this process, it is necessary to stress students' ability of independent exploration and imagination, and change passive knowledge infusion to independent study so as to overall improve students' professional ability. Meanwhile, such project teaching method can well offer employment direction and occupational planning for students.

The teaching process is not just students' knowledge learning process, and also the process of cultivating students' good occupational quality. Before classroom teaching, students are grouped, and then design themes are allocated in groups. The members in each group participate in the whole process of understanding, research, discussion, design and making until the works are completed. In the end, each group gives speeches and shows their works respectively. In the meantime, they deeply understand idea and adopt scientific the works of other groups, and conduct inter-group exchange and evaluation to enhance students' initiative and participation and reach the purpose of improving teaching quality.

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Research on Image Extraction and Registration for the Robot Based on SIFT

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Abstract: For machine vision as one of the important parts of intelligent robot autonomous navigation, this paper puts forward to choose a kind of target rotation, shape change, scale, and has good noise invariance matching algorithm of SIFT algorithm. With the existing laboratory environment as the background, the "key" with the help of a device to extract the image keypoint, and aim at these "key" reference pixels around calculating the son "description". Choosing FLANN(Fast Library for Approximate Nearest Neighbour) matching algorithm to match descriptors, calculating the moving relationships between image frames, and then determine the trajectory of the robot.

Keywords: SIFT algorithm; pixels; keypoint; descriptors; trajectory

1. INTRODUCTION

For autonomous navigation of the mobile robot in an unknown environment, based on vision sensors to collect the information of the surrounding environments and to a series of "thinking" itself[1], building environment maps and realizes independent location at the same time, and the purpose of autonomous path planning. The process of solving a problem like this is known as simultaneous localization and mapping (SLAM) [2]. In the process, robots will be controlled by the RGB-D SLAM algorithm according to the given task that we need to be clarified in advance before the location information of environments, whether is the location of the destination in this environment, avoiding the possible to meet obstacles to achieve the optimization planning path.

In 2012,Liu Li ,Wan Yaping used SIFT in motion method to obtain 3D information and carry out object localization can meet the demand of robot localization manipulation precision[3]. In 2014, Yuan Liang proposed a method combined with SIFT and Harris corner detector that can be used in the real-time and computation time is decreased[4]. In 2017, Zhu Qiguang improved SIFT based on subtractive clustering and the binarized feature descriptor to decrease matching time. In this article, proposing a SIFT algorithm in RGB-D SLAM to match descriptors, calculating the moving relationships between image frames, and then determine the trajectory of the robot[5]. In the process, the mobile robot needs through the "eyes" to capture the image information of keypoint extraction and matching, to discern the direction of, to avoid repetition tracing. In addition, this algorithm can effectively estimate the movement condition of the mobile robot.

2. KEYPOINT EXTRACTION AND MATCHING OF SIFT ALGORITHM

In the 1999 David G.Lowe based on the characteristics of existing detection method, combining with the idea of keypoint extraction has the invariance of popular SIFT algorithm is proposed[6], and in 2004 the algorithm in the actual operation has improvement and enhancement[7].

Mainly in image feature points in the process of generating have two steps. One is, in different scale spaces can be found keypoint (feature points). Another is, can be calculated the directions of the key points. The key points found by SIFT algorithm are some very prominent points that will not change due to light, affine transformations, and noise, such as corner points, edge points, bright points in dark areas, and dark points in bright areas. In scale space characteristics of SIFT algorithm decomposed by Lowe is four main steps as figure1 shown[7]:

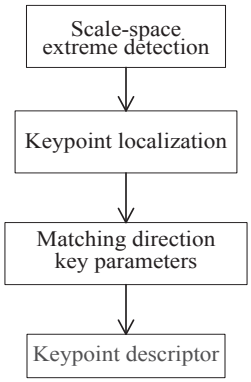


Fig. 1 SIFT algorithm test steps

(1) SIFT KEYPOINT EXTRACTION

SIFT(scale invariant features transform)is one of the classic algorithms of keypoint extraction. It uses pyramid hierarchical filtering method to detect feature

points, further clear the position of the extraction point extraction, small error. The method to detect feature points is the first step to a different perspective to repeat the size and location of the identification of detected object. Detecting the location of the image rotation invariant can be realized through the search characteristics of stable and through a space the size of the continuous implementation. Scholars at home and abroad through unremitting study: Gaussian function can be on different reasonable assumption functions meet the detect the ocation of the image rotation invariant features. Are obtained, the scale of the image space is defined as the equation of ***L (x, y, the delta)***, the functional by gauss equation has a scale can transform ***G (x, y, the delta)*** and ***I (x, y)*** of the input image function convolution, the convolution process could be carried out by the following equation[8]:

$$L(x,y,\delta)=G(x,y,\delta)*(x,y) \quad (1)$$

Said that * is a convolution operation, symbols and

$$G(x,y,\delta)=\frac{1}{2\pi\delta^2}e^{-(x^2+y^2)/2\delta^2} \quad (2)$$

(2) SIFT KEYPOINT MATCHING

Image registration is mainly divided into two methods: one is based on the characteristics of the method (feature -based), the other is a direct method (direct method). The SIFT algorithm is according to the image in the one-to-one correspondence of feature points matching the characteristics of the relationship. Supposed there are two frames respected by ***F1*** and ***F2***, corresponding feature points in turn:

$$P=\{p1,p2,p3,...,pN\}\ni F1 \quad (3)$$

$$Q=\{q1,q2,q3,...,qN\}\ni F2 \quad (4)$$

The ***p*** and ***q*** are the elements in R^3 , Can be calculated on the basis of a rotation matrix ***R*** and displacement vector meet $\forall i, pi=Rqi+t$ .However, due to the existence of errors in practice, the equal sign is basically impossible. So we solve ***R*** and ***t*** by minimizing an error:

$$\min_{R,t}=\sum_{i=1}^{N}\left\|p_i-(Rq_i+t)\right\|_2 \quad (5)$$

The SIFT algorithm has very strong ability to match, and their main features are:

a. The SIFT algorithm based on local feature extraction, and has the invariance of rotation, and scaling, not invariant characteristic scales, the visual angle in the image at the same time, illumination changes, an object move has a good stability, noise, etc.

b. The optimization of the sift algorithm not only has a matching recommend suite can also meet the needs of real-time performance.

c. The SIFT algorithm can extract a large number of image feature points, and it in great measure.

d. The SIFT algorithm can be combined with other algorithm diverse show.

e. The SIFT algorithm to extract the feature points accurately, match quickly and abundant information and the uniqueness of the good.

3. IMAGE PREPROCESSING

Kinect1.0 is a small, flat black box, the bottom is a can be fixed on the surface of the table and TV rack activity of small platform. It consists of a color camera, an infrared camera, an infrared projector of three kinds of equipment, mutual help mobile robot to achieve machine vision task to view 3D environment.

(1) CAMERA CALIBRATION ALGORITHM

Objects in the 3D world with the camera to there is a mapping relationship between image and camera parameters are the main factors affecting the mapping relationship. Through the camera calibration parameters are the keys to restrict images and real scene is the key to restricting the odometer accurate.

Captured by the camera images with objects in the 3D world there is a mapping relationship between, and the main factors affecting the mapping relationship is the camera parameters. Parameters are obtained through the camera calibration key to link images and real scenes, and the keys to restricting the odometer accurate. Currently popular calibration algorithm is mainly Tsai[9], Zhang Zhengyou's algorithm[10]and self-calibration algorithm. As a result of Zhang Zhengyou's board calibration method to implement are more precise, simpler, with Zhang Zhengyou's method as an example is introduced in this paper.

Zhang Zhengyou's algorithm in accordance with the same point in the plane of the principle can be connected through internal matrix, can think from the perspective of different positions and take pictures of the same plane to calculate the camera inside, and then calculate out the cords. 3D space ***M(x, y, z)*** and the corresponding two-dimensional plane camera point ***m(u,v, 1)*** relationship between the following:

$$Sm=A\begin{bmatrix}R & t\end{bmatrix}M \quad (6)$$

$$A=\begin{bmatrix}f_x & \gamma & C_x\\ 0 & f_y & C_y\\ 0 & 0 & 1\end{bmatrix} \quad (7)$$

Among them**:**

S —— The zoom factor;

A —— The camera's internal matrix;

R —— The camera follow transfer matrix;

t——The translation vector of the camera;

f_x, f_y —— Focus in ***x, y*** direction;

γ —— The deviation of pixels in ***x*** and ***y*** directions;

C_x, C_y ——Optical center coordinates in the image.

If will simplify the above formula, can get the following results:

$$Sm=HM \quad (8)$$

$$H=A\begin{bmatrix}r_1 & r_2 & t\end{bmatrix} \quad (9)$$

There is the homographic matrix, describes the space between 3D and 2D camera. Because Zhang Zhengyou's method is of a planar checkerboard calibration, the camera follows transfer matrix simply and two components can be selected. Due to the calibration of three-dimensional space is the Angle of the chessboard grid points, locations known beforehand, camera two-dimensional point can use commonly used such as Harris corner detection algorithm .So each shot can work out a picture.

After $\boldsymbol{H}$ will be written in the form of $\begin{bmatrix} h_1 & h_2 & h_3 \end{bmatrix}$, there are:

$$\begin{cases} h_1 = A \cdot r_1 \\ h_2 = A \cdot r_2 \\ h_3 = A \cdot r_3 \end{cases} \quad (10)$$

According to the unit following the basic nature of transfer matrix are**:**

$$r_1^T \cdot r_2 = h_1^T \cdot A^{-T} \cdot A^{-1} \cdot h_2 = 0 \quad (11)$$

$$r_1^T \cdot r_1 = r_2^T \cdot r_2 \quad (12)$$

$$h_1^T \cdot A^{-T} \cdot A^{-1} \cdot h_1 = h_2^T \cdot A^{-T} \cdot A^{-1} \cdot h_2 \quad (13)$$

$\boldsymbol{H}$ is calculated from the above formula, then I can get two equations of $\boldsymbol{A}$ to calculate $\boldsymbol{A}$, namely the internal matrix.

(2) IMAGE CORRECTION ALGORITHM

In most cases, the ordinary camera in the course of itself acquisition images, distortions often have certain disturbance on the experimental phenomena, seriously affecting the effects of the experiment. Especially in the wide-angle lens, can be introduced great distortion. In the process of imaging, the real straight line into a curve is the salient feature of image distortion. If the images keypoint extract and match directly, obvious error will increase greatly. Therefore, the image correction is a essential step for keypoint detection.

Gray-level interpolation method is a common image correction method; the main idea is to use the neighborhood pixels value to calculate the value of the current pixel. Such as bilinear interpolation method, the method selecting the distortion image $\boldsymbol{v}(x', y')$, the four most neighboring points on their grey value $\boldsymbol{v}(x', y')$ are known, and satisfy the following relations[11]:

$$v(x', y') = ax' + by' + cx'y' + d \quad (14)$$

4. RESEARCH OF IMAGE KEYPOINT EXTRACT AND MATCH

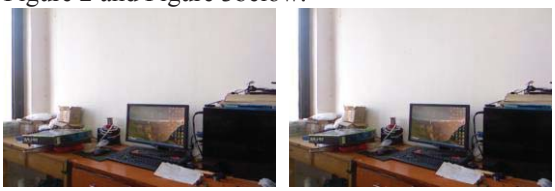
This paper mainly discusses the feature point extraction and matching based on SIFT algorithm in-depth research. The experiment platform information shown in the table1 below:

Table I. Experimental platform for information

Experimental	Configuration parameters
configuration	
Computer hardware	CPU:INTELCELERON3215U
Operating system	UBUNTU 14.04 32BIT
Visual sensor	KINECT1.0(640*480)
Program environment	C++ CMAKE
Design software	ROS[12]

(1) IMAGE KEYPOINT EXTRACTION

In order to further prove the SIFT algorithm in the Keypoint detection object has a special characteristic, this article use Kinect1.0 vision sensors in 4C-512 laboratory at school of Electrical Engineering and Automation to collect the surroundings environment information. The format of the images is PNG made with RGB images and obtain Depth image matched with each others. The pixel coordinates of both images have been processed by OpenNI[13] to realize the one-to-one correspondence. As shown in the Figure 2 and Figure 3below:



(a) RGB 1 (b) RGB 2

Fig.2 RGB images were collected by Kinect1.0

(a) Depth 1 (b) Depth 2

Fig.3Depth images were collected by Kinect1.0

(2) KEYPOINT OF IMAGE DETECT

Before the image keypoint are matched, the two images need to be extracted from the keypoint. Firstly, the " keypoint " in the picture are calculated, and then are calculated for the pixels around these keypoint to calculate "descriptors". These calculated steps, in OpenCV,calculated by cv::FeatureDetector and cv::DescriptorExtractor, respectively. Secondly, using the _detector->detect() function to extract keypoint. Finally, add key parameters such as radius and angle to calculate keypoint in these key points. This results in the experimental results shown in Figure 4. There are 849 keypoint in the image.

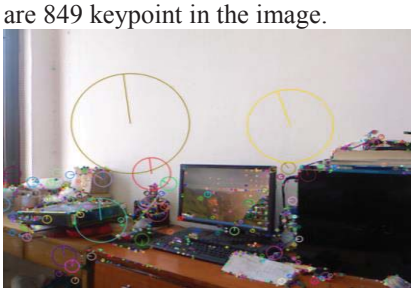


Fig.4 Keypoint extraction results

(3)Keypoint of image match

Using SIFT algorithm to depth camera to take to the RGB image feature points matching, because only between two images here for the position of horizontal rotation transform, experiments can estimate the level before the match line is correct, the rest of the match line is matched by mistake. So you need to sift matching operation steps, remove here four times greater than the minimum distance of the match. To get the best match effect, as shown in the Figure5 below:

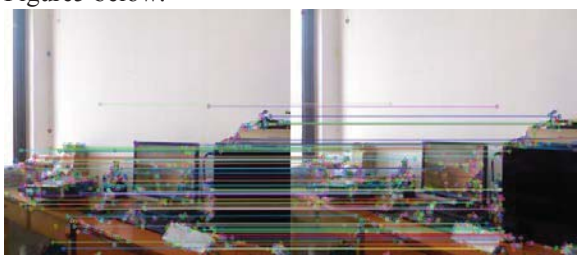


Fig.5 Keypoint matching results

In image feature point extraction and matching based on sift algorithm, system running environment OpenCV[14] may use "the Random Sample Consensus" operation method, Random to take part in the current match, solving, after the completion of the vector and “rvec” “tvec”including the rotation and displacement information, thus can estimate motion between two images. The result is output on the Ubuntu system terminal are shown in Figure6.

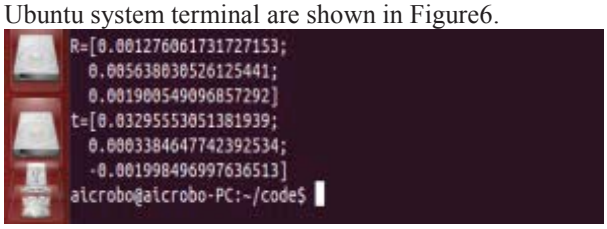


Fig.6 motion estimate results

5. RESULTS

SIFT algorithm for image Keypoints detection is one of the most efficient algorithm and matching field, has the very good scaling and rotation invariance. In the process of actual operation, remove the good match too little among picture frames, remove the solve PnP inliner more image frames, to prevent too much change matrix is at the same time. Improve the accuracy of Keypoint matching, for the following visual odometer (VO) research providing effective experimental data.

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Avoiding Vavle Pits of the Variable Rounded Piston Machining Based on MasterCAM

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Abstract: The avoiding valve pit must be machined to ensure the existence of the gap during the movement of the piston when designing the structure of the head of piston. Setting the variable rounded avoiding valve pit for an example in this text, the setting of various parameters used in the numerical control machining, the preparation process and the process of generating the NC code are completed by Mastercam software, and then complete the actual machining process, the influence of different programming methods in the machining process of the variable rounded avoiding valve pit is analysed, and the optimal method of machining is determined at the end.

Keywords: NC machining; MasterCam; avoiding valve pits; piston

The piston is an important component of the functional components of the four-stroke diesel engine. During the movement of the piston, it is esential to ensure the exist of clearance between the valve and the piston head to achieve the smooth movement of the valve and the piston, so as to realize four strokes of the four-stroke diesel engine smoothly. Therefore, the piston head is required to be machined to avoid the pit to ensure the exist of clearance during the process of piston machining[1].

During the process of piston machining, ordinary machining technology is very difficult to machine the piston due to the high precision and complex shape of the piston avoiding valve pits, and can not meet its requirements ,especially in the milling process, the piston avoiding valve pit is comprised of axisymmetric circular arc surface, its machining process requires the machine tool to have a good characteristics of surface processing to ensure the machining quality. In the past, traditional machining process often uses specialized forming catters to complete the machining, after the piston avoiding valve pit is machined, they are also subjected to many processes such as grinding and polishing of transision fillets and machining surface, the process is complex and difficult to grasp, in addition, the machining efficiency is low and the surface quality is poor. Above all, it is not suitable for modern enterprise production requirements. Therefore, the use of advantages of numerical control machining and the integration of CAD/CAM software has a good effect on improving the machining precision, surface quality and the production efficiency of the piston avoiding valve pit.

In CAD/CAM software, pro/E has advantages in curved surface modeling, and it also has its own features in physical parametric modeling. However, in terms of realizing machining, its parameter setting is more complicated. While Mastercam is relatively poor capable in designing product modeling to pro/E, but the ability to realize numerical control machining is excellent, and the operation is simple and reliable. Therefore, Mastercam and pro/E can be used together. In this text, the variable rounded piston avoiding valve pit is chosen as the machining object, the pro/E software is used to perform 3D solid modeling, and the machining process is programmed, the tool path is planned and the machining simulation is performed under the Mastercam, and then the NC code is generated to complete the actual machining of the variable rounded piston avoiding valve pit. When using Mastercam for numerical control simulation, two kinds of curved surface machining methods are used to programming and processing, and the effects of different curved surface machining methods on the piston avoiding vlvle pit during actual machining are analyzed. Finally, the optimal machining method for variable rounded piston avoiding valve pit is determined.

1. ESTABLISHING A SOLID MODEL OF THE VARIABLE ROUNDED PISTON AVOIDING VALVE PIT

(1) The solid model of the variable rounded avoiding valve pit

According to the requirements of various dimensions in Fig 1, a three-dimensional solid model of the variable rounded piston avoiding valve pit is created in the pro/E software. As shown in Fig 2, the rounded corner of the variable rounded piston avoiding valve pit is comprised with many different sizes of arc surface.

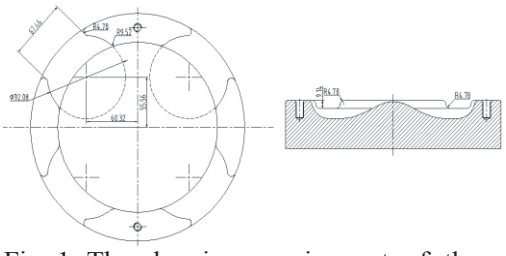

Fig 1 The drawing requirement of the variable

rounded piston avoiding valve pit

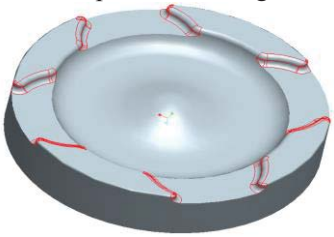

Fig 2 The three-dimensional solid model of the

(2) The transformation process of model files

After completion of modeling in the avoid valve pit under the aid of pro/E software, the model file of workpiece needs to be converted into IGES or STEP to facilitate the use of Mastercam, the converted documents need to be （*. stp）or （*. igs）, and other specification format files.

2. THE MILLING PROCESS OF THE VARIABLE ROUNDED PISTON AVOIDING VALVE PIT

(1) The program of numerical control machining

As the avoid valve pit is axialsymmetric, the overall machining is more convenient for the use of the curved surface machining characteristics of the CNC milling center. In the planning of machining route, the machining center is used to mill roughly to remove most of the machining allowance of the blank, and then perform the finishing milling. In the selection of the cutting specifications, the bottom milling is 0.3mm, the side finishing milling is 1mm, and the arc machining is 1mm. In the actual machining process, one valve pit can be individually rough finished and then the other parts are circular machining due to the axialsymmetry of the components.

(2) Determining the origin of the avoid valve pit

The variable rounded piston avoiding valve pit is evently distributed along with the piston head . Therefore, the center poistion of the piston head can be selected when determining the machining original point of the workpiece, such selection is more favorable for subsequent programming and process planning, and can ensure that the process standards are coincident with the design standardsof the piston components, which is beneficial to the actual numetric control machining.

(3) The selection of the tool and its cutting specifications

The workpiece used in this text is a variable rounded piston avoiding valve pit, the largest part of the diameter is 92.08mm, the size of the opening part is 67.64mm. In the selection of tools, while ensuring the machining efficiency but also to consider the interference between the tool and the workpiece. Therefore, the rough and finish machining of the circular arc transitional surface is to use a customized four-blade round nose end milling catter with a diameter of 50mm, the blade can be used for indexing and the circular bead is R3.

The workpiece material in actual machining is ZL109, after the heat treatment, the hardness can reach HB85-HB140, according to the actual situation of the tool and the workpiece, the cutting specifications is selected as shown in Table 1.

Table 1: the selection of the cutting specifications

cutting speed(m/min)	rotational speed(r/min)	feed rate(mm/min)	allowance for finish(mm)	feed rate (mm/min)
235	1500	1200	0.2	300

3. THE NUMETRICAL CONTROL SIMULATION OF THE MACHINING PROCESS

During the simulation process of the workpiece, two surface machining mathods by streanline finish and contour finish machining are adopted. During the simulation process of the streamline finish machining, the path is generated in accordance with the streamline direction of the the workpiece surface. When the continuous curved surface of the variable rounded piston avoiding valve pit is machined in this way, it can be machined along the streamline direction of the curved surface. But when the streamline finish machining encounters a small or excessive workpiece surface that requires to be machined, and the machining methods by shard processing are adopted for multiple complex surfaces, of which the machining path will have mutual influences. The rounded surface of the variable rounded piston avoiding valva pit studied in this text are continuous with each other and are arranged regularly. Therefore, the streamline finish machining can be used for machining. The parameter selection of the screamline finish machining is shown in Fig 3.

Fig 3 The parameters of the streamline finish machining

The other method used for curved surface machining in this text is contour finish machining. By this method, the machined workpiece is sliced in accordance with contour line, and the generated tool path also changes with the contour of the curved surface of the workpiece . Therefore, the method is more suitable for the machining of the complex curved surface, the processing method is essentially based on the contour line to divide the three-dimensional solid model into multiple two-dimensional plane graphics for machining. The contour finish machining method can be applied to the machining of the variable rounded piston avoiding valve pit to solve the problems of sequential selection of the curved surfaces and concentrated comnination in the curved surfacemachining, and contrapose the specific conditions of the curved surface of the workpiece, such as less slope of the curved surface,

more rounded corners, and the machining accuracy is increased, the tool path is selected to increase the shallow flat area, and the minimum cut depth of the layer is positioned at 0.01mm to solve the problem of too sparse tool path due to the same amount of feed between layers.

The parameters of the contour finish machining are selected as shown in Fig 4. The simulation of tool path is shown in Fig 5.

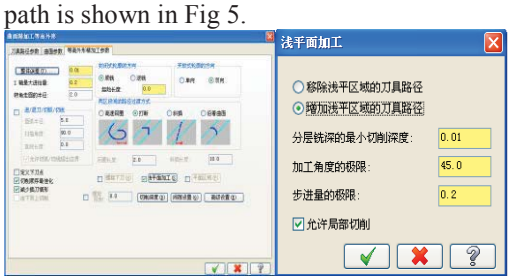

Fig 4 The parameters of the contour finish machining

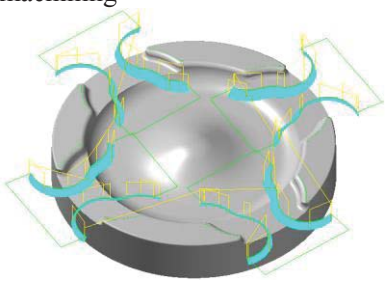

Fig 5 The simulational image of tool path

4. THE MILLING PROCESS OF THE VARIABLE ROUNDED PISTON AVOIDING VALVE PIT

The methods by the streamline finish machining and the contour finish machining are used for the milling process of the variable rounded piston avoiding valve pit, which has no influence on the machining effect. In the contrast, the operation problems in the programming process, the method of the screamline finish machining is relatively complex and difficult to change, and the circular arc transition surface cannot be selected intensively, while the use of the contour finish machining throughout the programming ang debugging process is simple and easy to modify. Therefore, the contour finish machining is more suitable for the machining process of the variable rounded piston avoiding valve pit.

Fig 6 The result of milling

5. CONCLUSION

The text aims at the the milling process of the variable rounded piston avoiding valve pit, the three-dimensional solid model of the workpiece was firstly established in the pro/E software, and then the three-dimensional solid model was imported into Mastercam to use the methods by the contour finish machining and the streamline finish machining for the simulation of the milling, and then generates the NC code required for milling, and completes the final actual machining process. Comparing the actual machining effect and the debugging of the specific programming operations of the methods in this text. The contour finish machining can not only ensure the accuracy of the workpiece in the machining process of the variable rounded piston avoiding valve pit, but also makes the programming and debugging process simple and easy to modify and the machining efficiency is higher when contraposing the machining process of the complex curved surfaces.

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Grain Condition Prediction Model Based on GA-RBF Neural Network

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Abstract: The grain storage environment is a complex system composed of many factors. It is difficult for conventional predicting methods to meet the accuracy of granary monitoring in modern times. A new grain situation prediction model based on GA-RBF neural network is established in this paper. This model aims at the disadvantages of slow learning speed and low accuracy for RBP neural network training. It uses genetic algorithm to optimize RBF neural network parameters. The experimental results show that the prediction model of granary condition proposed in this paper has high stability and small error, and it satisfies the current demand of grain prediction well.

Keywords: genetic algorithm; RBF neural network; grain situation prediction; modeling and simulation

1. INTRODUCTION

With a population of 1.3 billion people, China is a world leader in food production, storage and consumption. At present, the losses caused by mildew and insect damage are very common and serious in the world's grain reserves. The storage of grain seems to be simple but complex actually. The grain in the granary is affected by various environmental factors. The humidity, impurities, and pests of grain in the granary cause the temperature of grain in the granary to rise, and the structure of the granary affects the temperature exchange of the grain in the granary. Excessive temperatures can accelerate the life activities of food, cause food rot and mold, and seriously affect the normal storage and transportation of food. How to better solve the problem of forecasting the state of grain storage is a complex issue.

In recent years, Radial Basis Function (RBF) neural network has been widely used in engineering because of its simple structure, fast training speed, and independent output and initial weights. However, how to reasonably determine the structure and parameters of the network has not yet been systematically followed, and the performance of the network has been affected. The genetic algorithm with global search capability can optimize the RBF neural network and find the optimal network structure and parameters to ensure the best network performance. In this paper, the genetic algorithm is combined with RBF neural network algorithm, applied to the prediction of grain conditions, and the grain condition is monitored by predicting temperature, humidity, and CO2 concentration

2. RBF NEURAL NETWORK AND GENETIC ALGORITHM

(1) RBF Neural Network

Broomhead and Lowe first designed the RBF (Radial Basis Function) neural network in the late 1980s. For the first time, they applied the radial basis function to the neural network. RBF neural network is not only simple in structure, good generalization ability and approximation performance, but also has a good generalization ability and approximation performance, a fast training speed and a global optimum, so that the learning ability can be 1000-10000 times faster than the usual BP learning method. The definition of a generalized RBF network is as follows:

The input variable X of input layer (M dimension) is mapped to the hidden layer, which is equivalent to mapping the data in the low dimensional space to the high dimensional space (N dimension), and the number of input layer variables M is the dimension of the sample. The specific model is shown in Figure 1:

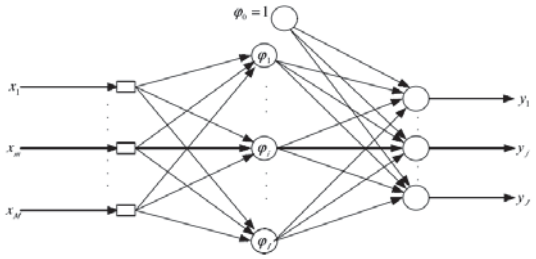

Figure 1 RBF neural network model

In the model structure, the input variable X is a M dimensional vector, and the hidden layer φ_i is a radial basis function. From the above figure, the function of the hidden layer is to map the input variable from low (M) latitude to high (I) dimension. For the radial basis function, it can be seen from the structure that the center is determined by the training algorithm and is no longer restricted to the input node. The design of radial basis function mainly includes structure design and parameter design. Structural design mainly refers to the design of hidden layer, which consists of the number of nodes in the hidden layer. The parameter design mainly refers to the design of radial basis function.

This paper uses Gaussian function as radial basis function. Assume that the Gaussian function is

$G(X_k, X_i)$ and its function is expressed as follows:

$$\varphi(X_k, t_i) = \exp(-\frac{1}{2\delta^2}\sum_{m=1}^{M}(x_{km} - t_{im})^2) \quad (1)$$

Where $t_i = [t_{i1}, t_{i2}, \ldots, t_{im}, \ldots, t_{iM}]$ is the center of the Gaussian function, δ_i is the variance, and $x_{km} - t_{im}$ is the Euclidean norm.

Assume that the training sample set is: $X = [X_1, \ldots, X_k, \ldots, X_M]$, the training sample is: $X_k = [X_{k1}, \ldots, X_{km}, \ldots, X_{kM}]$ $(k = 1, 2, \ldots, m)$, then the output of the RBF neural network can be expressed by the following formula, where $k = 1, 2, \ldots, n$:

$$Y_k = [Y_{k1}, \ldots, Y_{kj}, \ldots, Y_{kn}] \quad (2)$$

The desired output can be expressed as follows, where $k = 1, 2, \ldots, N$:

$$d_k = [d_{k1}, \ldots, d_{kj}, \ldots, d_{kJ}] \quad (3)$$

For the training sample X_k, the jth actual output after training with the RBF network is represented by the following formula, where $j = 1, 2, \ldots, J$:

$$y_{kj}(X_k) = w_{0j} + \sum_{i=1}^{I} w_{ij}\varphi(X_k, t_i) \quad (4)$$

(2) Genetic Algorithm

Genetic algorithm is an adaptive heuristic global search algorithm derived from biological evolutionary ideas. It finds the global optimal solution through the cycle of evolutionary processes such as selection, crossover, and mutation. The algorithm has a powerful global optimal solution search capability, problem domain independence, application robustness and simplicity of operation. The flow of the genetic algorithm is as follows:

a. Chromosome coding

Real number coding has the advantages of natural representation, large search range, and high accuracy. In this paper, the coding method is chosen. Each gene is represented by a real number. The code string consists of a central value n and a width σ. The individual representation is:

$$X_{g,i} = [x_{g,i1}, \ldots, x_{g,ik}, \ldots, x_{g,in}] \quad (5)$$

In the formula, $i = 1, 2, \ldots, N$.

b. Fitness function

The fitness function is the basis for the selection operation of the genetic algorithm, and the obtained fitness value is also the only criterion for distinguishing individuals from each other in the genetic algorithm. Considering that the purpose of optimizing the RBF neural network is to improve the accuracy of the output, and the accuracy is determined by the error between the network output value and the expected output value. Therefore, the fitness function is established as:

$$f(Y) = \frac{1}{J(Y)} = \frac{1}{\frac{1}{N}\sum_{j=1}^{N}[y_j - \hat{y}_j(X)]^2} \quad (6)$$

In the formula, $J(Y)$ is the square error function of the output layer; y_j is the network output expected value corresponding to the input vector X; $\hat{y}_j(X)$ is the network output corresponding to the jth input sample.

c. Selection

Using the ranking method with better robustness as the selection mechanism, individuals are first sorted in ascending order according to the size of the fitness value, and then the selection probability of calculating the chromosome is:

$$P_i = \frac{P_{\max}}{1 - (1 - P_{\max})^N}(1 - P_{\max})^{N_i - 1} \quad (7)$$

In the formula, $P_{\max}$ is the selection probability of the best chromosome; N_i is the rank number of the fitness value of chromosome i in the population.

Then, the roulette selection method is used to select each chromosome: calculate the cumulative selection probability $q_i(i = 1, 2, \ldots, N)$ of each chromosome, and generate a random number sequence $r_j(i = 1, 2, \ldots, N)$ in ascending order within the $(0, q_N)$ interval. If $q_{i-1} < r_j < q_i$, then select the ith chromosome into the next generation.

d. Crossover

Crossover is the most important means for genetic algorithms to acquire new and good individuals. This article uses the method of arithmetic crossover. Two chromosomes can be generated by linear combination of two chromosomes. Let (n_1, σ_1) and (n_2, σ_2) be the two groups of chromosomes randomly selected in the population. If they are crossed parents, the resulting offspring are:

$$\begin{cases} n_1' = n_1 + \alpha_1(n_2 - n_1) \\ n_2' = n_2 + \alpha_2(n_1 - n_2) \\ \sigma_1' = \sigma_1 + \alpha_3(\sigma_2 - \sigma_1) \\ \sigma_2' = \sigma_2 + \alpha_4(\sigma_1 - \sigma_2) \end{cases} \quad (8)$$

e. The mutation

The mutation can not only enable the genetic algorithm to have a local random search ability, but also accelerate convergence to the optimal solution in the neighborhood of the optimal solution. It can also maintain population diversity and prevent premature convergence. Using the method of non-uniform variation, this method has higher accuracy and fine-tuning ability. Let (n, σ) be the selected variant, and the descendants of the mutation are:

$$n = \begin{cases} n + \Delta(g, n_{\max} - n), r(0,1) = 0 \\ n - \Delta(g, n - n_{\min}), r(0,1) = 1 \end{cases} \quad (9)$$

$$\sigma = \begin{cases} \sigma + \Delta(g, \sigma_{\max} - \sigma), r(0,1) = 0 \\ \sigma - \Delta(g, \sigma - \sigma_{\min}), r(0,1) = 1 \end{cases} \quad (10)$$

In the formula, r is a random number in $[0,1]$; G is the largest genetic algebra; b is a parameter to determine the degree of inhomogeneity; $\Delta(g, y)$ returns a value in $[0, y]$, where $\Delta(g, y)$ tends to zero more and more as the genetic algebra g increases indefinitely.

(3) Combination of genetic algorithm and RBF neural network

The GA algorithm is an algorithm that simulates natural evolutionary selection. It has a great advantage in the generalization ability. Its greatest feature is its own set of search methods. It has a very good advantage in determining the data and width of neural network hidden layer nodes. It overcomes the slow speed of shrinkage and the characteristics of easy to fall into extreme values. GA has good scalability, which determines its ability to combine with other algorithms. A formula can be used to describe the combination of GA in feature selection and RBF:

$$\max_{S,P} T(S, P) \quad (11)$$

Equation 11 shows that (S, P) is a set vector with two parameters. It can describe our neural network parameters and network set parameters in the set. The set of network parameters is a set of standardized indicators collected from the situational understanding. Then the two sets are the problems of multiple sets of optimization combination, similar to cross-genetics in chromosomes. This collection combination depends on the number and complexity of the collections. If the set is relatively complex, such a set combination will inevitably affect the speed of the determination of the nodes in the hidden layer, and then have an impact on the prediction time performance, and cannot meet the system requirements of the rapid feedback performance. GA has shown a good ability in this respect. He has his own powerful spatial search capabilities, can compare the stability of the search characteristics, from the simulation of ethnic evolution process to find a suitable combination of methods, and the collection of natural selection, cross, mutation, can well overcome the problem of slow feedback . The basic flow is shown in Figure 2:

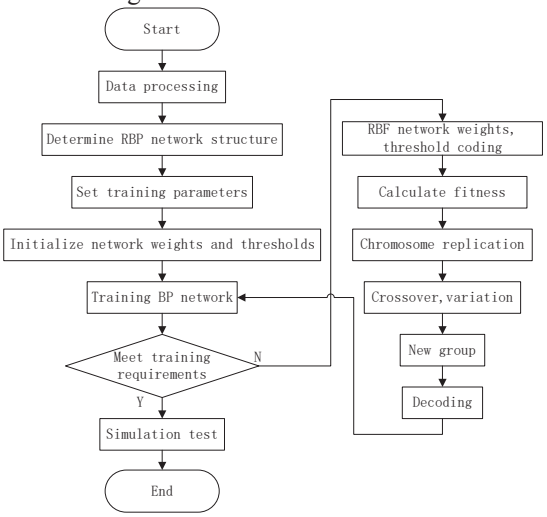

Figure 2 Basic flow chart

3. EXPERIMENT AND SIMULATION RESULTS

(1) Grain forecast standard

Factors that affect the quality of grain storage include temperature and humidity, harmful gases, insect pests, dust, and temperature and humidity outside the warehouse. According to the study, the metabolism of grain, mold, and eggs will be accelerated under the right conditions. A lot of heat and CO2 gas will be emitted through respiration. At the same time, due to the transpiration of food crops, the humidity in the warehouse directly reflects the freshness of food. Since three factors, namely, temperature, CO2, and humidity, are the main factors affecting food security, only these three factors are used to make predictions.

(2) Experiment and result analysis

In the experiment, the selection step is 0.1, the number of input units in the network is 2, and the delay time is 5. The number of trainings is 10,000, the training target error is 0.01, and the learning rate is 0.1. The genetic algorithm has a population size of 50, an evolution maximum algebra of 100, a crossover rate of 0.5, and a mutation rate of 0.1. Fifty sets of granary environment data were selected, 80% of which were randomly selected for training samples, 10% for variables and 10% for test samples.

In order to verify the superiority of the model, the combined model used in this paper is compared with

the prediction results of a single GA algorithm and a single RBF algorithm. The results are shown in the figure:

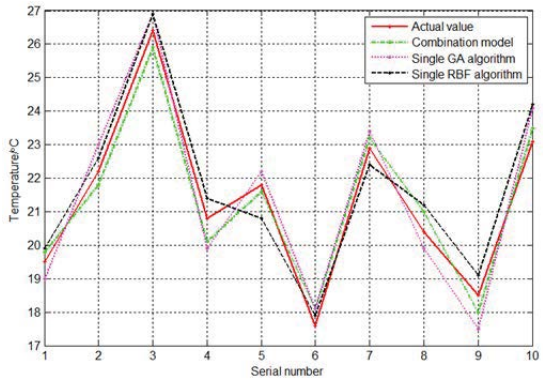

Figure 3 Temperature Prediction Results

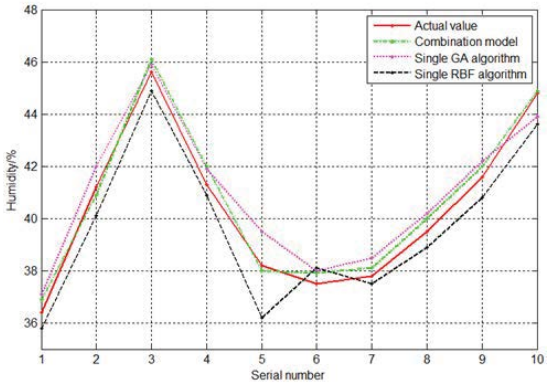

Figure 4 Humidity prediction results

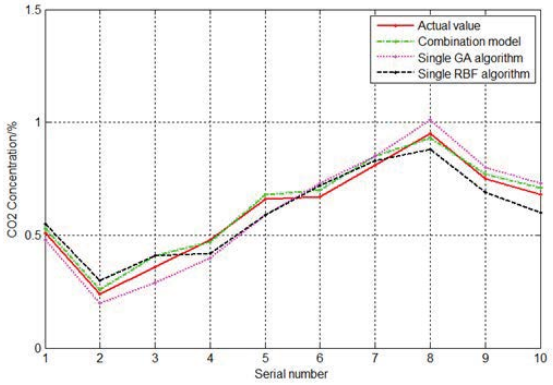

Figure 5 CO2 prediction results

After analysis, compared with a single genetic algorithm and RBF neural network, the GA-RBF combined model is more stable, and the prediction error range of the granary temperature, humidity, and CO2 concentration is smaller, and the prediction of the grain condition is more accurate.

4. CONCLUSION

In this paper, the parameters in the RBF network model are optimized by GA, and the prediction model of temperature, humidity and CO2 in the grain parameters is modeled and the simulation experiments are carried out. The experimental results show that the prediction method based on the GA-RBF neural network is more feasible and more accurate than the single prediction algorithm. At the same time, GA-RBF neural network has a simple structure, good generalization performance and high theoretical value. It has a high guiding significance for practical engineering applications and provides a new prediction model for grain condition monitoring systems.

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Selection of Neutral Grounding Method for 6kV ~ 35kV Distribution System in Petrochemical Enterprises

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Abstract: The neutral point grounding mode selection must consider a number of factors, such as the power supply reliability and fault range, Internal Overvoltage multiples, atmospheric overvoltage protection and insulation level of power system relay protection and insulation coordination, the requirements of communication system and signal interference effect. This paper from the actual situation of petrochemical system of distribution network based on the neutral point grounded through a resistance grounding and Neutral Resonant Grounding of these three methods were compared, analyzed their advantages and disadvantages. The specific circumstances of a petrochemical enterprise through a 35/10.5kV substation design, expounds the process of determining 10kV side of transformer neutral point grounding mode.

Keywords: petrochemical enterprises; neutral resonant; grounding;

1. INTRODUCTION

Distribution system neutral grounding mode selection is a systematic project, we must consider the reliability and continuity of power supply and distribution network structure, the size of the overvoltage and insulation coordination, relay protection and distribution network in the future development of the situation and other factors. Petrochemical enterprises in China, medium voltage distribution system mainly in 6 (10) kV, 35kV two voltage levels is more common. With the continuous expansion of the scale of petrochemical enterprises, power supply is also increasing, enterprises often formed a relatively independent, 6kV~35 kV distribution network and uses a lot of power cable. According to the "AC overvoltage protection and insulation coordination design specification" GB/T 50064-2014 requirements, in order to avoid the intermittent arc grounding overvoltage, not directly connected with the generator 6kV~20kV cable line single-phase grounding fault current is not greater than 10A; 35kV system single-phase grounding fault current is less than 10A, the system can use the neutral point without grounding, and measures must be taken to avoid the intermittent arc grounding overvoltage. At present, non direct grounded neutral point can be divided into: neutral resistance grounding, Neutral Resonant Grounding (earthing device Petersen) [1] etc..

2. DIFFERENT NEUTRAL GROUNDING MODE CHARACTERISTICS

(1) Neutral point ungrounded system

a. The system wiring diagram

Neutral system wiring diagram as shown in figure 1.

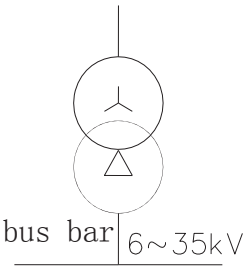

Figure 1 neutral ungrounded

b. The main features

1) neutral insulation, single-phase grounding faults do not form a short circuit, current through the grounding grid is only on the capacitor current, when the fault current is very small, the fault arc can be self extinguishing, only action in the signal (using the neutral displacement voltage) without action on the trip, the system can continue to run 2H with ground fault, in order to find the point of failure, improve the reliability of the power supply.

2)When the fault current is large, the grounding arc will be self extinguishing, easy to form arc intermittent arc grounding or persistent grounding. Intermittent arc will lead to dangerous overvoltages, resulting in relatively higher voltage, the amplitude is generally 2.5 times the operating voltage, up to 3 times, the insulation level of electrical forward higher requirements. Arc continuous grounding may lead to phase short circuit, if not timely treatment or ground fault protection configuration is not comprehensive, the abnormal situation is likely to expand to the whole accident.

3)In addition, because the phase neutral point grounding current is relatively small, in order to achieve sensitive and selective grounding protection is

(2) The grounding system of neutral resistance

a. The system wiring diagram

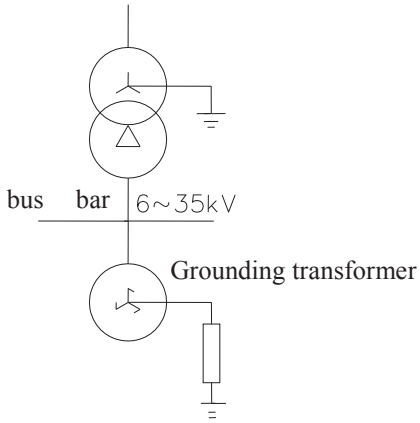

Figure 2 neutral point grounding via resistance

Neutral resistance grounding system wiring diagram as shown in figure 2.

b. The main features

1)Neutral point grounding via resistance is the resistance between the neutral point and the earth system access certain resistance. The resistance and power grid forms a shunt circuit to ground capacitance, capacitance current and resistive current when flowing through the neutral point through fault point is close to, can effectively inhibit the generation of single-phase grounding arc grounding overvoltage and resonance overvoltage.

2)Power supply system of 6kV~35 kV is mainly composed of a power cable, if the neutral point in the low resistance grounding mode, the resistance value is typically 10 ~20 ohm, single-phase ground fault capacitive current of 100 A~1000A, the current through the fault line can be large, zero sequence overcurrent protection setting, can quickly remove the fault line, favorable for relay protection. At the same time, voltage level is low, no high requirement on the insulation level of power supply and distribution system.

3)In the process of operation, the 6kV~35 parameters of kV distribution network even changes, the resistance value is also no need to adjust, the simple operation and maintenance.

4)The disadvantage is when the single-phase grounding fault happens, the instantaneous tripping, poor reliability of power supply; if the zero sequence protection action is not timely or resistmoves may lead to the occurrence of short effect; also caused on telecommunication systems also need to be carefully considered.

(3) Neutral Resonant Grounding System

a. The system wiring diagram

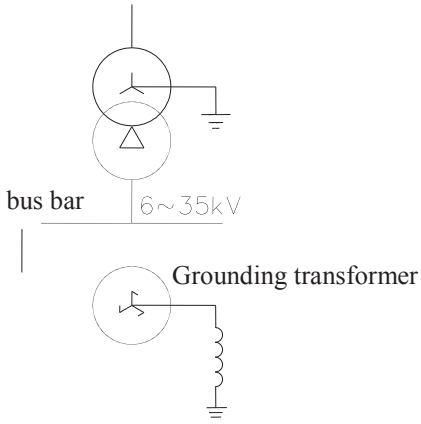

Figure 3 Neutral Resonant Grounding

The wiring diagram of the resonant earthed system is shown in figure 3.

b. The main features

1)Petersen coil grounding is also called grounding mode of neutral point resonant. According to the 50064-2014 GB/T article 3.1.3, when the 35kV system and the 6kV~20kV system is not directly connected to the generator capacitive current of single-phase ground fault is more than 10A, should adopt the neutral point grounding mode.

2)Petersen coil is also called as arc suppression reactor or the grounding fault compensation device, when the system single-phase ground fault occurs, the inductance current of arc suppression coil can produce the corresponding compensation single-phase earthed capacitive current, the grounding arc difficult to extinguish and prevent reignition arc, reducing the intermittent arc generation reduce the insulation flashover and ground fault current arcing rate, inhibit arc over voltage, long time arc avoided, reducing the possibility of single-phase fault for the development of two or more phase fault, and the single-phase metallic grounding fault, the sound phase can continue to run H 2, improve the reliability of power supply.

3)According to the domestic and foreign related research institutions, the arc suppression coil overvoltage suppression effect and the degree of disresonance are closely related, only the degree of disresonance in the range of + 5% to control the arc overvoltage level is limited to 2.6 times the phase voltage below [2].

4)For the arc suppression coil to keep running in state compensation, often require the operation of arc suppression coils in the near resonant point, with the development of the power grid and the change of operation mode, the arc suppression coil to run in the best position, may make the residual flow is not effectively suppressed due to arc grounding voltage; arc suppression coil will lead to the size and direction of the ground current change sensitivity to small current line selection device is affected.

3 NEUTRAL GROUNDING MODE SELECTION

(1) Calculation of capacitance current

The 35/10.5kV region of a petrochemical enterprise

substation design, all 10kV output circuit adopts cable wiring, 10kV bus line total cable length of about 10km, the cable section of the 95mm 2, substation grounding capacitor current value increased by 16% meter[3].

Capacitive current calculation:

$I_C = 0.1U_r l$ (A)

The above formula U_r- line rated line voltage, kV;

l- the length of the line, km;

I_C- the capacitive grounding current of A.

Through calculation, 10kV bus single-phase grounding capacitive current is 11.6A (the current standard neutral grounding mode, single-phase grounding fault is not greater than 10A).

Because of the petrochemical enterprises most load as a grade two or load, higher requirements on the reliability of power supply, the several kinds of neutral grounding mode of the advantages and disadvantages, taking into account the region substation and superior substation grounding line characteristics, and the influence on relay protection minimum. Final substation 10kV side neutral grounding mode of the neutral point grounding mode of this region (Petersen coil grounded), when the system single-phase ground fault occurs, can continue to supply 2h, so as to eliminate the fault, ensure the continuity of power supply.

(2) Automatic tracking compensation arc suppression coil device selection

The traditional arc suppression coil manually tuned, not only will make the grid short-term lost compensation, and can not effectively control the single-phase ground fault current after compensation, the change of arc suppression coil automatic tracking compensation device with power grid operation mode, timely, rapid adjustment of arc suppression coil, the degree of disresonance is always prescribed range, when single-phase grounding system occurs, adjusting the inductance value in a short period of time, the grounding residual current reactive component is zero, to avoid the intermittent arc grounding overvoltage[4].

Automatic tracking compensation device to change the inductance of the different methods, can be divided into adjustable turns , adjustable air gap type, adjustable capacitive type, adjustable DC bias magnetic, thyristor regulating type etc. Different kinds of automatic tracking compensation arc suppression coil with different characteristics.

a. Adjustable turns: adjusting speed, arc suppression coil near resonance, in order to avoid the series resonance overvoltage is too high, need a series of damping resistance in Petersen coil, the resonant overvoltage in the permitted range. for the advantages of simple manufacturing process, low cost[5].

b. Adjustable the air gap : reactor core is fromed from static core and dynamic core, through the continuous adjustment of the air gap between the static iron core, stepless continuously adjusting inductance changing magnetic flux. For the disadvantages of large noise, overheated running.

c. Capacitance adjustable: capacitance adjustable arc suppression coil is a certain quantity of access through the capacitor to offset the inductance of arc suppression coil current. Because of the inductive current and capacitive current of the phase difference of 180 degrees, the two arithmetic, therefore, to offset the inductor current through the capacitor current, the arc suppression coil two side capacitor current converted to one side, to change the inductance compensation current of arc suppression coil, without damping resistance[6].

d. Adjustable DC bias magnetic: fast response, can automatically eliminate the single-phase grounding fault, and the output current can be adjusted continuously in 0~100% of the rated current, the residual current is small, simple structure, low noise.

Based on the above ways, by comparison the 10kV substation side neutral point regulated by a thyristor type automatic tracking compensation arc suppression

(3) Coil capacity

Petersen coil capacity calculation:

$S = 1.35 I_C \frac{U_N}{\sqrt{3}}$ (kVA)

The above formula S- arc suppression coil with the total capacity of kVA;

I_C- the capacitive grounding current of A;

U_N- system rated voltage, kV.

Calculate the 10kV arc suppression coil capacity of 90kVA, because the 10kV side of the triangle connection, the neutral grounding transformer leads, considering the load of 260kVA, the choice of 400kVA grounding transformer and arc suppression coil combination device[7].

4. CONCLUSION

Neutral grounding is a comprehensive technical and economic problems related to power system in many aspects, in order to ensure the reliability of safe operation and power plant and substation of petrochemical enterprises, which requires comprehensive consideration of petrochemical enterprises according to the specific situation, choose the most grounded neutral point of the appropriate. This paper through a petrochemical enterprise 35/10.5kV area substation on the specific circumstances, by calculation and analysis, determines the 10kV side of transformer neutral point using the configuration of automatic tracking and compensating arc suppression coil equipment to limit the arc grounding over voltage.

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Dose Estimation of Medical Diagnostic X-ray Workers in Tianjin

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Abstract: **Objective:** According to the normalized workload method, cumulate the personal dose estimation of medical diagnostic X - ray workers in Tianjin city. **Method:** By using the normalized workload method and using the X-ray exposure history information, the individual cumulative dose of medical diagnostic X-ray workers in Tianjin from participating in radiological work to 1990 was calculated. After 1990 the dose was calculated by using the 1990 annual dose and the personal service age. The combination of the two resulted in the individual cumulative dose of the medical diagnostic X-ray workers in Tianjin during the period from participating radiation work to ending radiation work. **Result:** The cumulative dose for most of medical diagnostic X-ray workers through their worklife in Tianjin is 20-150mGy, with an average value of 115.66mGy. Most of the annual dose of medical diagnostic X-ray workers in Tianjin is lower than 20mGy/year, and the average value is 4.34 mGy/year. **Conclusion:** The average cumulative dose and average annual dose of medical X-ray workers began to work in different years in Tianjin were lower than that reported in the literature.

Keywords: The medical diagnostic X-ray workers in Tianjin; Dose estimation; The normalized workload method

1. INTRODUCTION

As an important occupational group exposed to X-rays, medical diagnostic X-ray workers have received low-level occupational external radiation for a long time and their health effects have received widespread attention at home and abroad. Smith[1]et al., Matanoski[2]et al., Boice[3] et al., Aoyama[4]et al., Yoshinaga[5]et al., and Andersson[6]et al. conducted radiological carcinogenic epidemiological investigations on radiographers. In order to investigate the health effects of medical diagnostic X-ray workers, Chinese organized health and medical units in 24 provinces to carry out epidemiological surveys. The analysis of malignant tumors in medical diagnostic X-ray workers showed that leukemia, skin cancer, breast cancer, and thyroid cancer are related to X-ray irradiation [7].

In order to further evaluate the risk of low-dose radiation carcinogenesis, the dose received by medical diagnostic X-ray workers gradually attracted people's attention. Since there were no radiation dose detection devices in countries around the world before 1950, it was not possible to know the dose that medical diagnostic X-ray workers received during worktime. In order to estimate the size of the dose they received, various countries established dose-reconstruction models. In the United States and Japan, based on data obtained by the film dose method, statistical model parameters were obtained for dose reconstruction [8-10]. In China, different periods of machine equipment were used to carry out simulation measurements to obtain basic data, which led to a statistical model for dose reconstruction [11].

In this paper, personal dose information is derived from the dose reconstruction of medical diagnostic X-ray workers in Tianjin, which provides basic dose data for low-dose radiation carcinogenic dose effects studies, and then develops radiation protection dose limits for occupation-exposed populations. It provides the main theoretical basis for predicting the lifetime risk of cancer and guidance for future radiation protection.

2. MATERIALS AND METHODS

(1) Research object

The study participants were members in the exposed group of the Tianjin cohort, which was established for the malignancy incidence epidemiological survey of Chinese medical diagnostic X-ray workers in 1980.

(2) The X-ray exposure history

In the epidemiological investigation data of medical diagnostic X-ray workers in China [7, 12], the ray exposure history of the Medical Diagnostic X-ray Workers who took part in radiological work until 1990 in Tianjin cohort was investigated. The survey was conducted in the form of a questionnaire. It was obtained that medical diagnostic X-ray workers in Tianjin started working on radiation, engaged in radiation work types (thorax, gastrointestinal imaging, filming), used protective equipment, ray machine type and other information.

(3) Dose reconstruction method

Zhang Liangan proposed a dosimetry estimation

model for personal dose reconstruction based on workload, job type, and protection conditions, which is a normalized dose calculation method. This method divides the medical diagnostic X-ray worker's working conditions into several types according to the protection conditions and work types, and determines the conversion relationship between different types of workloads. The workload of various types (number of inspectors) is normalized to a certain type of workload. In this way, different types of workload can be added together to arrive at a total normalized workload for dose estimation [13]. The basic formula of this estimation model is as follows

$$D_i=PW_i \quad (1)$$

Since the X-ray exposure history survey of medical diagnostic X-ray workers in Tianjin was conducted only until 1990, no investigation of occupational exposure history was continued after 1990. However, since the 1970s, with the country's emphasis on medical radiation, the medical radiation protection conditions have been continuously improved, and medical radiation-related standards and regulatory systems have been promulgated, greatly improving the level of supervision and monitoring, The radiation dose received by the people is getting lower and lower. As a result, the annual dose change of medical professionals in different periods in China is small. After 1990, the annual dose change of medical diagnostic X-ray workers tends to be stable in Jiangsu Province [13]. Therefore, the annual dose of Tianjin Medical Diagnostic X-ray workers after 1990 should also be stable. Each person's annual dose in 1990was multiplied by the corresponding length of service to arrive at the accumulated dose during the period 1990 to the end of radiation work. Finally, the combination of the two resulted in the individual cumulative dose of the medical diagnostic X-ray workers in Tianjin during the period from participating radiation work to ending radiation work

3. RESULT

(1) Dose estimation results

a. Frequency distribution of individual cumulative doses

The statistical results of the individual cumulative dose frequency distribution for medical diagnostic X-ray workers in Tianjin are listed in Table1.

Table1 The personal cumulative dose frequency distribution of medical diagnostic X-ray workers in Tianjin

Dose rang(mGy)	Num -ber	Cumulative dosemean(mGy)	Radiological service average(year)
-10	5	7.9	3
10-19.99	12	16.3	7
20-29.99	46	25.5	13
30-39.99	49	35.5	18
40-49.99	112	44.8	23
50-99.99	413	72.9	29
100-149.99	173	119.3	29
150-199.99	45	167.3	32
200-249.99	23	221.0	31
250-299.99	18	278.1	31
300-349.99	13	326.6	32
350-399.99	15	381.2	31
400-449.99	9	425.6	29
450-499.99	13	472.8	32
500-549.99	7	519.4	26
550-599.99	6	569.0	30
600-	12	742.4	29
Total	971	115.6	27

b. Frequency Distribution of Individual Average Annual Dose

The statistical results of individual annual dose distributions of medical diagnostic X-ray workers in Tianjin are shown in Table2.

Table 2 The individual Average Annual Dose Frequency Distribution of Medical Diagnostic X-ray Workers inTianjin

Annual dose range (mGy)	Number	Cumulative dose mean(mGy)	Radiological service average(yea r)
-0.99	3	28.2	31
1-1.99	124	45.3	28
2-2.99	395	61.6	27
3-3.99	160	94.1	27
4-4.99	110	118.6	27
5-5.99	44	131.7	25
6-6.99	19	182.3	28
7-7.99	17	191.9	26
8-8.99	13	268.1	31
9-9.99	12	268.7	30
10-19.99	58	428.5	30
20-	16	613.0	22
Total	971	115.6	27

Length of service, and annual average dose of individuals in Tianjin Medical Diagnostic X-ray workers who started radiation work in different

4. CONCLUSION

It can be seen from the results, the cumulative dose for most of medical diagnostic X-ray workers through their worklife in Tianjin is 20-150mGy, with an average value of 115.66mGy. Most of the annual dose of medical diagnostic X-ray workers in Tianjin is lower than 20mGy/year, and the average value is 4.34 mGy/year. Compared with the average annual dose of each group that began to engage in X-ray work in China in different years which was found by Wang[14] et al., the change trend is basically the same, but the dose of Tianjin medical diagnostic X-ray workers is obviously lower than that reported in the literature. These datas provide dose basis for the epidemiological cohort investigation of medical

X-ray workers, and provide basic data for risk evaluation of low dose radiation carcinogenesis, so it is necessary to estimate the personal dose of medical diagnostic X-ray workers in Tianjin.

ACKNOWLEDGMENT

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Research and Practice on Nurturing O-P-E-N Talents of Mathematics Major

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Abstract: In the context of new engineering disciplines, this article explores the O-P-E-N model for the training of innovative talents in mathematics major, that is, Object, Process, Emulation, Need four levels progressive talents training model. Team building and capacity development are open-ended. Encourage the integration of mathematics with engineering, economics and other fields. This is another connotation of the O-P-E-N model. Applying this model for the training of mathematics professionals can achieve the goal of improving the traditional model, the quality of teaching, and the students' comprehensive literacy and innovation ability.

Keywords: O-P-E-N model; open team; mathematics major; talent training.

1. INTRODUCTION

The era of data science has come and the basic position of mathematics has become more obvious. However, due to the difficulty of mathematics learning and the limitations of traditional education models, the training of mathematics professionals has become a widespread concern in colleges and universities. How to cultivate innovative talents adapted to the needs of social development is an important issue that is being explored in many mathematics departments. All kinds of comprehensive universities in China are engaged in the construction of mathematics specialty and the reform and practice research on the training mode of professional talents[1-2].

This paper aims to explore the new model of innovative talent cultivation for mathematics majors in colleges and universities. Truly realize the change from being teacher-centered to education-centered. Realize the transition from knowledge-centered to capability-centered. Realize the shift from lecture-centered to learning-centered. Ultimately realize the connotation of higher education[3-5]. Leave the creativity of teaching to teachers and return the initiative of learning to students. Develop students into innovative people. Give full play to student personality. Effectively promote teaching work. Improve the quality of teaching and innovative talents.

2. O-P-E-N TALENT TRAINING MODEL

O-P-E-N teaching mode is Object, Process, Emulation, Need four levels progressive talents training model.

First of all, make clear Object and take it as guidance. A clear object is a necessary condition for improving efficiency. A man without goal is like a ship without a rudder, doomed to drift, stranded in the mudflats of disappointment. The same is true of the teaching process, and the clear teaching objectives clearly define the direction of teaching. The teaching object is the starting point and destination of teaching. It is the teacher's explicit explanation of the learning achievement or final behavior that the student achieves. All teaching activities are centered on teaching objects and personnel training goals. As far as it is concerned, it has the inherent stipulation to govern the teaching practice, plays a role in governing and guiding the teaching process, and is also the basic basis for teachers to design classroom teaching. The analysis and determination of teaching objectives is the starting point of teaching design. It first determines the expectations of teaching on the level of student learning content, and gives teacher a clear direction. Secondly, it provides the measurement and evaluation criteria for the completion of teaching tasks. Therefore, it is a basic and important prerequisite for teachers to make clear teaching and personnel training objects.

Secondly, Process management. Teaching process management includes teaching process planning, process implementation, process supervision and process improvement. The main body of a good teaching and learning environment is students. It is possible to achieve a positive interaction between teaching and learning by building a core team of students for teaching and research. Select qualified students to form this team. With the team as the core, the students of the entire specialty are encouraged to conduct professional-teacher-led, student-centered learning and research group activities. Conduct group discussion activities on a regular basis. Regularly invite relevant professional teachers to give lectures. Involve the student's core team in teaching process planning, process implementation, process testing, and process improvement.

Thirdly, Emulation of competition. Practice training through competitions to promote students to apply the theoretical knowledge learned in the classroom to solve practical problems. Through competitions, students can use their experience to apply their knowledge, thereby stimulating students' enthusiasm for learning and realizing the use of competition to promote learning.

Finally, Need driving. Research, develop, and collect

practical problems in the field of professional teaching and introduce them into student practice. Cultivate students' practical ability to meet the needs of the industry, and expand social services to achieve the purpose of need-driven teaching.

3. O-P-E-N TRAINING MODEL FOR MATHEMATICS MAJOR TALENTS

According to the North China University of Science and Technology 2016 new talent training program and mathematics talent training objectives, combined with the characteristics of mathematics major, O-P-E-N teaching model is introduced.

(1) Object of teaching

In 2014, the Mathematics Teaching Guidance Committee of the Ministry of Education promulgated the "National Regulations for the Training of Mathematics Professionals" and pointed out that: This major develops senior specialized talents who master the basic theory and basic methods of mathematical science, have the ability to use mathematical knowledge and computers to solve practical problems and are trained in scientific research. These talents can be engaged in teaching, research work in the education, science and technology, economic and financial sectors, or practical application, development research and management work in production, operation and management department, or continuing to pursue graduate degree. The actual work capabilities include: (1) the ability to acquire knowledge: including self-learning ability, expression ability, social ability, computer and information technology application ability; (2) the ability to apply knowledge: including comprehensive application knowledge to solve problems and comprehensive experimental capabilities; (3) the ability to innovate: including creative thinking ability, innovative experimental ability, scientific and technological development ability, and scientific research ability. We put forward the goals of personnel training and teaching for Mathematics and Applied Mathematics and Information and Computing Science. The goal of training talents for Mathematics and Applied Mathematics is to cultivate high-quality composite applied mathematics talents who master the basic theory and methods of mathematics, have good mathematics thinking ability and mathematics literacy, and at the same time have relevant foundation in finance and economics, have strong adaptability, master the use of modern information technology and quantitative analysis methods and make qualitative analysis and quantitative calculation of financial and economic activities. The goal of personnel training in Information and Computing Science is to cultivate high-quality applied scientific talents and data scientists with good mathematical literacy in the context of data science and engineering calculations who Master the basic theory, methods and skills of computational science and data analysis, received initial training in scientific research and software development, have the ability to use computational technology and cloud computing platforms to solve large-scale engineering calculations and data resource utilization problems.

(2) Process management

The key to process management lies in team building and management methods. With the mathematics teacher as the core, inviting the engineering professional teachers who have the foundation for cooperation to participate in to found teachers team, undertaking the work of teaching, guidance, and supervision. Select students with excellent academics to form a student team, with the team as the core to drive the students of the entire professional group to carry out learning, research and discussion group activities, and let the student team participate in the planning, implementation, detection and improvement of the cultivation process. Improve students' participation in learning, and change from "teaching mainly" to "learning mainly". Explore the integration of the study in class and out of class. Actively advocate research teaching. Set up small class seminar. Use inquiry-style, case-based, problem-based teaching methods. Use modern teaching modes such as MOOC, Flipped Classroom, etc. Constantly innovate teaching methods, improve teaching efficiency, and stimulate students' enthusiasm, initiative, and creativity. Strengthen independent learning. Strengthen students' learning ability. Focus on scientific thinking and scientific method training to provide students with the necessary ideas and methods for lifelong learning. Focus on the cultivation of students' ability. Pay attention to the all-round development of moral, intellectual and fitness level as well as the appreciation of aesthetics. The cultivation of ideological and moral character, scientific spirit, humanistic quality, healthy personality education, and innovative practical ability is carried out throughout the entire process of talent training. Place emphasis on conducting extra-curricular science and technology activities focusing on the training of scientific research projects and subject competitions. Increase the proportion of social practice to promote quality. In the summer of 2017, we organized the "Engineering Computation Summer Training Camp". In November, we invited the researcher of Chinese Academy of Sciences Dehao Yu to give a report and invited the experts of the Big Data Department of Computer Network Information Center, Chinese Academy of Sciences and Jidong Oilfield Information Center to give students cross-disciplinary lectures. Broaden the horizon of students and improve their overall quality.

(3) Emulation of competition

Practice training for students through competition and promote students to apply the theoretical knowledge learned in the classroom to solve practical problems. Students of mathematics major can participate in various competitive events. Encourage students to

participate in China Undergraduate Mathematical Contest in Modeling, Mathematical Contest in Modeling/Interdisciplinary Contest in Modeling, the Challenge Cup, ASC Student Supercomputer Challenge, etc. Exercise students' practical ability and creative ability through a variety of competitions. Stimulate students' enthusiasm for learning, and achieve the purpose of teaching with competition. Teaching with competition is to combine the actual needs of society, combine the content of courses, skills, and innovation with specific course content and professional training objects, combine discipline competition with curriculum learning and skills training, integrate learning, practice, competition, teaching and management. Taking the competition as an opportunity, the purpose is to improve the students' professional skills and sense of innovation, and at the same time improve the teaching level of the teachers' team and the management service level of the school. Achieve the overall improvement of the college students' professional skills and professional practice ability to lay the foundation for participation in practical topics and future career development.

(4) Need-driven

To meet the need of industry, research, develop, and collect practical problems in different professional fields, introduce them into student practice, and cultivate students' practical ability. At the same time, expand social services and achieve the purpose of need-driven talent training. In order to cultivate innovative talents, mathematics teachers need to establish close links with teachers of various disciplines, openly attract other professional teachers to put forward the mathematical difficulties encountered in scientific research, and carry out cooperation so as to provide students with opportunities for real problems. Financial mathematics direction of Mathematics and Applied Mathematics is to carry out student professional practice activities based on financial data analysis laboratory, including securities investment analysis and quantitative investment model research. Mathematical theory and application direction is to carry out differential equation modeling and solution, algebraic representation theory, portfolio optimization and other aspects of research. Relying on the key laboratory of data science and application in Hebei province, the information and computing science major works closely with the Computer Network Information Center of Chinese Academy of Sciences, HBIS Technology Center, and the Jidong Oilfield Information Center to carry out research on data analysis and numerical simulation in related fields. In the era of rapid development of big data, the internet of things, and artificial intelligence, the demand from outside the school provides a good opportunity for the mathematics professional participating companies to provide information intelligence, and can apply the mathematics knowledge learned in the school to solve practical problems. Improve students' interest in learning while benefiting the company. It also provides a channel for the employment of mathematics graduates.

4. CONCLUSION

This paper discusses the O-P-E-N talent training model for mathematics majors and conducts preliminary practice. Through the four stages of Object, Process, Emulation, and Need, an open teacher team and student team are built. Meet the needs of society and jointly cultivate innovative talents. In the practical problem solving section, it is possible to directly provide mathematical solutions to problems in various fields. The cultivated mathematics talents can stay in this major for further study, and they can also go through the professional graduate studies based on the actual topics involved in the undergraduate degree, which will also play a supporting and promoting role in the cultivation of graduate students in our university. Each link of the O-P-E-N model is independent and closely linked. It applies to all majors and has good promotion and application value.

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Application of Multivariate Statistical Methods in Carrying Capacity of Water Resources in Hebei Province

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Abstract: In view of the subjective randomness of fuzzy comprehensive evaluation algorithm, it is proposed to use the principal component analysis method and k-means dynamic clustering method for comprehensive evaluation of water resources carrying capacity. Firstly, the indicator system of water resources carrying capacity was established, and 12 indicators were selected to comprehensively assess the water resources carrying capacity of major cities in Hebei Province. Secondly, principal components analysis was performed on 12 indicators. Three principal components were selected to represent the original indicators. Then, k-means dynamic clustering was conducted to classify major cities in Hebei Province into two types of cities based on water resources carrying capacity. Among them, Handan City, Xingtai City, Shijiazhuang City and Baoding City are the first-class cities, and the remaining cities are the second-class cities.

Keywords: multivariate statistical analysis; water resources carrying capacity; principal component analysis; k-means clustering

1. INTRODUCTION

The research results of foreign water resources carrying capacity are relatively few in China, and they are often categorized as research in sustainable development theory. Among the few research results abroad, the literature [1] studied the quality and demand of water resources in the Bodrum peninsula. The literature [2] analyzes the environmental carrying capacity of land resources and water resources in Yogyakarta, and gives the critical values of land resources and water carrying capacity. The literature [3] analyzes the balance of water supply and domestic demand in the Algerian capital of Algeria, and introduces the concept of water resources carrying capacity (WRCC).

The exploration of water resources carrying capacity in China began with the study of water resources in the arid regions of northwestern China. Due to different research purposes, the definition of environmental carrying capacity is different, and the existing definition of water resources carrying capacity can be roughly classified as water resources development. The maximum capacity used and the maximum support scale of water resources are two types [4]. The research methods include general trend method, multi-objective analysis method, fuzzy comprehensive evaluation method, principal component analysis method, and system dynamics method. Among them, principal component analysis method has strong objectivity. Therefore, this paper intends to use principal component analysis method for Hebei. The water resources carrying capacity of the province is studied.

2. RESEARCH METHODS

(1) Establishing an evaluation index system for water resources carrying capacity

The purpose of establishing the evaluation index system is to select suitable indicators and establish an orderly and comprehensive evaluation index system according to the index system. The establishment of the indicator system for water resources carrying capacity needs to proceed from the theory of sustainable development and closely integrates the application of system theory in water resources. The indicator system should include the water resources subsystem, population subsystem, socio-economic subsystem, and ecological environment system. [5]

The establishment of the indicator system for water resources carrying capacity must also follow the principles of testability, system, level, and comprehensiveness. [5-6] Based on the above principles, the Hebei Water Resources Bulletin and the Hebei Economic Statistics Yearbook For the data source, 12 indicators were selected to build a three-tier index system for water resources carrying capacity. Figure 1 shows the indicator system of water resources carrying capacity.

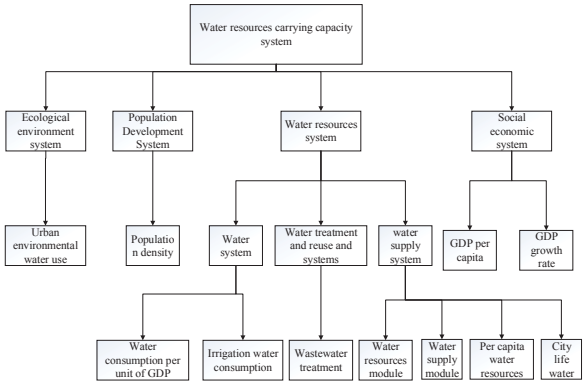

Figure 1 Indicator System of Water Resources Carrying Capacity

(2) Water resources carrying capacity evaluation method

a. Principal component analysis

In the research of multi-index problems, principal component analysis is usually used to achieve the goal of dimensionality reduction. [6] Using the principal component analysis method, the development level of the system can be measured. The principle of principal component analysis is as follows:

There are m samples, each sample observes p indicators: X_1, X_2, Λ, X_P, get the original data array:

$$X = \begin{pmatrix} x_{11} & x_{12} & \Lambda & x_{1p} \\ x_{21} & x_{22} & \Lambda & x_{2p} \\ \mathrm{M} & \mathrm{M} & \mathrm{O} & \mathrm{M} \\ x_{m1} & x_{m2} & \Lambda & x_{mp} \end{pmatrix} = \begin{bmatrix} x_1 & x_2 & \Lambda & x_p \end{bmatrix} \quad (1)$$

$$X_i = \begin{pmatrix} x_{1i} \\ x_{2i} \\ \mathrm{M} \\ x_{ni} \end{pmatrix}, \ i = 1,2,\Lambda\ ,p \quad (2)$$

Calculate the correlation coefficient matrix

$$R = \begin{pmatrix} r_{11} & r_{12} & \Lambda & r_{1m} \\ r_{21} & \mathrm{M} & & \mathrm{M} \\ \mathrm{M} & \mathrm{M} & \mathrm{O} & \mathrm{M} \\ r_{n1} & r_{m2} & \Lambda & r_{mm} \end{pmatrix} \quad (3)$$

In formula (2), the correlation coefficient of the original variables x_i and x_j is calculated as $r_{ij}(i, j = 1,2,...,m)$

$$r_{ij} = \frac{\sum_{k=1}^{n}(x_{ki} - \bar{x}_i)(x_{kj} - \bar{x}_j)}{\sqrt{\sum_{k=1}^{n}(x_{ji} - \bar{x}_i)^2 \sum_{k=1}^{n}(x_{ki} - \bar{x}_j)^2}} \quad (4)$$

Finding eigenvalues and eigenvectors

Solve the eigenvalue equation with the Jacobi method:

$$| R - \lambda_i | = 0 \quad (5)$$

By solving the characteristic equations, m eigenvalues and eigenvectors corresponding to each eigenvector can be obtained.

$$\begin{cases} F_1 = a_{11}X_1 + a_{12}X_2 + \Lambda + a_{1p}X_p \\ F_2 = a_{21}X_1 + a_{22}X_2 + \Lambda + a_{2p}X_P \\ \Lambda \ \Lambda \\ F_m = a_{m1}X_1 + a_{m2}X_2 + \Lambda + a_{mp}X_p \end{cases} \quad (6)$$

Extract principal components based on cumulative contribution rate

The ratio of the variance (p<m) of the first p composite indicators to the total variance of all indicators, ie, the cumulative contribution rate

$$a = \frac{\sum_{k=1}^{p}\lambda_k}{\sum_{i=1}^{m}\lambda_i} \quad (7)$$

The number of principal components usually required to be extracted satisfies $a > 0.85$, indicating that the extracted p comprehensive indicators retain 85% of the original indicator information.

Principal component composite score calculation

The principal component analysis is used to extract p principal components and obtain the principal component score. However, this score does not take into account the contribution of the principal component to the variance contribution rate. Therefore, the principal component's variance contribution rate is calculated as the weight of each principal component. Comprehensive score F'.

$$F_i' = \frac{\lambda_i}{\lambda_1 + \lambda_2 + \Lambda + \lambda_p} F_i \quad (8)$$

b. K-means cluster analysis

The extracted principal components were clustered to classify the water resources carrying capacity of major cities in Hebei Province for evaluation.

In clustering algorithm, dynamic clustering algorithm has the advantages of high efficiency and high speed. The most common algorithm is the k-means dynamic clustering algorithm. The specific calculation steps are as follows:

Select the initial clustering point and initial classification.

Calculate the initial K class averages, and then calculate its distance to the initial K class one by one for all samples. If a sample is closest to his original class, it is still in the original class, otherwise it is moved to it. From the nearest category, recalculate the center of the class that lost the sample and the center of gravity of the class that received the sample, and recalculate the mean of each class as the aggregation point for that class.

Recalculate step (2) until all samples cannot be

reached. [7]

(3) Case study of evaluation of water resources carrying capacity

This paper uses 12 indicators to build a water resources carrying capacity system. They are: urban environmental water consumption X_1, population density X_2, water consumption per unit of GDP X_3, irrigation water consumption X_4, water consumption for wastewater treatment X_5, total water resources X_6, total water volume X_7, Per capita water resources (billion cubic meters per person) X_8, urban public water consumption X_9, per capita GDP X_{10}, GDP growth rate X_{11}, total population X_{12}.

First calculate the correlation coefficient matrix between variables, then calculate the eigenvalues and eigenvalues and the cumulative contribution rate, as shown in Table 1.

Table 1 Interpretation of total variance

Ingredient	Initial feature value			Extract the square sum of loads		
	Total	Variance percentage	Accumulation %	Total	Variance percentage	Accumulation %
1	5.817	48.473	48.473	5.817	48.473	48.473
2	2.888	24.066	72.538	2.888	24.066	72.538
3	1.454	12.120	84.658	1.454	12.120	84.658
4	.714	5.951	90.610			
5	.653	5.444	96.053			
6	.238	1.982	98.035			
7	.157	1.308	99.343			
8	.044	.369	99.712			
9	.027	.224	99.937			
10	.008	.063	100.000			
11	1.078E-16	8.982E-16	100.000			
12	-1.119E-16	-9.325E-16	100.000			

From Table 1, we can see that we have selected the first three principal components, and the cumulative contribution rate has reached 84.658%, which represents most of the information of the original indicator and achieves the goal of dimensionality reduction for subsequent research. From equation (8) we can calculate the composite score of the principal component.

Table 2 Main component composite score

Administrative division	FAC1	FAC2	FAC3	overall ratings
Handan	-0.10531	0.04917	-1.05236	-0.19674658
Xingtai city	0.22648	-1.04755	-0.99987	-0.30720181
Shijiazhuang City	2.16734	1.40308	-0.86931	1.50393487
Baoding City	0.57269	-0.10279	-1.58866	0.07047372
Hengshui City	-0.83393	0.00681	-0.16067	-0.49640911
Shengzhou City	-0.74295	0.80175	0.5046	-0.1268337
Langfang City	-0.78721	1.39595	0.51235	0.01542235
Tangshan City	1.20292	0.76897	2.0391	1.1925673
Qinhuangdao City	0.54881	-1.11308	0.87617	0.12645161
Zhangjiakou City	0.04554	-1.09611	0.54137	-0.20353709
Chengde City	0.24771	-1.74661	0.57876	-0.26509342
Dingzhou City	-1.23617	0.25174	-0.66184	-0.72877282
Xinji City	-1.30591	0.42866	0.28036	-0.58425242

According to the principal component scores, we can carry out k-means dynamic cluster analysis and divide 13 cities in Hebei Province into two categories, among which Handan City, Xingtai City, Shijiazhuang City and Baoding City are the first type, and other cities are the second type. Referring to the relevant literature [5], it is known that one type of city is an overloaded city, and the second type of city is a weakly overloaded city.

3. CONCLUSION

Based on the full analysis of the relevant data of water resources in Hebei Province, this paper selects a number of indicators to form an evaluation index system for water resources carrying capacity. The impact factors of urban water resources carrying capacity were analyzed from four aspects: the water resources system, social economy, ecological environment, and population development subsystems. These influencing factors combined with the sustainable use of water resources and sustainable development indicators proposed by On the basis of comparison and learning, the candidate indicators for urban water resources carrying capacity were obtained.

The principal component analysis method is used in processing indicators, and the information contained in the original indicator is replaced by a few new indicators, that is, principal components, which are more objective in the calculation process and subjective randomness is avoided. At the time of clustering, Handan City, Xingtai City, Shijiazhuang City and Baoding City were divided into one category and the overall score was low, indicating that the water resources carrying capacity was poor.

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Influence of Load on Power System Stability

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Abstract: With the interconnection of the regional power grid, the content of the power of low-voltage distribution systems is constantly rising, the power supply of distribution systems meet their own needs at the same time they usually transmit electricity back to the main system through the system interconnection transformer, low-frequency oscillation has become a prominent issue in China's power system. Studying the transient stability of power system is of great significance to its planning, design and safe operation, however, when carrying out the transient stability calculation of the power system, adopting different load models will greatly affect the result of the calculation. This article analyzes the current general survey of some domestic and foreign experts and scholars, Combing, summarizing the relevant literature, to carry out further research.
Keywords: electric power system; stability; load model

1. INTRODUCTION

With the increasing of load center level, large-capacity long-distance transmission is constantly increasing; the issue of voltage stability of the power system is also increasingly prominent. In recent years, many voltage instability events have occurred worldwide, and many voltage instability events have led to the collapse of the system, resulting in a large blackout, not only to the power sector and other electricity industry to bring a huge economy Loss, but also greatly affected the people's normal life. Therefore, it is undoubtedly of great theoretical and practical significance to study the problem of voltage stability, study the mechanism and development process of voltage instability, and propose measures to effectively prevent voltage instability and voltage collapse.

Voltage instability events usually occur in the load area bus. When the power supply is far away from the load center, the transmission line is heavily loaded or the load center is reactive, especially when the dynamic reactive power support is insufficient, the system is prone to voltage instability by the terminal bus. The voltage instability caused by the terminal bus has a very close relationship with the characteristics of the integrated load below the bus bar. The process of voltage instability is the process of the unbalanced and gradual deterioration of the load power. The system collapse caused by voltage instability is such a kind of instability. Therefore, the relationship between integrated load characteristics and voltage instability is the key to the research of voltage stability.

2. INFLUENCE OF LOAD ON VOLTAGE STABILITY

(1) Definition of Voltage Stability

Physical essence

From a physical point of view, the voltage stability of the power system is the ability of the power system to maintain the load voltage within a specified operating limit [1]. This ability mainly depends on whether the power delivered by the network to the load meets the power requirements of the load itself. If the power delivered by the network to the load cannot meet the load's own power requirements, the load voltage will drop, and in severe cases, the system will fail or even collapse.

(2) Domestic research

The definition of voltage stability defined by foreign classic [2]: The voltage stability of power system is defined as the ability of the power system to maintain the voltage of all nodes in acceptable steady-state values under normal operation or under disturbed conditions; When a disturbance such as load increase, or system conditions change, causing the voltage continued, uncontrollable decline, the system will enter the voltage instability. This definition describes in detail and comprehensively the performance characteristics of the power system in two states: voltage stability and voltage instability.

(3) Foreign research

China's "Guide on security and stability for power system" also gives the definition of voltage stability. Voltage stability refers to the ability of the system voltage to maintain or recover within the allowable range after a small or large disturbance to the power system, without the possibility of voltage collapse [3]. This is the definition of voltage stability based on the actual operation of the power system.

Voltage instability mechanism

In accordance with the time of voltage instability, voltage stability can be divided into short-term voltage stability and long-term voltage stability. Short-term voltage stability, also known as transient voltage stability, has a time-domain range of less than 10 s, voltage collapse is mainly caused by load components with fast-tuning characteristics such as induction motors, electronically controlled loads and DC-link converters. Long-term voltage stability time domain range of several minutes, typically 2 ~ 3 min, voltage collapse is mainly caused by the dynamic characteristics of the load with automatic tap changer, generator maximum excitation limit and temperature control load.

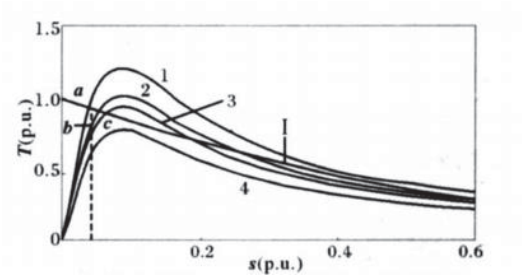

Fig. 1 Torque-slip characteristic curves of induction motor

Short-term voltage instability mechanism

Let's analyze the induced motor load caused by short-term (transient) voltage instability. When a disturbance occurs in the system, such as removing a certain line or a generator, the voltage of the induction motor suddenly drops. If the terminal voltage drop is small, the input electromagnetic torque is less than the output of the mechanical torque, the speed decreases, the slip increases, the operating point moves to the right, the electromagnetic torque continues to increase, while the mechanical torque is slightly reduced small. In the above process, on the one hand, as the slip increases, the equivalent impedance of the motor decreases, so that its terminal voltage will decline; on the other hand, the slip will increase the motor current increases, Network reactive power increases, also led to the motor voltage drop. As this voltage drop, the electromagnetic torque characteristic will move downward. If the input electromagnetic torque equals the output mechanical torque when the motor slip increases to a slip value, the system will operate stably. If the terminal voltage drop is large, the electromagnetic torque of the motor is always less than the mechanical torque during the speed reduction, the induction motor will stall [1], the speed decreases rapidly, meanwhile, the reactive power absorbed from the grid increases sharply, this causes a further decrease of the terminal voltage, which causes successive stalling of adjacent induction motors in parallel. As a result, the voltage of the load bus bar continuously decreases, which eventually leads to voltage instability.

Long-term voltage instability mechanism

If the system can maintain the transient voltage stability after the disturbance, the system will run stably after the dynamic process in the transient time range. At this time, the voltage is lower than the normal operating voltage and the system is in a more vulnerable state. After about a few tens of seconds to a minute, the OLTC in the load zone begins to act in an attempt to recover the voltage on its low voltage side, which results in the restoration of the power absorbed by the voltage-sensitive load element from the grid and an increase in the voltage drop across the transmission line. Instead, the voltage drops. OLTC regulation effect is equivalent to increasing the admittance of the integrated load, the load characteristic curve and thus continues to move down, load bus voltage followed by declining.

The recovery of load power will lead to the increase of transmission line current, the increase of power loss, and will lead to the increase of generator reactive output and the increase of excitation current. When the generator excitation current exceeds the limit value for a certain time, the over excitation limiter will act and the excitation current will be reduced to the normal value through the adjustment device. As a result, the terminal voltage of the generator suddenly drops, the output reactive power decreases, which will result in an increase of reactive power near the generator output and an increase of excitation current. When the limit value exceeds a certain value, its OX will follow the action and cause a chain reaction of other generators. If there is no intersection between the P-V graph and the load characteristic curve, the power transmitted by the entire system to the load node at any voltage will not meet the load's own power requirements and the system will experience voltage instability.

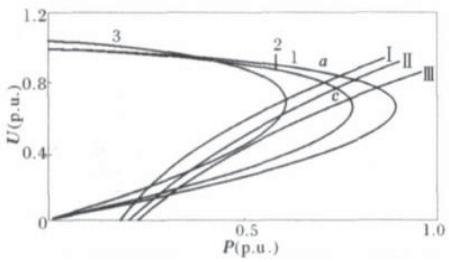

Fig. 2 PV characteristic curves of load bus

Analytical method of voltage stability

Voltage stability is divided into small interference voltage stability and large interference voltage stability. Small interference voltage stability analysis methods are mainly tidal current simulation method and small interference analysis method, large interference voltage stability analysis methods are mainly time domain simulation method.

The power flow simulation

In this method, the conventional power flow simulation is performed by increasing the load continuously to obtain the P-V characteristic curve of the system, and the system transmission power limit point is taken as the voltage stability critical point. Since the constant power model is used in the load flow during the tidal current iteration, the Jacobian of the current flow is singular at the maximum transmission power point of the P-V curve, and the power flow iteration does not converge. Therefore, the voltage stability critical point cannot be obtained.

In response to this problem, researchers are devoted to developing various methods to calculate the transmission power limit as accurately as possible. CFC method is a widely used method, which obtains the solution of continuous power flow equation with load as a parameter and gradually approximates the maximum transmission power point through a series

of "prediction-correction" calculations.

Small interference analysis

The small interference analysis method linearizes the system of nonlinear differential equations describing the power system around the equilibrium point. By analyzing the eigenvalues of the state matrix of the small interference equation, the stability of the system at a given operating point is judged. It is a dynamic system of small interference strict mathematical method of stability analysis. At present, this method is mainly applied to the qualitative analysis of the voltage stability of a simplified two-node or three-node (including OLTC) system to discuss the influence of the characteristics of various components and their interactions on the voltage stability of the system.

Time simulation method

If we can use the accurate mathematical model of each component and the simulation algorithm with higher accuracy and better numerical stability to simulate the whole power system in time domain, we can reflect the whole real process of voltage instability in the system, Steady variety of factors. Therefore, the time simulation method is considered as the most accurate method for all voltage stability analysis methods and is used to measure the accuracy of other analysis methods.

H Bifurcation theory

Bifurcation theory is a qualitative analysis of the properties of the solution to nonlinear differential equations. When the system parameters change around a certain critical value (bifurcation point), the properties of the solution to the differential equations describe the nonlinear system change qualitatively, corresponding to the change of the system stability.

Energy Function Method

Energy Function Method by using Lyapunov direct method, evaluates the stability of the system described by nonlinear differential equation. The method provides a quantitative measure of system voltage stability using an energy function that clearly shows the distance between the system's current operating point and the point where voltage collapse occurred.

Voltage stability index

The voltage stability index is a physical quantity that reflects the voltage stability of the current operating point of the system. There are two kinds of indicators: state index and margin index.

The state index is an indicator of the degree of voltage stability by describing the physical quantities of the system operating states and their changes. There are mainly the values of the deterministic Jacobian matrix, the minimum mode characteristic value and the minimum singular value. Due to the nonlinearity of the power system itself, it is difficult to calculate from the state index how much load the system can increase to become unstable, which affects its practicability. However, state metrics are useful for judging weak nodes or weak areas in your system.

The margin index is an indicator of the degree of voltage stability based on the distance from the current operating point of the system to the point of voltage instability, including active load margin P, reactive load margin Q, and voltage margin V. The margin index can intuitively represent the voltage stability of the current operating point of the system to operators, and the indexes P and Q are relatively linear [4]. Therefore, it has been widely used in practice.

Influence of load on transient stability

Statical load power

Static load model is usually expressed as follows

$$P = P_0\left[a_P\left(\frac{U}{U_0}\right)^2 + b_P\left(\frac{U}{U_0}\right) + c_P\right]$$

$$Q = Q_0\left[a_q\left(\frac{U}{U_0}\right)^2 + b_q\left(\frac{U}{U_0}\right) + c_q\right]$$

Among them, the voltage quadratic constant impedance load that voltage once said that the constant current load, constant term constant power load. Obviously, in static load, the trend of constant impedance load and constant current load are basically the same with the node voltage, while the power absorbed by constant impedance load is the most affected by the node voltage and proportional to the square of voltage variation. In order to reflect the situation under the most serious situation, the static load model used in this paper adopts pure impedance load model to study.

The mechanism of motor load absorption power affected by the change of terminal voltage

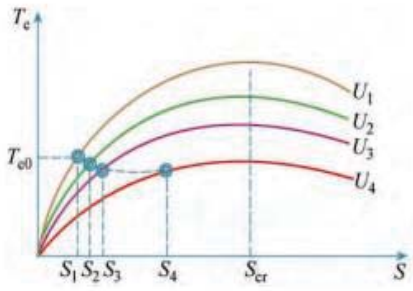

Fig. 3 Induction Motor Static Torque - Slip Characteristic

Motor load absorption power by the terminal voltage changes for the stable operation of the motor at different terminal voltage static characteristics. In the static process, when the voltage drops rapidly, the electromagnetic power of the motor decreases rapidly, but the slip cannot suddenly change, so the mechanical load is basically unchanged, and the motor decelerates and the slip increases. According to the slip-voltage characteristics, the electromagnetic power of the motor will decrease as the voltage decreases, and increase as the slip increases. However, the mechanical load decreases as the slip increases. When the electromagnetic power and mechanical load

reach equilibrium, the motor stabilizes at the new operating point [5, 6]. Therefore, in the transient process, the motor slip, the load will be a series of fluctuations in the overall static and steady direction of the specified movement.

Power recovery characteristics of different load models after fault

In order to study the recovery of power absorbed by the dynamic and static loads during the same voltage recovery after instantaneous fault, the equivalent static load and motor load are connected to a load node, and the instantaneous fault occurs at the node after the two types of load absorbed by the power fluctuations.

Through the research, we can see that under the situation that the system tends to be stable and the voltage returns to normal after the fault, the trend of static load and dynamic load fluctuates basically and the fluctuation trend of node voltage is basically the same.

Obviously, when the fault is large and the voltage of the node where the load is fluctuating is large, the rapid increase of the power absorbed by the motor load may lead to its violent fluctuation and even instability of the system. Therefore, the influence of motor load on the transient stability of the system may be related to the operating status and fault type of the system.

3. CONCLUSION

Influence of Load on Power System Voltage Stability

The power absorbed by the static load is mainly affected by the voltage change, and the static load does not absorb more reactive power like a motor load after a fault. The reactive power absorbed by the constant impedance and the constant current load will also decrease with the decrease of the system voltage during the recovery after the fault. To a certain extent, the reactive power shortage of the receiving end system is alleviated, which is in favor of the system voltage recovery.

Influence of Load on Power System Transient Stability

After the fault recovery phase, the motor torque decreases, and then gradually decelerates and the slip increases. As the slip increases rapidly within a short period of time, the motor will absorb extra power from the system and the power will remain at a high level, Swing near the power before failure. For the receiving end, the active power absorbed by the constant impedance load after the fault decreases with the voltage drop, which means that the active unbalance of the receiving terminal unit decreases, which is in favor of the system power balance. The increase of the motor load after the fault means The affected units by the active imbalance increases, is not conducive to system power balance. For the sending end, the effect of motor load and constant impedance load on system stability is just the opposite of the effect at sending end.

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Feature Extraction of Seismic Waveform Signals Based on Factor Analysis Method

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Abstract: In order to better express the characteristics of the waveform information, a model for feature extraction of seismic waveform signals based on factor analysis method is established. With the help of correlation coefficient matrix, the KMO method and Barr Litt sphericity are used to test whether the original variables are suitable for factor analysis, then factor load matrix is estimated. The factor rotation is carried out, and the feature vectors are extracted. Because of the missing values for the data, the mean substitution method is used to deal with the missing values. Extract the most suitable characteristic parameters intuitively. Finally, the threshold and amplitude with high correlation are selected as the characteristic parameters.

Keywords: Feature Extraction; Seismic Waveform Signals; Factor Analysis Method

1. INTRODUCTION

Earthquakes have tremendous destructive power and have caused huge losses to people's lives and property, it will also cause secondary disasters such as tsunami, landslides, collapses, and ground fissures. According to statistics, there are more than 5 million earthquakes on the Earth each year, which means that tens of thousands of earthquakes occur every day. Therefore, earthquake prediction has become an urgent problem to be solved. During the earthquake, the earth's crust releases vibrations caused by energy quickly, and seismic waves are generated during the earthquake. With the improvement of detection technology, people have established a wide range of seismic observation network to monitor seismic activity.Seismic waveform signals are currently the only means of monitoring seismic activity. The feature parameters are extracted by a factor analysis method.

2. METHOD OVERVIEW

There are two core issues in factor analysis: one is how to construct the factor variable; the second is how to interpret the factor variable.Therefore, the basic steps and solutions for factor analysis are centered around these two core issues.Factor analysis often has the following four basic steps:

(1) Confirm whether the original variable to be analyzed is suitable for factor analysis.

(2) Construction Factor Variables.

(3) The rotation method makes factor variables more interpretable.

(4) Calculate factor variable scores.

3. EXTRACTION OF THE SEISMIC CHARACTERISTIC SIGNAL

There are two core issues in factor analysis: one is how to construct the factor variable; the second is how to interpret the factor variable.

(The data comes from the school game modeling problem of North China University of Science and Technology.)

(1) intercept data to determine the study object:

Observe the waveform information data and find that the end of a single complete signal is 0 continuous, the algorithm removes the single complete signal obtained from the 0-sequence and obtains M1~M110, a total of 110 sample sets. The resulting collection accounted for 60.66% of the total element weight, and more than 20,000 elements were studied.

(2) Feature Extraction

a. Data Preprocessing

In order to eliminate the data difference due to the magnitude of the seismic wave energy, the waveform data used in the experiment was normalized.

$$PX_1 = \frac{X - \min(x)}{\max(x) - \min(x)} \tag{1}$$

In the formula: PX1----Amplitude of the waveform data after normalization

X----- original recorded waveform signal amplitude

b. Characteristics of seismic waveforms

Selection of factor analysis variables (selection of relevance, which is conducive to dimension reduction) --- standardization

Find the mathematical expectation and standard deviation Si of each variable;

$$\bar{x} = \frac{(x_1 + x_2 + \ldots + x_n)}{n} \tag{2}$$

$$Si = \sqrt{\frac{((x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \ldots + (x_n - \bar{x})^2)}{n}} \tag{3}$$

Standardized processing:

$$Z_{ij} = (\mathrm{X}_{ij} - \bar{x}) / \mathrm{Si} \tag{4}$$

Where: the normalized variable value; the actual variable value

Then reverse the sign before the inverse index. Normalized variable values fluctuate around 0. A value greater than 0 indicates an above-average level, and a value below 0 indicates a below-average level.

Covariance matrix or correlation matrix based on samples, estimated random parameters

Table 1 Component Matrixa

	element	
	1	2
Threshold - mean squared error	0.692	-0.682
The largest value	0.729	-0.653
Ringing count	0.456	0.845
Duration	0.916	0.362
Rise Time	0.958	0.241
Picking method: analysis of the main component.		
a. Capture 2 components.		

Choose a method—estimate the factor loading matrix to calculate key statistical characteristics

X=AF, the factor load matrix A is not unique. The software uses different parameter estimation methods to find the corresponding estimation matrix. This paper uses the principal component method.Get two parameters z_1 , z_2 .

$$z_1 = \sum_{i=1}^{n} i * x_i \quad , \quad Z_2 = \sum_{j=1}^{n} j * x_j \tag{5}$$

Where Xi represents the first column of data and Xj represents the second column of data.

Rotate the factors to clarify the meaning of the factors and name them. Use factors to explain the composition of variables

If the factor load is relatively even, the economic meaning of the initial factor load matrix description is not obvious, and when it is difficult to determine the relationship with each factor, factor rotation is needed.Through factor rotation, the contribution of common factors after rotation is more dispersed, and the main factor is named to determine the economic meaning.

Table 2 Rotating element matrix

	element	
	1	2
Threshold - mean squared error	0.084	0.968
The largest value	0.130	0.970
Ringing count	0.895	-0.346
Duration	0.932	0.319
Rise Time	0.885	0.438

Score

Table 3 scores

Z_1coefficient	Z_2coefficient
0.401134	-0.50918
0.422582	-0.48753
0.264331	0.630878
0.530981	0.27027
0.555327	0.179931

4. THE SIMULATION RESULTS

Earthquakes have tremendous destructive power and have caused huge losses to people's lives and property,it will also cause secondary disasters such as tsunami, landslides, collaps

(1) Results of Feature Extraction

Table 4 KMO and Bartlett Certification

Kaiser-Meyer-Olkin Measure sampling appropriateness.		0.653
Balltlett's Spheroidal Verification	About Jiafang	808.902
	df	10
	Significantness	0.000

Because KMO=0.653 is close to 1, suitable for factor analysis,With 0.000<0.05, the original assumption correlation coefficient matrix is rejected as a unit matrix, indicating that there is a correlation between variables, that is, suitable for factor analysis.

Table 5 Communalities

	Start	Capture
Threshold - mean squared error	1.000	0.944
The largest value	1.000	0.958
Ringing count	1.000	0.921
Duration	1.000	0.970
Rise Time	1.000	0.976

The second column of data in Table 5 shows that the higher degree of common variables Indicates that most of the information in the variables can be extracted by factors.

Explanation: The result of factor analysis is valid.

Table 6 shows the total number of variations

element	Starting feature value		
	total	mutated %	Accumulate %
1	2.976	59.512	59.512
2	1.794	35.884	95.396
3	0.151	3.029	98.425
4	0.070	1.397	99.822
5	0.009	0.178	100.000

Feature extraction

Only the first two factors have eigenvalues >1, and the accumulation accounts for 95.396%, so the first two factors are extracted as characteristic parameters, Select thresholds and amplitudes as characteristic parameters.

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Research Progress on Surface Modification Technology of Medical Titanium Alloy

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Abstract: titanium alloy is widely used in medical field and is an important material for replacing and repairing hard tissue. Some main problems existing in medical titanium alloys are described. The properties of different medical metals were evaluated, and the main methods of surface modification of titanium alloys were introduced, including physical and chemical methods, advantages and disadvantages of modification methods and their application scope. Finally, some defects of titanium alloy functionally gradient materials are discussed and its future development is prospected.

Keywords: titanium alloy; functionally gradient material; surface modification; biological activity

1. INTRODUCTION

Biomedical materials are used to diagnose, treat, repair, or replace diseased tissues, organs, and improve function[1]. Titanium and titanium alloys have excellent physical and chemical properties, good biocompatibility, good corrosion resistance, and can be used as medical metal materials[2]. However, titanium, as a biological inert material, can not form a firm chemical bond between the implant and bone. It is easy to cause loosening and fracture of the implant under external force, and eventually lead to the implant failure[3]. Therefore, enhancing the surface bioactivity of titanium alloys has become one of the research hotspots in the field of medical materials.

For titanium alloys, there are two main ways to enhance the surface biological activity of titanium: one is to start with the material itself, change the composition of the alloy, and develop medical titanium alloys with better comprehensive properties; Secondly, titanium and titanium alloy were treated by various surface treatment methods. The surface modification of titanium alloy has become a hot research field because of its low bioactivity and high cost. This paper introduces the development of medical metals, evaluates the development of medical titanium alloys of different medical alloys and the surface treatment technology of titanium alloys, and analyzes various surfaces. The advantages and disadvantages of the treatment methods are also discussed and the future development is prospected.1

2.1 Plasma spraying

The plasma spraying method[4] is to put the sprayed raw material powder into the powder feeder and use the non-transfer arc spray gun to heat the raw material powder to the melting or semi-melting state, and then spray the coating onto the substrate surface at high speed with the plasma flame flow. The advantage of this method is that almost all metals, alloys and ceramics can be used as spraying materials. Li Mao [5] sprayed tantalum coating on titanium surface by plasma spraying method. The cell experiment results show that the cell adhesion of Ta coating is significantly higher than that of Ti coating, indicating that Ta coating has better cell adhesion than Ti coating. Better cell biocompatibility.

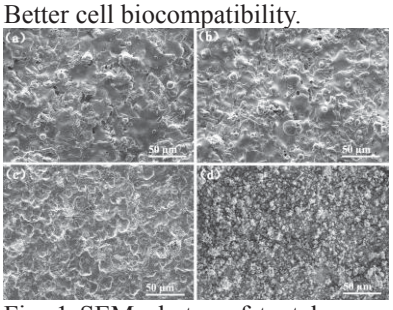

Fig. 1 SEM photos of tantalum coatings prepared at different spraying distances

2.2 Hydrothermal method

Hydrothermal method[6]refers to the process of heating in a specific closed vessel (reactor) to create a high temperature and high pressure reaction environment, which causes the dissolution or recrystallization of refractory or insoluble substances. It has the advantages of simple equipment, convenient operation, easy control of the preparation process, wide applicability and environmental protection. Moreover, the reaction of titanium metal in hydrothermal solution is an interfacial reaction, which ensures that the generated product is closely bound to the titanium substrate. Guo Huan[7]used hydrothermal method to form structured and uniform nanostructured films on titanium surface. The samples prepared by hydrothermal method were further mineralized in simulated body fluids. After immersion in simulated body fluid for 7 days, the surface of the modified titanium sheet can induce the deposition of hydroxyapatite, which can effectively improve the bioactivity of the material.

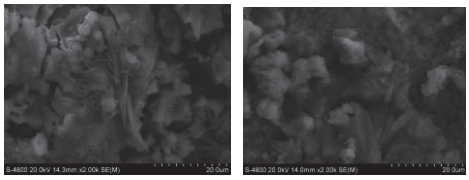

Fig.2 Hydroxyapatites after 7 days

2.3 Anodic oxidation

Anodic oxidation[8]is a process in which metal sheet is electrolyzed as anode and metal oxide is formed on the surface of metal sheet, and the oxide layer reacts immediately with a certain ion in electrolyte solution to produce chemical dissolution. The coating prepared by this method has high bonding strength with the substrate, but the coating is thinner and the preparation cost is higher, so it is not suitable for large-scale industrial production. TiO_2 nanotubes have been prepared on titanium surface by anodizing method, such as Kodarna, etc., as shown in figure 6. Simulated body fluid immersion test showed that the composite modified titanium dioxide nanotubes could Hydroxyapatite deposition on its surface was induced fast enough.

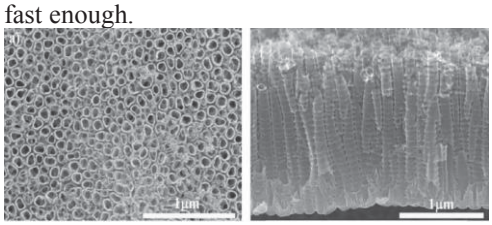

Fig.3 SEM pictures of TiO2 nanotubes prepared by anodic oxidation

2.4 Microarc oxidation method

Microarc oxidation (Mao), also known as plasma oxidation deposition technology, in which metals or alloys such as $Al_2OMg(Ti)$ are placed in electrolyte, and spark discharge spots are produced on the surface of the material by electrochemical method, which is used in thermochemistry. The oxidation layer is formed by the interaction of plasma chemistry and electrochemistry. It is developed from anodic oxidation, but it breaks the voltage limitation of anodic oxidation. This method has the advantages of simple process and no pollution to the environment. It can deal with elements with different shapes, but it also has some problems, such as noise in production process, high energy consumption and so on. Wu Sui-dan using Micro-arc Oxidation Technology in Pure Porous calcium-phosphorus coating was prepared on titanium surface. Cell experiments showed that the cell proliferation and alkaline phosphatase activity of the porous calcium phosphate coating formed on the surface of titanium after microarc oxidation were higher than those of pure titanium, which indicated that the coating had good biological activity.

2.5 Compound technology

Compared with traditional medical materials, metal based biomedical composites, such as stainless steel and titanium alloy, have high mechanical strength, good flexibility, good fatigue resistance and excellent molding process. However, the application of single metal materials in physiological environment is facing the important problem of corrosion. If metal ions spread to biological tissues, it will cause toxic and side effects, and the degradation of their own properties will easily lead to implant failure. Therefore, a metal-based biomedical composite with good biocompatibility and corrosion resistance is a new type of material to be developed by researchers.

The interaction between materials and organisms is complicated, in order to make implant materials better adapt to human environment, it often needs a variety of technology synthesis. Wu Zhenjun [27] prepared Al_2O_3 with porous structure by anodic oxidation method, and then prepared a HA/Al_2O_3 composite biological coating on aluminum substrate by electrodeposition. See figure 3, this coating has high strength and good mechanical properties. It also showed excellent stability in SBF and induced the formation of bone-like apatite. Deng Feilong [28] prepared honeycomb porous structure by micro-arc oxidation method, and formed more polycrystals on titanium surface after hydrothermal treatment. The results showed that there was more HA formation on the surface and the ratio of calcium to phosphorus was close to that of bone, and had good biological activity.

3. CONCLUSION

With the improvement of living standards and the rapid renewal of medical technology, people pay more and more attention to their health. Titanium alloy has excellent comprehensive properties and good biocompatibility. It can be widely used in medical field, such as dental implants, artificial prostheses and other medical devices. At present, the surface bioactivity, corrosion resistance, wear resistance and blood compatibility of medical titanium alloys have made great progress, and these problems have been basically solved. However, there are important differences between the substrate and the coating, which makes it difficult to achieve high strength bonding between the coating and the substrate. It is difficult for a single modified layer to meet the needs of many kinds of properties, so the new coating preparation principle and preparation are developed. The preparation of composite coatings has become an important development direction of surface modification.

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CT Image Reconstruction Based on Radon Transform and Edge Detection

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Abstract: This article is based on the data of the A-question in the National University Student Mathematical Modeling Contest 2017. Through analysis of the X-rays after gain processing, the energy information of the unknown object is used to determine the number of groups of two special positions perpendicular to the coordinate axis. 0-1 planning model was established to count the number of 0s in each of the 180 groups of data, and the 60th and 150th groups were determined to be in two special directions. The angles were 0° and 90°, respectively, and the 180 rotation directions were [30 °, 210 °]. For the 60th group and the 150th group, the simulation was performed on the given calibration template. The spacing of each receiving unit is 0.2778mm, and the coordinate of the rotation center is (-9.4444, 6.1111). By analyzing the image reconstruction principle of CT system, an image reconstruction model based on Radon transform and its inverse transform is established, and the original images of attachment 3 and attachment 5 are reconstructed, the position and geometric shape of the square tray where the image is located are established.
Key word: 0-1 planning; Radon transformation; Radon inverse transformation.

1. INTRODUCTION

CT can perform tomographic imaging of biological tissue and engineering material samples by using the energy absorption characteristics of the sample without destroying the sample, thereby obtaining the internal structural information of the sample. X-rays incident parallel to the detector are perpendicular to the plane of the detector. Each detector unit is viewed as a receiving point and is equally spaced. The relative position of the X-ray emitter and detector is fixed, and the entire transmitter-receiver system rotates 180 times counterclockwise around a fixed center of rotation. For each X-ray direction, the ray energy absorbed by the two-dimensional to-be-detected medium located at a fixed position is measured on a detector having 512 equally-spaced units, and 180 groups of received information are obtained after processing such as gain. The CT system often has errors in its installation, which affects the imaging quality. Therefore, it is necessary to calibrate the installed CT system, that is, to calibrate the parameters of the CT system with a sample of a known structure, and to image the sample with unknown structure.

2. THE DETERMINATION OF THE CENTER OF ROTATION

(1) Data processing

Draw a data image map, analyze the approximate rotation angle, perform 0-1 planning on the data of Annex 2, select the number of 0s in each group, and plot the number of each group 0 to obtain two vertical coordinate system light sources. The two sets of data simulate the data in both directions. There are some groups of data sets, some of which are relatively loose, and a curve that can be seen more clearly in the image. We specify that the detector's leftmost receiving unit is number 1, where there are more data-intensive groups. The data is analyzed and processed, and it can be concluded that there is a light source perpendicular to the X-axis and the light source is above the X-axis and the detector is below the X-axis. This basically determines that there is a part of the rotation range of the light source above the X axis.

(2) Perform 0-1 planning on the data and filter out the number of 0s in each group of data.

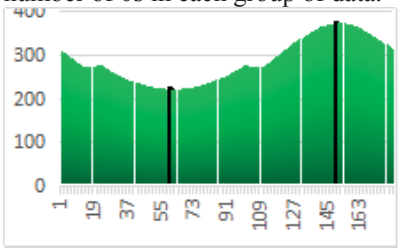

Figure 1. The number of 0s in each group of data in the data

From the number of 0 images in each group, the number of 0s in the 60th group is the lowest, and the number of 0s in the 150th group is the largest. Therefore, the direction of the light sources corresponding to the two groups of data is: Group 60: Light Vertical to the Y axis, parallel to the X axis, illuminates in the negative direction of the X axis. Group 150: The light is perpendicular to the X-axis, parallel to the Y-axis, and shines in the negative direction of the Y-axis. The 60th and 150th sets of data were simulated. The simulation image is shown

in Figure 2:

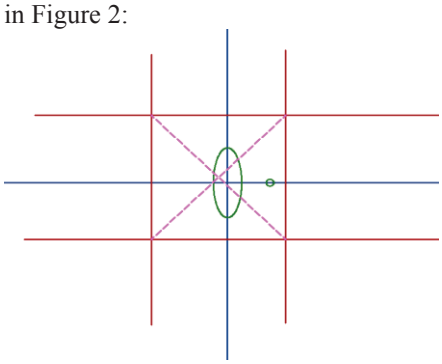

Figure 2. Simulation of data for groups 60 and 150

(3) Establish a 0-1 plan for Group 60 data and Group 150 data.

Group 60: 0: [1,90] ∪ [378,512] 1: [91,378]

Group 150: 0: [1,45] ∪ [75,168] ∪ [279,512] 1: [46,74] ∪ [169,278]

Taking the center of the ellipse as the origin, the distance between each receiving unit is used as the unit length to establish a rectangular coordinate system. In the simulation of Fig. 3 for group 60 and group 150, the intersection of the two-direction edge rays is (-290,278), (222,278), (-290,-234), (222.-234). The center of rotation is the intersection of the diagonals of the squares intersected by the two sets of edge rays, and the coordinates of the center of rotation in this coordinate system are calculated.

$$x_i = \frac{x_1 + x_2 + x_3 + x_4}{4}$$

$$y_i = \frac{y_1 + y_2 + y_3 + y_4}{4}$$

The center of rotation is calculated as (-34, 22).

(4) Conversion Unit Length and Angle Solution

In the square tray, both the ellipse and the circle have actual unit lengths. By analyzing and counting the two sets of data, the ratio of the actual length to the established unit length of the coordinate system is 5:18. Therefore, the spacing between each receiving unit is 0.2778mm. Therefore, the coordinates of the center of rotation in the coordinate system whose actual length is unit length with the center of the ellipse as the origin are (-9.4444, 6.1111). In the table obtained by the number of zeros in each group of data, it can be understood that the rotation angle is uniformly changed. Since there are 90 sets of data between the 60th group and the 150th group, the angles are also different by 90 degrees, so the 1 degree is rotated. 1 time. So these 180 directions are in the direction of the integer degree in [30°, 210°].

3. DON TRANSFORM BASED IMAGE RECONSTRUCTION MODEL

(1) CT image reconstruction principle

The basic principle of CT image reconstruction can be simply described as follows: the original image is reconstructed by using X-ray projection data obtained by projecting an unknown region. When the rays pass through the unknown region, some of the photons in the rays must be absorbed or scattered. According to the Lambert-Beer absorption law, the probability of each photon disappearing depends on its own energy and the linear attenuation coefficient of the unknown region. The CT scanning system measures the intensity of radiation before and after passing through an unknown area. Assume that the initial intensity of the ray is, and after passing through the unknown region, its intensity:

$$I = I_0 e^{-\mu(x,y)dl}$$

Where is the length of the ray passing through the unknown region, the linear attenuation coefficient of the ray to the unknown region, which is a function of the position?

$$\mu(x,y)dl = In\frac{I_0}{I}$$

Therefore, the CT image reconstruction is estimated by enough projection data, and the obtained image can be converted into a CT number to represent the reconstructed image [1].

When reconstructing an image, in order to approximate a digital image, the unknown area is generally planned as a small square. Each small square represents a pixel with an equal density value. When the trend is infinite, you can use this image. The digitized image approaches the original image. Therefore, the original value of the image can be reconstructed simply by finding the value of each pixel in the digitized digitized image.

Assuming that the reconstruction image function is and the projection data is, the task of the image reconstruction algorithm is to reconstruct the field distribution based on the scan measurement data in a limited number of directions. That is, the input data of the reconstruction algorithm is the projection data of the original image, and its output is the reconstruction value under a certain error condition[2]。

(2) Radon transform

The Radon transform is the basic method for image reconstruction and is the polar coordinate of a Cartesian coordinate system.

$x = r\cos\varphi; y = r\sin\varphi; \varphi = \arctan(y/x)$

$f(r,\varphi)$ Integration along a straight S line

$p(l,\theta) = \int_{-\infty}^{+\infty} f[\sqrt{l^2+s^2}, \theta + \arctan(s/l)]ds$

$p(l,\theta)$ is the projection of $f(r,\varphi)$ in the direction of θ, denoted by $[\Re f](l,\theta)$, called the Radon transform of function $f(r,\varphi)$. Suppose we use y_i to represent the estimated value $(l_1,\theta_1)(l_2,\theta_2)...(l_I,\theta_I)$ of the measured I-number of the Radon transform $[\Re f](l,\theta)$ of $\Re_i f$, then the vector y_i consisting of Y is the projection measurement vector in image reconstruction. The image reconstruction is to estimate the image vector F from the known vector

y [3]

The Radon inverse of $f(r,\varphi)$

$$[\Re^{-1}p](r,\varphi)=\frac{1}{2\pi^2}\int_0^{\pi}\int_{-\infty}^{+\infty}\frac{[\partial p(l,\theta/\partial l)]}{r\cos(\theta-\varphi)-l}dld\theta$$

$$f(r,\varphi)=\frac{1}{2\pi^2}\int_0^{\pi}\int_{-\infty}^{+\infty}\frac{[\partial p(l,\theta/\partial l)]}{r\cos(\theta-\varphi)-l}dld\theta$$

Theoretical proof: In the case of full projection, Radon transform can accurately reconstruct the field distribution of $f(r,\varphi)$.

(3) Elliptical Radon Transformation

The inverse transformation of the hyperbolic Radon transform is not actually a hyperbolic path integral, but its inverse operator is an integral along the elliptical path. The discrete form of an elliptical Radon positive transform can be defined as:

$$u(\tau_0,V)=\sum_{n=1}^{Np}d(\tau(p,V,\tau_0),p_n)$$

Definition of $\tau(p,V,\tau_0)$:

$$\tau(p,V,\tau_0)=\tau_0\sqrt{1-p^2V^2}$$

In this equation, V is the velocity, τ is the two-way travel, $p=\sin\theta/V$ is the ray parameter, θ is the angle between the ray and the vertical [4]

(4) The data is imported into MATLAB to get the image of each group:

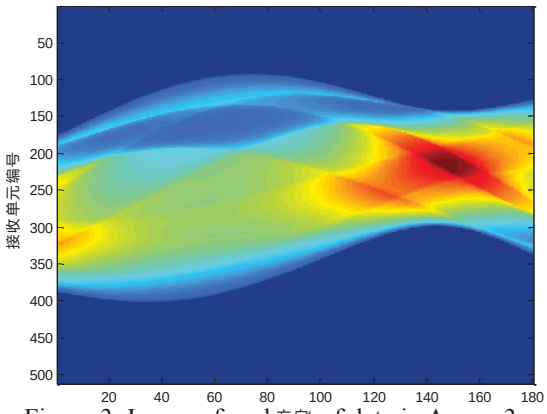

Figure 3. Image of each set of data in Annex 3

The unknown material obtained by applying the Radon inverse transformation procedure to the data of Annex 3 is:

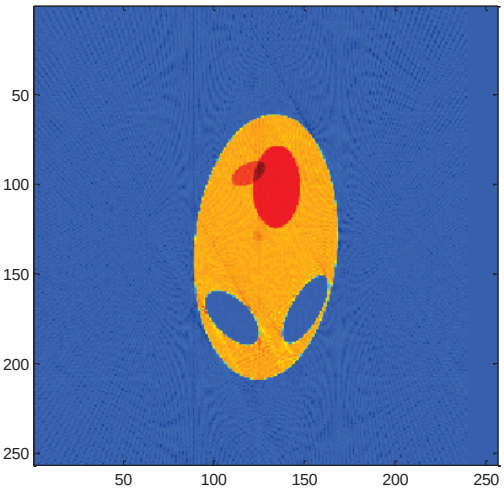

Figure 4. Rebuild image of attachment 3 unknown

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Sustainable Development of Society

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Abstract: A national sustainable development model based on time series prediction is established. Firstly, the social vulnerability and human health level were chosen as the decision-making index of the model, secondly, the index data of the next year were predicted by the three exponent smoothing method, and then the method of multivariate linear regression was used to curve fitting, and the fitting graph of traffic data and sanitary measures were obtained. Finally, the fitting function and the development model are obtained.

Keywords: Time series prediction; Sustainable development; Multivariate linear regression;

1. INTRODUCTION

Since the beginning of the modern environmental movement of the the 1860s, balancing human needs with the health of the Earth is a topic of considerable debate. In order to regulate this imbalance, the concept of sustainable development was introduced in the 80 's [1]. Sustainable development is defined as "sustainable development: the ability to meet the needs of contemporary people without compromising the future generations to meet their own needs." In order to measure and differentiate which countries and policies are sustainable, the use of multivariate linear regression method for curve fitting, to obtain traffic data and health measures to fit the map, the establishment of a national sustainable development model, at the same time can distinguish which is the most need to support and intervention countries.

2. MODEL ESTABLISHMENT

(1) Preparation of the model

Today's social sustainable development research has become a craze, but the historical process of Chinese and modern history shows that there is fragility in social development, prosperity and decline are everywhere, and there must be regularity.

At present, the development mode of "inner biochemistry and extensive type" of national economy is confronted with serious environmental problems and resource crisis, and social fragility provides a new way of thinking and perspective for the sustainable development of the country [2]. By studying the number of deaths in traffic accidents in different countries each year compared with the world average level, as an indicator to evaluate the national social vulnerability. The data lookup is obtained as shown in Figure 1:

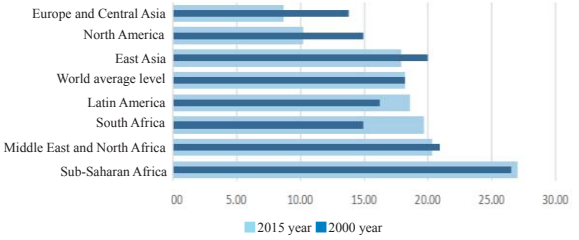


Figure 1 Death toll in traffic accidents in different countries

According to the number of traffic deaths per five years in different countries, social vulnerability is divided into 4 levels, 10,20,30,40, social vulnerability from low to high, and drawn on the map, as shown in Figure 2:

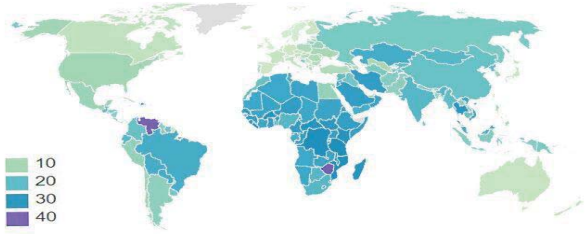


Figure 2 Zoning map of social vulnerability in different countries

More than 1.25 million people are killed each year. Another 20 million to 50 million people are seriously affected by road traffic injuries [3].While road traffic mortality has declined in most areas, 200,000 people are still dying each year in sub-Saharan Africa, the Middle East and North Africa. As can be seen from the above picture, the highest rates of road traffic-related mortality are found in low-and middle-income countries (lmics) [4]. Although these countries have only about half the world's cars, these countries now account for 90% of global road traffic fatalities and non-fatal traffic injuries.

In the process of pursuing the sustainable development of ecology, economy and society, human beings pay more attention to the sustainability of their own health [5]. Health is the basis of human survival and development, so

human health level as an important indicator of sustainable development evaluation. Percentage of the population through medical measures in different countries.

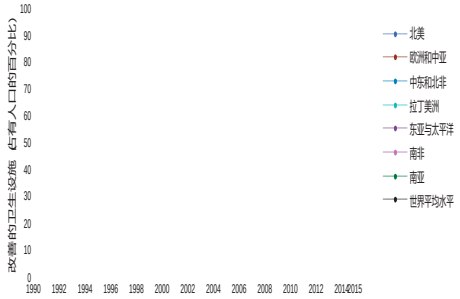


Fig 3 Data map of health facilities improved in different countries

(2) Time series Analysis method

A time series is a sequence of data that is arranged in chronological order, varies over time, and is interrelated. In this paper, the exponential smoothing method [6] is used in the prediction of Time series, in which the exponential smoothing method is divided into one exponential smoothing method, two exponential smoothing method and three exponential smoothing method according to the different smoothing times. One exponential smoothing method overcomes the disadvantage of moving average method. However, when the linear trend of the time series changes, there is still a significant lag error when the exponential smoothing method is used to predict [7]. It must therefore be amended as well. The modified method is the same as the trend moving average method, that is, two exponential smoothing, and the linear trend model is established by the rule of lag deviation [8]. This is the two-time exponential smoothing method. Its calculation formula is:

$$\begin{aligned} S_t^{(1)} &= \alpha y_t + (1-\alpha) S_{t-1}^{(1)} \\ S_t^{(2)} &= \alpha S_t^{(1)} + (1-\alpha) S_{t-1}^{(2)} \end{aligned} \tag{1}$$

The smoothing value of $S_t^{(1)}$ is the first exponent in the formula, and the $S_t^{(2)}$ is the smoothing value of two exponent. When the time series is $\{y_t\}$ and the linear trend begins at a certain time, a similar trend moving average method can be used to predict the linear trend model [9].

$$\hat{y}_{t+T} = a_t + b_t T, T = 1,2,\Lambda \tag{2}$$

$$\begin{cases} a_t = 2S_t - S_t^{(2)} \\ b = \dfrac{\alpha}{1-\alpha}(S_t - S_t^{(2)}) \end{cases} \tag{3}$$

When the change of time series shows the trend of two times curve, it is necessary to use three times exponential smoothing method[10]. The three exponent smoothing is based on two exponential smoothing, and then smoothed again, the formula is:

$$\begin{cases} S_t^{(1)} = \alpha y_t + (1-\alpha) S_{t-1}^{(1)} \\ S_t^{(2)} = \alpha S_t^{(1)} + (1-\alpha) S_{t-1}^{(2)} \\ S_t^{(3)} = \alpha S_t^{(2)} + (1-\alpha) S_{t-1}^{(3)} \end{cases} \tag{4}$$

The $S_t^{(3)}$ three exponent smoothing value in the formula. The prediction model of three exponent smoothing method [11] is:

$$\hat{y}_{t+T} = a_t + b_t + c_t T^2, T = 1,2,\Lambda \tag{5}$$

which

$$\begin{cases} a_t = 3S_t^{(1)} - 3S_t^2 - S_t^{(3)} \\ b_t = \dfrac{\alpha}{2(1-\alpha)^2}\left[(6-5\alpha)S_t^{(1)} - 2(5-4\alpha)S_t^{(3)}\right] \\ c_t = \dfrac{\alpha^2}{2(1-\alpha)^2}\left[S_t^{(1)} - 2S_t^{(2)} + S_t^{(3)}\right] \end{cases} \tag{6}$$

Recent data on the mortality and sanitation (percentage of population occupied) caused by road traffic injuries in different countries[12] are obtained as shown in table 1. The first exponential smoothing is performed to predict the value of the next year.

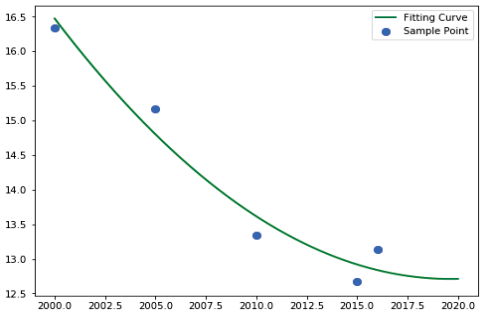
Table 1 Mortality caused by road traffic injuries (per 100,000 persons)

Countries		2000 year	2005 year	2010 year	2015 year	$\alpha = 0.25$ 2016year
North America	Canada	9	7	6	6	7
	United States	16	15	13	11	13.75
East Asia	China	22	22	20	19	20.75
	Malaysia	25	24	22	22	23.75
Europe	Albania	15	14	14	14	14.75
	Ireland	11	9	5	4	7.75
Average		16	15	13	12	13

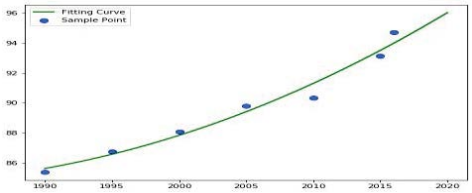
Table 2 Sanitary facilities (percentage of population occupied)

Countries		1990 year	2000 year	2010 year	$\alpha = 1/6$ 2016forecast
North America	Canada	99.37	99.51	99.63	99.92
	United States	99.49	99.53	99.73	99.87
East Asia	China	59.32	65.43	70.33	82.35
	Malaysia	86.75	89.91	93.60	97.85
Europe	Albania	78.01	84.94	87.38	95.73
	Ireland	89.47	89.22	91.42	92.45
Average		85.40	88.09	90.35	94.70

According to the prediction model of time series, we can use SPSS to fit the table 1 data into linear function and two times function respectively. It is found that the R square value is 0.901, the fitting degree is high, and the curve does not tend to be monotone function, so it is better to make an exponential smoothing prediction, and the fitting function and image through the actual data, such as Figure 4, Figure 5.



$$y = 0.0097736x^2 - 39.478x + 39878.1136$$



$$y = 0.0097736x^2 - 39.478x + 39878.1136$$

ACKNOWLEDGMENT

In this paper, the method of multivariate linear regression is used for curve fitting to obtain traffic data fitting graph and health measure fitting graph, finally, it concludes that traffic data is negatively correlated with national sustainable development, and health measures are positively correlated with national sustainable development.

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Analysis of Charging Stations Based on Monte Carlo Simulation

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Abstract: The whole article involves two main parts of countries and users, two components of the charging stations and the electric vehicles, and five events including the charging station development plan, the investment plan, the electric vehicle growth plan timeline, the classification system, and the technological change to the transportation selection. By discussing elastic coefficient among the GDP growth rate, the charging station penetration rate and the growth rate of electric vehicles, it is concluded that the key factor affecting the growth of electric vehicles proportion is the popularity level of charging stations. Then, in order to develop a charging stations network applied to different countries, national development degree C which describes the relationship among population density, geographical location and wealth distribution is introduced. Constructing a classification system of national electric vehicle growth plan by using investment plan model and elasticity coefficient. Sensitivity analysis is conducted to explore the feasibility of classification systems, and it is obtained that the key factors that trigger the selection of different approaches to growing the network are the wealth distribution and population density. Finally, we combine all the analysis to discuss the impact of technology change to the options.

Keywords: electric vehicle; human cell thinking; Monte Carlo; weighted Voronoi diagram; charging station

1. INTRODUCTION

Due to the use of gasoline and diesel vehicles, the serious environmental pollution problem, the gradual depletion of energy [1], and the high economic cost are confusing. It is an irreversible trend to use new energy such as electricity to solve the depletion of energy consumption. Tesla has recently come into view. Now, the use of electric vehicles [2] is in a nascent stage, but the use of new energy vehicles is certainly a trend. To enter the era of full electric vehicles more smoothly in the future, the followings need to be done: Firstly, study how a country invests in charging stations. Then, develop a full schedule of automotive electrification, and on this basis, consider the differences among different countries, then build a classification system and analyze the feasibility. Finally, discuss how technological developments affect analysis of the increased use of Electric vehicles.

2. ASSUMPTIONS AND SYMBOL DESCRIPTION

(1) Assumptions

a. All chargers which are in a charging station are charged in the same way.

b. The number of chargers in each charging station is five.

c. Electric vehicles used in the U.S are Tesla.

d. The number of charging stations does not include the use of privacy.

e. Electric vehicles charge only once a day under slow-charge conditions.

f. The average daily electricity consumption of electric vehicles must include two charging methods.

g. Electric vehicles charging duration is uniquely related to daily mileage.

(2) Symbol Description

Symbols	Definitions
ξ	Coefficient of elasticity
L_{EV}	Daily mileage
T_S	Charging start time
σ_{sta}	Rate of charging station penetration growth
CR	Consistency verification y ratio
e_j	Entropy value
w_j	Entropy weight
C	National development coefficient

3. MODEL OF CELL-CHARGING

(1) Source of Model Idea

Obviously, the issue involves two main parts: states and users; two components: charging stations and electric vehicles; five events: charging station development plan, investment plan, schedule of growth plan, plan of growth plan of different countries, macro-environment change of science and technology development. For the country: the construction of low-cost, high revenue are principles of the charging station construction to be considered. For users: convenience, saving money are principles should be considered.

(2) Determination of the Number of Charging Stations based on Differential Equations

Assuming that x and y are the coordinates of any charging station, f (x, y) is the range covered by the

charging station:

$$Z=f(x,y) \tag{1}$$

Compute the integral for two sides:

$$dz = df(x,y) \tag{2}$$

$$dz = \frac{\partial f(x,y)}{\partial x} + \frac{\partial f(x,y)}{\partial y} \tag{3}$$

The range covered by each charging station must meet the daily mileage range of electric vehicles [2], while the daily driving mileage of electric vehicles is related to the charging duration. Assuming electric car's power consumption W per hundred miles is constant, and the electric car's charging power P_{cm} is also constant [3], when the charger power is k_x, the electric car's daily mileage:

$$L_{EV} = 100\frac{T_C \cdot P_{cm}}{W} k_x \tag{4}$$

$$dz = \pi \cdot (dL_{EV})^2 \tag{5}$$

Combine the equations [7] above:

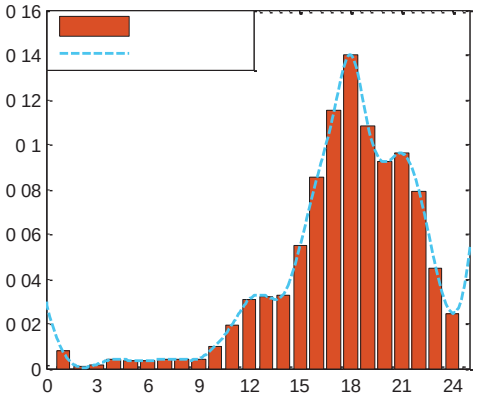
$$\begin{cases} dz = \dfrac{\partial f(x,y)}{\partial x} + \dfrac{\partial f(x,y)}{\partial y} \\ dz = \dfrac{\pi(\partial L_{EV})^2}{\partial x} + \dfrac{\pi(\partial L_{EV})^2}{\partial y} \\ L_{EV} = 100\dfrac{T_C \cdot P_{cm}}{W} k_x \end{cases} \tag{6}$$

(3) Data Simulation and Solution based on Monte Carlo

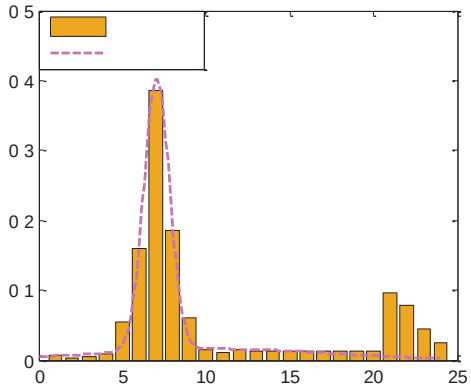
a. User Charging Behavior

Electric vehicle charging methods are slow charging and fast charging. Suppose a electric car charge only once when they return to start location a day in slow mode. When the battery reaches the alert value of the battery or the remaining battery capacity is insufficient to meet the user's follow-up mileage, the user will choose to fast charging in their journeys.

Using the representative statistics from the National Cooperative Highway Research Program of the United States, the distributing disciplinarian of slow charging and fast charging start charging time [4] are obtained by fitting:



a. Fast charging



b. Slow charging

Figure 1 Charging two kinds of different charging start time distribution

- Distribution of Slow Charging

Remark the charging start time is TSC, then the probability density function is:

$$f_{T_{Sc}}(t) = \begin{cases} \dfrac{1}{\sigma_s\sqrt{2\pi}} \exp[-(\dfrac{(t-\mu_s)^2}{2\sigma_s^2})] & (\mu_s - 12) < t \le 24 \\ \dfrac{1}{\sigma_s\sqrt{2\pi}} \exp[-(\dfrac{(t+24-\mu_s)^2}{2\sigma_s^2})] & 0 < t \le (\mu_s - 12) \end{cases} \tag{7}$$

In the formula, μ_s =17.6, σ_s =3.4

- Distribution of Fast Charging

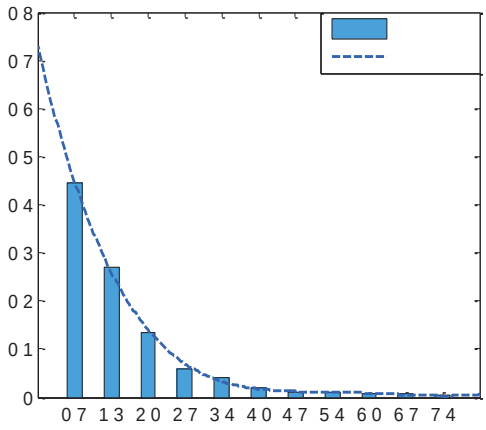
Remark the fast charging start time is TS, then the user's travel time probability density function can be expressed as:

$$f_{T_s}(t) = a_1 e^{-(\frac{x-b_1}{c_1})^2} + a_2 e^{-(\frac{x-b_2}{c_2})^2} \tag{8}$$

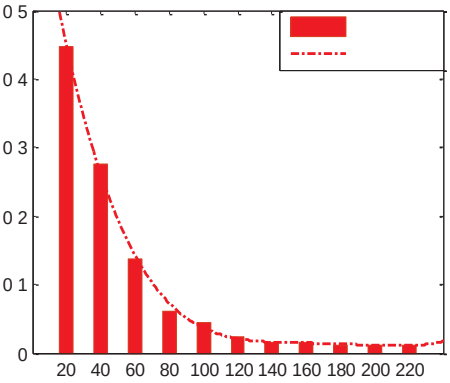
In the formula, a_1 =0.389, b_1 =7.046, c_1 =1.086, a_2 =0.016, b_2 =10.610, c_2 =9.667

b. Charging Time

According to the NHTS survey of the driving daily mileage of private vehicles and the normalization of the statistical data, the daily driving mileage and the charging time distribution of electric vehicles are obtained:



a. Charge time probability density distribution



b. Probability density distribution of trip mileage

Figure 2 Probability Distribution of charging time and trip mileage

From Figure 2, the charging time of electric vehicles is mainly distributed within 0 to 3 hours, rarely more than 6 hours. In order to obtain the distribution of the continuous charging time of the electric vehicle, the histogram is fitted by using the MATLAB curve fitting tool. Then mileage probability distribution function can be obtained according to the continuous charging time of the electric vehicle T_C:

$$f_{T_C}(L_{EV}) = a \cdot e^{bL_{EV}} + c \cdot e^{dL_{EV}} \qquad (240 \geq L_{EV} \geq 0) \quad (9)$$

In the formula, a=-0.8225, b=-976.06, c=0.8919, d=-0.8912

c. Simulation

Use Monte Carlo to get the charge expectation of an electric car in a day and the compound curve of electric car charging. Due to the random nature of Monte Carlo, multiple tests are required and then averaged to ensure the accuracy of the prediction.

According to the flow chart (in appendix). Taking the number of electric vehicles N as 10 million, repeat the operation 50 times to obtain the average value of an electric vehicle charging load in a day. Using the same method, change the charging mode, two kinds of charging mode single electric vehicle charging load expectations are obtained:

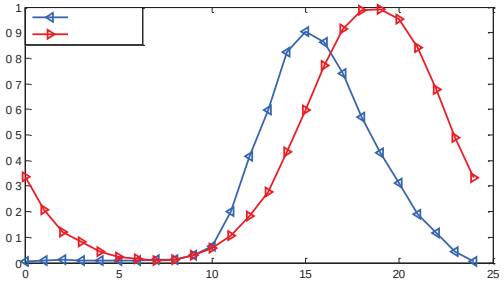


Figure 3 Single electric vehicle charging load expectations

From Figure. 3, the fast charging and slow charging of Tesla are 904w and 160w respectively, and valley loads are 7.86w and 7.67w respectively. Average daily power consumption of fast charging is 6.4kw·h, average daily power consumption of slow charging is 9.5kw·h. The total electricity consumption of an electric car in a day is 16kw·h.

4. DISTRIBUTION OF CHARGING STATIONS OF URBAN, SUBURBAN AND RURAL AREAS

Using Google Earth software to read the coordinates of these areas, divide the obtained coordinates into three regions according to city, suburban and rural areas. The ratio of the number of charging stations contained in each region is the distribution result. We use a few typical areas, using Matlab to draw three-dimensional contour map of latitude and longitude coordinates and the number of stations in each region.

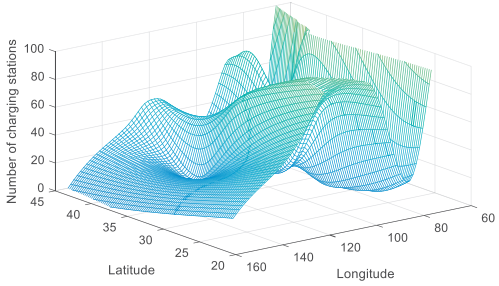


Figure 4 Charging station distribution of American urban, suburban, rural areas

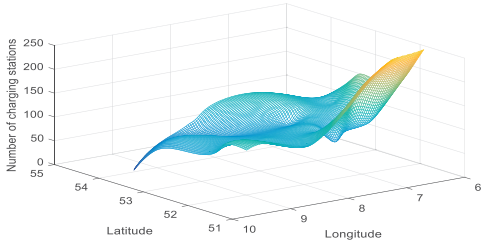


Figure 5 Charging station distribution of Irish urban, suburban, rural areas

It can be concluded whether it is the United States or Ireland, the city is the largest proportion of the number of charging stations, followed by the suburbs, and the smallest is rural areas. The proportions of cities in the United States are lower than the proportion of cities in Ireland.

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Analysis of Bus Mobile Payment Based on Linear Function Model

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Abstract: With the increase of mobile payment technology, more and more companies and individuals have begun to use mobile payments. The bus began to use mobile payment, which solved many inconveniences of physical bus card payment and cash payment, and saved labor costs. This paper analyzes the travel data of some passengers in a certain city, and draws some conclusions about mobile payment in public transportation.

Keywords: Mobile payment; Multivariate function; Analogical reasoning; Profit model.

1. INTRODUCTION

Focusing on the first problem, a mathematical multiple-variable function model was constructed to quantitatively analyze the profitability of third-party payment agencies. Third-party payment platform has four major profit models that a fee of C, advertising fee H, Service fee W and deposit interest income K. Solving the four profit models: The fee is related to the deposited capital and has a linear relationship; advertising fee H is a fixed value, the service fee W includes access fees, service fees and transaction fees. The access fee and service fee are constant. Trading commissions are related to deposits and have a linear relationship; the interest income K of the deposited funds is the interest that the third-party payment platform receives after depositing the deposited funds into the bank, which is divided into two types: current and regular. This interest minus the risk reserve is made profitable by third-party payment platforms. The cost of third-party payment platform operation is fixed. Finally, adding these parts and subtracting the expenditure is the profitability of the third-party payment platform.

For the second problem, we first use analogical reasoning and hypothesis to obtain the relationship between the population density in different regions of the city and the number of riders in the area. After that, the settlement funds obtained by the payment agencies after the bus in all areas of the city have paid for the third-party platform for public transport. Finally, based on the model established in Issue 2, we estimate the profitability of public transport in all areas of the city after third-party payment.

In response to the third problem, through the collation of attachment data and the answers to the above two questions, we can see that the third-party payment institutions profit model and the weight of each model, as well as the profitability of the third-party payment platform in the test city. Develop a business plan feasibility report for mobile payment companies, including tangible and intangible benefits. Tangible benefits include cost savings and revenue generation. Intangible benefits include accumulating data, establishing credit systems, and making recommendations to companies.

2. RESTATEMENT OF THE QUESTION

"Internet +" as the core driving force for the interconnection and interoperability of information systems and the openness and sharing of data resources has become a facility and tool for the transformation and replacement of Chinese enterprises. With the rise of “Internet Plus,” urban public transport, which is the main window of the city, has gradually become more diverse. The original cash payment and entity swiping had many drawbacks and could no longer meet the needs of travel payment methods. Therefore, bus mobile payment came into being. With the advantage of the region, Hangzhou Public Transport and Alipay vigorously cooperated to provide passengers with mobile payment methods such as Alipay scan code, which brought great convenience to citizens and tourists in this tourist city. In addition, Guangzhou Yangchengtong and Qingdao Truth Buses also cooperated with Alipay. Bus services and mobile Internet, big data, and cloud computing are widely connected and in-depth integration, and the public transportation of the city is plugged into the “Internet +” wings, providing people with more convenient, personalized and personalized travel services. Now we need to solve the following problems:

Analyze the large amount of information and data given.

Based on some of the bus payment information and data given to analyze the characteristics of travel payment.

Establish a commercial profitability mathematical model for public transport third-party payment platforms.

Forecast and estimate the profitability of third-party platforms for all mobile payments based on partial payment information during the trial run.

Analyze the feasibility of increasing profitability based on the data.

3. SYMBOL DESCRIPTION AND MODEL ASSUMPTIONS

(1) Model assumption

Assume that the access fees charged by third-party payment platforms to merchants are all set;

Assume that advertising costs are independent of the number of active users on the platform.

Assume that the expenditure amount of the third-party payment platform is constant under the condition that the region is unchanged;

Assume that the bank's interest rate is based on the central bank's current interest rate of 0.35% and the regular interest rate is 1.1%;

Assume that for a given 7 days, deposits of gold have been in the hands of third-party payment platforms.

Assume that the number of passengers traveling in February is approximately equal to each month.

It is assumed that the proportion of travel payment methods for commuters in other regions is the same as the measured quarter area.

(2) Symbol Description

Symbol	Meaning
0	Bus mobile payment method
1	Bus card payment method
Null	Not swiped
C	Fees
H	Advertising fee
W	Service fee
g	Precipitation funds
K	Interest income
P	Revenue from third-party payment platforms
α	Reserves account for the proportion of deposited funds
t	Storage time
μ	The sum of the access fee and service fee
i	Linear relationship
δ	Third party platform expenses
n	The difference between the interest rate charged with the handling fee and the interest rate paid for the fee

4. THE ESTABLISHMENT AND SOLUTION OF THE MODEL

(1) The establishment and solution of model one

a. The main factors affecting the profitability of third-party payment platforms:

Fees

The fee is the difference between the fee charged by the third-party payment platform to the bus company and the fee paid to the bank. Put two-dimensional codes and POS machines on buses to provide bus companies with inquiries, reconciliations, recovery and refunds, and other handling fees related to clearing transactions. However, the profits derived from this profit model are relatively low, so it is necessary to increase transaction flow to increase its profit.

Advertising fee

Merchants have the need to distribute promotional advertisements on PCs and mobile phones on third-party payment platforms. Third-party payment platforms will charge merchants who advertise on their platforms a certain advertising fee.

Service revenue

This model is essentially Alipay's use of free and convenient online electronic payment services to attract users. When the user population is large, this can be used as a bargaining chip to provide electronic payment services to merchants that need this user traffic so that users can use it at merchants. Alipay pays directly. Such a direct payment method will increase the sales volume of merchants, but Alipay also charges access fees and service fees from merchants. In addition, a certain percentage of the transaction commission is charged according to the total amount of transactions.

Precipitation fund interest income

The interest income of the deposited funds is also the "preparation fund" of the "Measures for the Payment of Clients' Provisions for the Payment of Funds" – the cash received in advance from the payment agencies to receive the client's payment services. The funds consumed by passengers are first imported into a third-party payment platform. After a period of time, the third-party payment platform will enter this portion of funds into the bus company's account. As a result, a time lag is created from the payment of passengers to the arrival of funds to the bus company's account, thus forming deposit funds. The precipitation funds here include the precipitation funds of the third party payment platform and the precipitation funds of the bus card. After the customer's reserve fund in the form of current deposits meets the needs of the daily payment service, other customer deposits can be "stored as demand deposits, unit time deposits, unit notice deposits, agreed deposits, or other forms approved by the People's Bank of China". But the period "may not exceed three months", that is, this part of the reserve fund can be converted into a three-month period of fixed deposit. If the third-party payment platform can better realize the capital settlement of the bus card, then this part of the profit is very considerable.

b. The establishment of the model

According to the foregoing, the analysis of the factors affecting profitability first establishes a general form of profitability model.

$$P = P(C + H + W + K) \tag{1}$$

P is the revenue generated by the third-party payment platform.

C is the processing fee, C is related to the deposit fund g obtained by the third-party payment agency and is linear:

$$C = ng(n \leq 1) \tag{2}$$

H is the advertising fee, which is the fixed value:

$$H = m_1 \tag{3}$$

W is the service fee. The service fee includes the sum

of the access fee and service fee paid by the merchant to the third-party payment platform as a constant μ. There are trade commissions paid by merchants to third-party payment platforms. This is related to the deposit fund g and has a linear relationship i:

$$W(g) = i\,g + \mu \tag{4}$$

K is the interest income from the deposit funds. The third-party payment agencies put the deposited funds they got into the bank to get interest. According to Annex III, the risk reserve ratio must not be less than 10% of the interest income from its bank account. Therefore, the third-party payment institution can obtain up to 90% of interest income. The third party payment platform puts the deposited funds g into the bank for both current storage and regular storage, and the time limit must not exceed 3 months. Then:

$$K = 0.9\alpha * \frac{t}{365} * 0.35\% + 0.9\alpha(1-\alpha)g * 1.1\% \ (t \le 90) \tag{5}$$

The amount of expenditure of the third-party payment platform is δ, because the amount of expenditure is not related to the amount of deposited funds, so it is a fixed value, that is:

$$\delta = m_2 \tag{6}$$

By combining the above formulas, we can get the expression of total profit:

$$P = ng + ig + \mu + 0.9\alpha * \frac{t}{365} * 0.35\% + 0.9\alpha * (1-\alpha)g * 1$$

(2) The establishment and solution of model two

a. The establishment of a model

Urban density objectively reflects the intensity of human social activity within the urban space, and it can give a lot of indication information related to the city's activities. Urban density provides an effective way for us to understand the law of urban development and quantitative analysis. In urban transport, urban density is an important indicator for studying transport demand.

Question 2 seeks for the profitability of the third-party payment platform in the core area of the city after a quarter of the installation of mobile payment equipment for buses and subways. From this, it can be inferred that all public transport in the entire city can achieve profitability after third-party payment by bus. The core area accounts for a quarter of the entire transportation line, and other areas account for three quarters of the entire transportation line. The precipitation funds obtained by the third payment platform are related to the number of rides, reflecting that the number of rides in the city is related to the population density of the districts in the city. Because we do not know the population density of the districts in the city, and most of the cities in China that have buses and subways are provincial capitals, and because now China's public transit subways only carry out third-party mobile payments, Hangzhou is the only one we have in Hangzhou. Take the city as an example to compare the profitability of all the public transport of the city after the payment of the third-party mobile platform. Through looking up the literature, it is known that the main urban area of Hangzhou is as shown in the figure. The first step is to pay public transport and third-party platforms for subway transportation. According to the survey on population density in Hangzhou by the Hangzhou Bureau of Statistics in 2017, the main urban areas of Hangzhou include Shangcheng District, Xiacheng District, Jianggan District, Gongshu District, Xihu District and Binjiang District. The population density of the total population of these 4 districts is 3,309,400; and the population density of other districts in Hangzhou is:

Table 1 Population Density in Other Areas of Hangzhou

Area	West Lake Scenic Area	Yuhang District	Fuyang District	Tonglu County	Chun'an County
Population density (million people)	3.06	125.89	73.35	42.20	34.91

Area	Economic and technological development zone	Dajiang Agglomeration Area	East Strict	Xiaoshan	Lin'an City	Jiande City
Population density (million people)	31.98	17.05	39.1	58.7	44.5	

In addition to the main urban area, the total population density of other urban areas is 5,708,800 peop5le. Beca1use urban transport routes are used in all areas of the city, Therefore, the key difference between the implementation of all public transport by payment agencies and the realization of third-party public transport platforms and the implementation of a quarter-way route to achieve deposits from third-party platforms is the size of population density. The population density L has a function i=I (L) with the number of passengers traveling I. Through data processing, the average number of times the city's occupants can take the subway and bus in February can be obtained. Based on the ratio of the population density of the main urban area to the total population density of other urban areas, the average number of passengers who choose to take the bus and the average number of times to ride the subway in the same month are calculated. The proportion of the payment methods selected by the occupants of the main urban area and the rest of the urban areas that are open to the public transportation third-party payment platform is affected by many factors, and it is cumbersome to consider. Therefore, it is assumed that the proportion of boarding payment options selected by the occupants of the main urban area is the same as the proportion of boarding payment methods selected by other urban occupants. From this, it is possible to predict and estimate the profitability

of all public transport in the city after the third-party payment by public transport.

5. MODEL EVALUATION

Advantages

The model is easy to understand and easy to promote;

The model clearly shows how much of the four factors affect the profitability of third-party payment platforms;

When the data processing and model solving are fully used, mathematics software such as MATLAB solves the problem well, and the ideal results are obtained by fully utilizing the various information in the topic and better combining the test of the model;

Disadvantages

The weights of some factors in the model are mainly based on the subjectively given data, and may be one-sided. In practice, they can be properly adjusted according to the focus, without affecting the overall effect. If the relationship between the factors can be analyzed in detail, the weight vector can be determined by the two comparison matrices. The result may be more objective, but the workload may be relatively larger.

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Analysis of The Hit Rate of a Land-based Ballistic Missile against the Aircraft Carrier

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Abstract: As a weapon for the country, land-based missiles are being included in strategic development projects by more and more countries. In order to maintain the safety of China's territorial waters, it is of great significance to design the operational trajectory model of land based missiles in order to achieve precise strike for aircraft carriers. For the hit rate problem, first, the approximate calculation of the target hit area of the missile is carried out by the transformation of the coordinate system, and then the factors affecting the hit probability of the missile self-guidance are analyzed. Finally, the probability model of the missile hit probability is established by using the method of comprehensive consideration of the multi-layer factors

Keywords: Multiple coordinate system; PID NN; Kalman filtering algorithm; characteristics of missile interception

1. APPROXIMATE CALCULATION OF TARGET HIT AREA BY MISSILE

When shooting a carrier with a missile, the target hit area is the projected area of the ship on the vertical plane in the direction of the missile falling velocity. Simplified model, the aircraft carrier is equivalent to a rectangular body, its volume is:

$$V = L \times H \times W \tag{1}$$

Formula: L is the equivalent length of the aircraft carrier; W is the equivalent width of the aircraft carrier; H is the equivalent altitude of the aircraft carrier.[1]The ballistic simulation shows that the velocity vector and the horizontal plane of the missile are very small when hitting the carrier, so the simplified rectangle can be projected to the vertical plane perpendicular to the direction of the ballistic direction, and the projection area of the rectangular, the size is $2d \times 2h$。Then, ignoring the influence of the earth curvature on the correlation angle, we obtain D and L. First, the geometric center of the cuboid is the origin O_m, and the $X_m$axis is parallel to the projection of the velocity vector of the missile hitting the aircraft carrier in the horizontal plane. The Y_m axis is perpendicular to the X_m axis in the vertical plane, and the Z_m axis is determined by the right hand rule [2]. The coordinate system $O_mX_mY_mZ_m$and the aircraft carrier geometry model are moved along the Y_m axis simultaneously, so that the origin $O_m$is in the XOZ plane of the geodetic coordinate system. Get the coordinate system $O_{m1}X_{m1}Y_{m1}Z_{m1}$.As shown in Figure 2: φ_c is the angle between X coordinates and X_{m1} coordinates; φ_m is the angle between X axis and V_m; q_m is the angle between V_m and X_{m1}, that is, the angle of aircraft carrier, and $q_m = \varphi_m - \varphi_c\varphi_c$ After derivation:

$$\begin{aligned} 2d &= L|\sin q_m| \cdot \\ 2h &= H \end{aligned} \tag{2}$$

Under the ground coordinate system $OX_gY_gZ_g$, the position of the carrier is (x_{m0}, y_{m0}, z_{m0}), and the position of the missile is (x_d, y_d, z_d).The conversion relation between the ground coordinate system $OX_gY_gZ_g$ and the coordinate system $O_mX_mY_mZ_m$ is

$$\begin{bmatrix} x_m \\ y_m \\ z_m \end{bmatrix} = \begin{bmatrix} \cos\varphi_c & 0 & \sin\varphi_c \\ 0 & 1 & 0 \\ -\sin\varphi_c & 0 & \cos\varphi_c \end{bmatrix} \begin{bmatrix} x - x_{m0} \\ y - y_{m0} \\ z - z_{m0} \end{bmatrix}$$

It follows that when the missile crosses the plane$Y_mO_mZ_m$, the position of the missile in the $O_mX_mY_mZ_m$ coordinate system is (x_{md}, y_{md}, z_{md}). When $-d \le z_m \le d$ and $-h \le y_m \le h$, the missile hit the target.

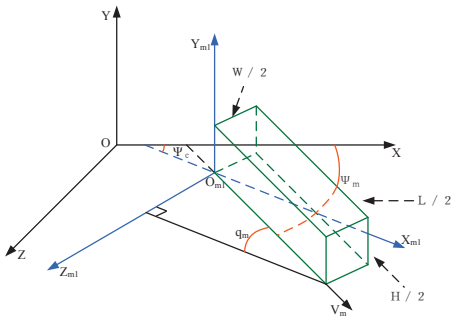

Figure 1: Relationship between icon geometry model and coordinate system $O_{m1}X_{m1}Y_{m1}Z_{m1}$ and ground

coordinate system

2. HOMING PROBAILITY OF ANTI SHIP MISSILE

At the end, the probability of a missile tracking automatically until hitting the target is called homing hit probability, which is PHoming.

The size of PHoming depends on the dispersion characteristics of the missile's landing point and the area of the target hit area. It is generally considered that the dispersion of the point of arrival obeys normal distribution, and the dispersion on the Y axis and the Z axis are independent [3].

The center of dispersion of the falling point is m_y、m_z, the probability deviation of the falling point is E_y、E_z, and the target hit area is S, as shown in the figure.If the origin of the coordinates is in the center of S, there are

$$P=\iint_s \frac{\rho^2}{\pi E_y E_z}\exp\left\{-\rho^2\left[\frac{(y-m_y)^2}{E_y^{\,2}}+\frac{(z-m_z)^2}{E_z^{\,2}}\right]\right\}dydz$$

By knowing that the aircraft carrier is equivalently treated as a cuboid, the target hit area S is a rectangle, then

$$\mathrm{P}=\frac{1}{4}\left[\hat{\phi}(\frac{d+m_z}{E_z})+\hat{\phi}(\frac{d-m_z}{E_z})\right]\cdot\left[\hat{\phi}(\frac{d+m_z}{E_z})+\hat{\phi}(\frac{d-m_z}{E_z})\right]$$ As a result, the larger the target area is, the greater the homing probability is, and the S is related to the starboard angle, and only when the starboard angle is near 0 or 180 degrees, because the target area is significantly smaller, the PHoming is greatly reduced .[4]

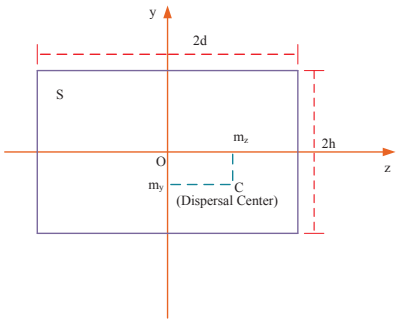

Figure 2 Target equivalent graph

3. HIT PROBABILITY MODEL OF ANTI SHIP MISSILE[5]

In view of various factors of missile weapon system, a comprehensive expression for predicting the hitting probability of missiles is presented.

$$P = P_{\text{reliable}} \cdot P_{\text{Capture}} \cdot P_{\text{Homing}} \cdot P_{\text{Penetration}}$$

is the reliability probability of the missile; P_{Capture} is the probability that the missile only captures the predetermined target; P_{Homing} is the probability of hitting the target by the missile homing; $P_{\text{Penetration}}$ is the probability that the missile breaks through the antimissile system:

$$P_{\text{Penetration}} = P_{\text{High conductivity}} \cdot P_{\text{Naval gun}} \cdot P_{\text{interfere}}$$

is the probability that the missile is not intercepted by the enemy air missile,,the $P_{\text{Naval gun}}$ is the probability that the missile is not intercepted by the enemy dense artillery, and the $P_{\text{interfere}}$ is that the missile is not disturbed by the enemy electronic interference. Probability of loss:

$$P_{\text{interfere}} = P_{\text{active}} \cdot P_{\text{Dilute}} \cdot P_{\text{centroid}}$$

To sum up, the final expression of the hit probability is

$$P = P_{\text{reliable}} \cdot P_{\text{Capture}} \cdot P_{\text{Homing}} \; P_{\text{High conductivity}} \cdot P_{\text{Naval gun}} \cdot \mathrm{P}_{\text{active}} \cdot P_{\text{Dilute}} \cdot P_{\text{centroid}}$$

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Research on Land based Missile Attacking Aircraft Carrier

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Abstract: In this paper, the trajectory formulation of ground-based missile attacking enemy aircraft carrier is studied. The dynamic trajectory equation of the missile is established by six degrees of freedom, and the trajectory image is obtained by STK simulation. Then Monte Carlo shooting model is used to study missile hit rate and error analysis. According to the title data, the mathematical model of missile operation and the algorithm of hitting target are designed

Keywords: Dynamic orbit equation; SDOF; Monte Carlo simulation shooting; STK simulation

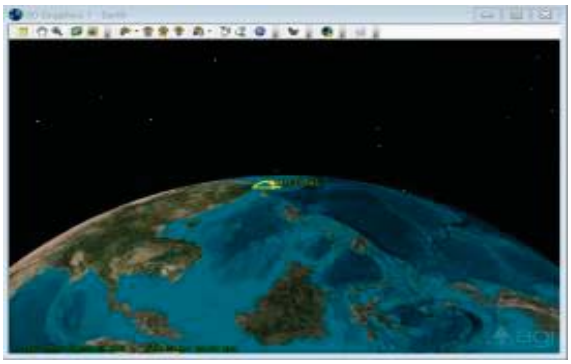
1. INTRODUCTION

Abstract: In this paper, we mainly study the orbit development of land-based missile against an enemy aircraft carrier, then make error analysis on the hit rate of the design plan, and design the mathematical model of missile operation and the algorithm of hit target according to the problem data. Firstly, the initial data is introduced into STK, the static trajectory model of the missile is established, and then the simulation of the missile flight is carried out and the simulation data such as the flight time, altitude and pitch angle are obtained. Based on this data, six degrees of Freedom equations (1) (2) (3) are established to describe the trajectory of the missile. Finally, the solution to the equations is: 6s in the

$$\begin{cases} \delta_x = k_{px}(\gamma_V - \gamma_{V*}) + k_{dx}(\dot{\gamma_V} - \dot{\gamma_{V*}}) \\ \delta_y = k_{n_z}(n_z - n_{z*}) + k_\theta(\theta - \theta*) + k_{w_z}(w_s - w_{z*}) \\ \delta_z = k_{n_y}(n_y - n_{y*}) + k_{\psi V}(\varphi_V - \varphi_{V*}) + k_{w_y}(w_y - w_{y*}) \end{cases}$$

firing section, 20s in the cruise section, and the highest point of the missile orbit is 124 meters. For problem two, based on the six-degree-of-freedom model established in question one, firstly, the middle and last strike process of the missile is studied, and then based on the simulation data, a six degree of Freedom Simulation program is established to predict the terminal position of the aircraft carrier and set it as the final guide strike point. According to the guidance law of the missile, proportional guidance method is introduced, and the proportional automatic guidance equation (7) is used to guide the end strike. Finally, the flight process of the missile is simulated and the dynamic orbit equation of the missile is obtained: Aiming at the third question, the Monte Carlo target model is established to study the missile hit rate and analyze the error, obtain the data with higher fitting degree, and finally verify the correctness of the six-Degree-of-freedom equation. Finally, the interception test is used to verify the effectiveness of the model optimization. Keywords: dynamic orbit equation Six degrees of Freedom Monte Carlo simulation of target STK simulation

The specific coordinates of known missiles and aircraft carriers have been converted to (longitude 123.75 °E, latitude 25.65 °N). When the aircraft carrier is at rest, the problem can be understood as the problem of missiles hitting fixed points. After simplification, STK can be used to simulate the



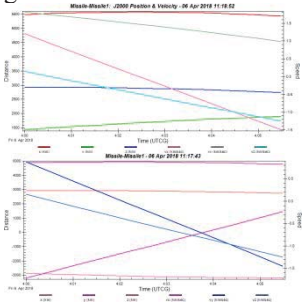
process of missile Missile1) attacking aircraft carrier Ship. The 3D simulation diagram can be obtained:

Is described in the inertial coordinate system. For the land-based anti-shipmissile with close distance, the

$$\begin{cases} \delta_x = k_{px}(\gamma_V - \gamma_{V*}) + k_{dx}(\dot{\gamma_V} - \dot{\gamma_{V*}}) \\ \delta_y = k_{n_z}(n_z - n_{z*}) + k_\theta(\theta - \theta*) + k_{w_z}(w_s - w_{z*}) \\ \delta_z = k_{n_y}(n_y - n_{y*}) + k_{\psi V}(\varphi_V - \varphi_{V*}) + k_{w_y}(w_y - w_{y*}) \end{cases}$$

coordinate system attached to the earth can be

approximately regarded as the inertial to study the trajectory. The kinematic platform dynamics of 6-DOF parallel mechanism is used to simulate the trajectory model of the missile and to draw the flight position and velocity diagram of the missile in the geocentric inertial coordinate system.



Taking the initial position of the missile as the origin, the model of ballistic longitudinal plane is established. The trajectory is divided into three stages: initial launch, cruise and terminal attack. The missile motion equations describe the relationship between the force and torque of the missile and its motion parameters. The equations of dynamics, kinematics, mass, geometry and control are referred to.

(1) The initial launch stage equations of a missile can be divided into two parts: the pitching channel and the yaw channel.

Pitching channel: the initial emission section is controlled by attitude, and the pitch angle of the scheme is adopted $\vartheta^* = 5^o \sin(0.2\pi t + \pi)$

Yaw passage: attitude control is used in the initial launch section, and the yaw angle of the scheme is adopted. $\Phi^* = 0$

The end time of the initial stage is: 1. T ~ (6) s.

(2) Midcourse equations:

Pitching passage: cruise section using height control scheme, scheme height $H^* = 7000$

Yaw passage: the cruising section adopts the proportional guidance method, and the guidance law is as follows $\dot{\psi}_v = 4\dot{q}$ From the topic, we can know that the end time of cruising section is: 20 s.

Terminal attack segment equations:

Pitching channel: the end attack section is guided by proportional guidance. The guidance law is $\dot{\theta} = 4\dot{q}$

Yaw passage: the terminal attack section adopts the proportional guidance method, the guidance law is as follows $\dot{\varphi}_v = 4\dot{q}$

In order to observe the trajectory change of missile more clearly and intuitively, we use ode45 function to solve differential equations in MATLAB from three aspects. The results of trajectory calculation.

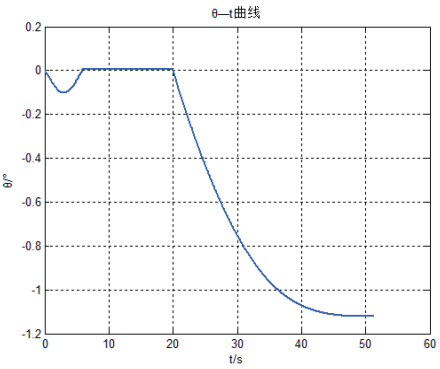
2. QUESTION II

The equations of motion of missile include: dynamics and kinematics equation of missile centroid, dynamics and kinematics equation of projectile body rotating around center of mass, mass change equation and geometric relation equation of transformation angle of coordinate system, etc.

(1) The missile control system adopts the feedback control system of overload, attitude angle and angular rate of missile body. The control system equation is as follows:

$$\begin{cases} \delta_x = k_{px}(\gamma_V - \gamma_{V*}) + k_{dx}(\dot{\gamma}_V - \dot{\gamma}_{V*}) \\ \delta_y = k_{n_z}(n_z - n_{z*}) + k_\vartheta(\theta - \theta*) + k_{w_z}(w_z - w_{z*}) \\ \delta_z = k_{n_y}(n_y - n_{y*}) + k_{\psi V}(\varphi_V - \varphi_{V*}) + k_{w_y}(w_y - w_{y*}) \end{cases}$$

(2) The object is regarded as a particle, and the moving model of the target is as follows



$$\begin{cases} \frac{dV_T}{dt} = a_x \\ V_T\left(\frac{d\theta_T}{dt}\right) = \\ -V_T \cos\theta_T\left(\frac{d\varphi_{VT}}{dt}\right. \\ \frac{dx_T}{dt} = V_T \cos\theta_T \\ \frac{dy_T}{dt} = V_T \sin \\ \frac{dz_T}{dt} = -V_T \cos\theta \end{cases}$$

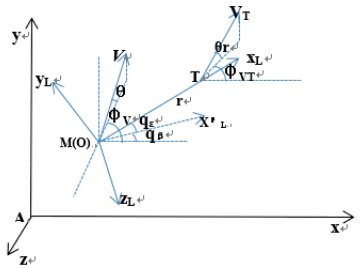
The space relative position of the missile to the target is shown in. In the figure $O_{x_L y_L z_L}$ is the Line-of-sight coordinate system, its origin 0 is taken on the missile centroid; the x_L axis is parallel to the center of mass of the missile and the centroid of the target, and the y_L axis is located in the plumb vertical plane containing the x_L axis, perpendicular to the x_L axis, and the z_L axis is perpendicular to the other two axes to form the right-handed coordinate system. Another definition: the angle of sight high and low angles q_ε the angle between r and water level A_{xz} in the missile target connection, if r is above the water level, then q_ε positive, vice versa; the angle of sight azimuth q_β is the angle between the projection of r on the horizontal A_{xz} and that of the axis of along A_x axis, When A_y axis counterclockwise direction to the projection line, the angle of sight azimuth q_β is positive, negative.

According to the relative position of the missile and the target, the relative motion equation of the missile

and the target can be derived as follows:

$$\theta = N_1 q_\varepsilon, \varphi_V = N_2 q_\beta \cos q_\varepsilon$$

The highest point in the early part of the missile track is the starting point of the research, when the missile is in a horizontal state, and the coordinate origin is the point of zero elevation directly below the missile's center of mass, and the spatial right-angle coordinate system is established. According to the data of the missile at the end of the first part of question 1, MATLAB is used to predict the trajectory of the missile and the change of trajectory inclination, as shown in the figure.



3. QUESTION 3

The orbit calculation model of STK software mainly includes three perturbation models of J2, J4 and HPOP. Through a lot of experiments and data analysis, it can be concluded that TLE corresponds to the number of flat roots and HPOP is the number of instantaneous roots. Both the calculation model and the input of J4 perturbation models are the number of flat roots.

Therefore, it is necessary to convert the number of TLE under the root number system to the number of classical tracks under the root number system, then to the classical track number under the system of the transient number. When using the HPOP perturbation model of STK software, the classical rail under the system of the transient root number is used. Other orbital prediction models use the classical orbital radical number under the system of flat radical number as input. The number of orbital roots calculated from the position and velocity vector of the spacecraft at any time by the transformation between the vector and the orbital root number is called the instantaneous orbital root number or instantaneous root number. The number of instantaneous roots at different times is different. The mean value of the number of instantaneous roots is called the mean orbital root number, or flat root number [6].

In 1959, according to the idea of averaging method in nonlinear dynamics, Kozai proposed the mean radical method for the perturbation of the main harmonic terms J - 2 and J - 4, and constructed the power series solution of the perturbation equation of motion. At the same time, Brou-wer gives a more complete perturbation solution by using Delaunary variable based on Von-Zeipel transform method.

The basic steps of missile simulation with Monte Carlo method are as follows:

(1)According to the motion characteristics of the missile and the typical target motion law, the ballistic simulation model of the missile with six degrees of freedom is established.

(2)Determine the main random interference factors and their distribution in the missile flight.

(3) According to the distribution law of various random disturbance factors, the corresponding mathematical probability model is constructed.

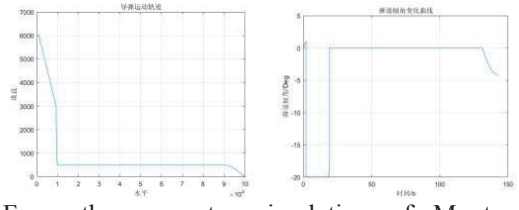
(4)The random disturbance sampling value is loaded into the missile six-degree-of-freedom 4-trajectory simulation model, and the parameters of the perturbed trajectory s and the impact point are obtained by computer simulation.

(5) Repeat the steps (4) for multiple simulated shooting to obtain multiple random trajectory impact point parameter subsamples

(6) The statistical eigenvalues of the impact point parameters are obtained by processing the simulation results.

Based on the six degrees of freedom ballistic mathematical simulation model of disturbed missile, Monte Carlo target simulation program is compiled under MATLAB. The fourth order Runge-Kutta method is used to solve the differential equations, and the random numbers of normal distribution are obtained according to the central limit theorem.

Firstly, the disturbance factor is set to zero and the shooting number is set to 1. The results of ballistic simulation are compared with the ideal ballistic parameters. The results are consistent with each other, and the correctness of the simulation model can be verified. Then the shooting times are set to 300 and the Monte Carlo target is loaded with random interference. The distribution of the impact point of the missile in the plane of the Oxz target is obtained as shown in the figure. In the figure, "*" is the dispersion of the impact point of the disturbed missile in the target plane, and "Hu" is the mean value of the scattered point, that is, the expected impact point.



From the computer simulation of Monte Carlo shooting, the missile hit accuracy is obtained by using Monte Carlo method for 300 times, and the impact point of missile is highly distributed in the plane of Oxz target, and the impact point of missile is highly distributed in the plane of Oxz target. From the normal distribution law, and the average impact point is located at the center of the target plane, it can be seen from the statistics of the parameters of the missile impact point in Table 1 that the expected impact point of the missile is very close to that of the ideal ballistic impact point: 3199.506,081n1.499,910-200.316 445). And the variance of the impact point in

triaxial direction is smaller, which indicates the guide. When the missile is affected by certain disturbance factors, it can still achieve a higher hit precision under the action of the control system, and the missile hit accuracy is higher when the missile is 0.87 m calculated by formula (7).

Through the simulation calculation of the hitting precision of the micro missile by Monte Carlo shooting, it can be seen that the hitting precision of the missile is high, which meets the requirement of accurate strike. The simulation results verify the accuracy of the missile six degree of freedom ballistic simulation model and the disturbance factor model. At the same time, it is proved that the Monte Carlo method is effective and feasible for the missile target simulation. The simulation results can also provide guidance for missile development and combat training, which is of theoretical and practical significance.

4. MODEL GENERALIZATION

For the model of land-based anti-ship missile, the similarity between missiles can be extended to attack other land target buildings, moving tank armored vehicles and bases. After simplifying the missile, the model can be applied to the target model of artillery, and can also be applied to the model construction and hypothesis of similar satellite launch, and the real-time monitoring and adjustment of the model can be carried out.

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Forecast of Public Transit Payment in Hangzhou Based on the Big Data of Transit Payment

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Abstract: In 2017-year Alipay in Hangzhou opened the transit mobile payment model. Therefore, a clear grasp and forecast of public transport in Hangzhou will undoubtedly have a great impact on business profitability.

Keywords: Train the machine; Multivariate nonlinear; Big date; Public transport payment;

1. PUBLIC PAYMENT HABITS

First, the 20 million sets of data collected are screened with Excle. Sorting out the proportion of different public transport payment methods, and establishes the relationship model between the public transport payment mode and the time point and the quarter.

Secondly, the number of bus travel and the number of public transport to pay a certain proportion, collation of relevant data. The relevant multivariate nonlinear regression equations are obtained by using Python to train the machine.

Finally, the results of the daily use of mobile payment in Hangzhou were stable at 430,000.

(1) The proportion of payment method

Through the analysis of the 2017 public traffic travel payment data of Hangzhou, it is concluded that under the influence of no special circumstances, the accounting ratio of bus card payment,mobile payment and other is 2:2:1.The correlation ratio is shown in figure 1.

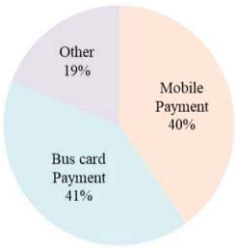

Figure 1 The proportion of payment method diagram

(2) Quarterly and payment methods

Regard the quarterly change as a variable, the integrated processing of the relevant large data. Establish a relationship model between quarterly and payment methods. The relationship betwwn quarterly and payment mode is shown in figure 2.

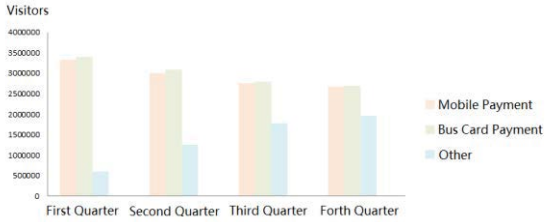

Figure 2 The relationship betwwn quarterly and payment methods diagram

Thus, it can be learned that with the change in the seasons, people's payment methods have changed accordingly. Although the number of other payment methods (such as: cash) increasing, mobile payment and bus card payment still occupies a great advantage.

(3)Payment mode and time point

With the further research, it is found that travel time is also one of the important factors that affect payment mode. To establish the relationship model between travel time and payment mode by collating relevant data.

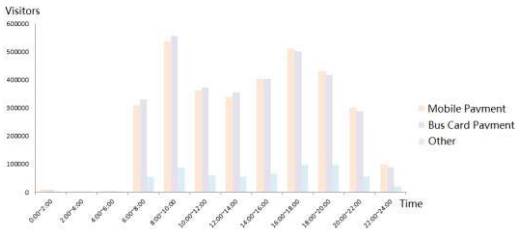

Figure 3 The relationship between travel time and payment mode

Therefore, it can be inferred that at 6:00 to 14:00 the mobile payment is higher than the bus card payment frequency. At 16:00 to 24:00 the bus card is higher than the mobile payment frequency. and the cash payment frequency is far smaller than the other two kinds of payment methods at any time.

2. FORECAST OF MOBILE PAYMENT QUANTITY

Under the condition that the mobile payment can be satisfied, the number of people who choose the mobile payment travel and the number of people who

choose the public transportation have some certain connection. Integrate data of Hangzhou citizens' travel in February 2017

Chart 1 Integrate data of Hangzhou citizens' travel in February 2017

Time	Mobile Payment Tips	Pubilc Transport Trips
20170207	448944	4821420
20170208	450387	5306890
20170209	446311	6131415
20170210	445657	6805982
20170211	446457	7542433
20170212	444805	8214935
20170213	445674	8842651

The above data is trained by machine in Python, and the nonlinear regression equation of the number of mobile travel (x) and the number of public transportation (y) is given as follows:

$$y = -2E-21X^6 + 5E-15X^5 - 5E-09X^4 + 0.0029X^3 - 896.45X^2 + 1E+08X - 1E+13 \quad (1)$$

Therefore,we can make a forecast diagram with Python

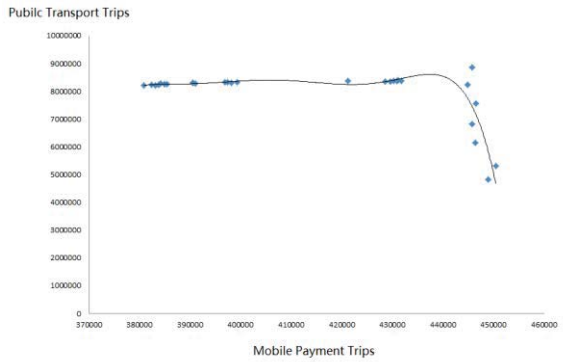

Figure 4 Relationship prediction diagram

The regression coefficient of the above curve is 0.789 (the closer the regression coefficient is to 1 the better). Therefore, the above formula can explain to a large extent the relationship between the public traffic travel and the mobile payment. By analyzing the data, we know that the public traffic in Hangzhou is about 8.2 million. The number of mobile payments per day in the use of the on-going travel has reached about 380,000. Through such a large day to make the ngqing University of Technology, 2016.

dosage is not difficult to find public transport mobile payment business development space is huge.

3. CONCLUSION

Public transportation companies and Third-party payment platforms should be concerned enough about this. The proportion of public transport with different payment types should fully take into account the public's payment habits. The maintenance time of public transportation should also be linked with the quarter, the time point, realize the maximization of resource utilization.

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Using Public Transport Payments to Analyze Revenue and Expenses of Third Party Payment Platforms

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Abstract: Bus mobile payment is the area where third-party payment platforms gradually increase investment. This paper analyzes the profit and expenditure of the third-party payment platform based on the mobile payment. This article takes the four aspects of fees, advertising fees, interest income from deposits, and service fees as profit indicators. Proposed the use of least squares method for the processing fee, linear regression method to fit the service fee, and then use the entropy weight method to evaluate the model to get the following four index weights, establish a profit model, and get a one-year profit. It reflects the accuracy of the calculation of weights in the profit calculations by the establishment of indicators and the entropy method.

Keywords: Entropy method; Least squares method; Profit model

1. INTRODUCTION

The profit-making methods of third-party payment platforms are mainly composed of four types, namely, handling fees, advertising fees, interest income from deposits of funds, and service fees. The specific relationship is shown in Figure 1.

For profit X, the fee, advertising fee, deposit interest income, and service fee are used as model indicators. Procedures fees x_1; advertising costs x_2; deposited funds interest costs x_3; service fees x_4. then: $X=\{x_1,x_2,x_3,x_4\}$

2. TOTAL PROFIT CALCULATION

(1) Calculation cf fees

Based on the number of people's needs, we need to establish a model to find out the function of the number of people following the change of time, so as to obtain the daily traffic for calculation. The following is the formula fitting process:

According to the data calculated in question 1, the relationship between time and number can be obtained as Table 1

Table 1 Relationship between time and number

Time	Number of people
0:00~2:00	988
2:00~4:00	17
4:00~6:00	539
6:00~8:00	46721
8:00~10:00	70034
10:00~12:00	43175
12:00~14:00	38851
14:00~16:00	45996
16:00~18:00	63130
18:00~20:00	58601
20:00~22:00	36004
22:00~24:00	11712

From the table can be drawn on the flow of people over a certain period of time. According to the table, the data is transformed into MATLAB software, the image is obtained by fitting, and the formula of human flow is obtained.

Solution of the Fitting Function of Target Value and Index Based on Least Squares Method.

According to the least squares model established in the first question, the target values and index values can be substituted into the parameter indexes as shown in the table 2:

Table 2 Indicators Available Parameter Indicators

Parameter value	Confidence intervals for each parameter
p1=0.0002721	(-0.001596,0.00214)
p2=-0.03821	(-0.2569,0.1805)
p3=2.283	(-8.636,13.2)
p4=-75.55	(-379.1,228)
p5=1509	(-3633,6651)
p6=-1.862e+04	(-7.32e+04,3.597e+04)
p7=1.393e+05	(-2.2e+05,4.986e+05)
p8=-5.962e+05	(-1.991e+06,7.984e+05)
p9=1.297e+06	(-1.546e+06,4.139e+06)
p10=-1.068e+06	(-3.326e+06,1.19e+06)

Using MATLAB to fit the statistical values shown in Table 3:

Table 3 Statistics

SSE	R-square	Adjusted R-square:	RMSE
5.62e+07	0.992	0.956	5301

From the table, the fitting equation is established, that is, the equation is:

$$R=P_1\times t^9+P_2\times t^8+P_3\times t^7+P_4\times t^6+P_5\times t^5+P_6\times t^4+P_7\times t^3+P_8\times t^2+P_9\times t^1+P_{10} \quad (1)$$

After the query calculation:

$$x_1=(1.25\%RY-0.5\%RY)\times 365\times 661 \quad (2)$$

After a query, it is known that a bus ride is 2 yuan.

$$x_1=13736540693 \quad (3)$$

(2) Calculation of advertising costs

Because the Internet and mobile clients owned by the third-party payment platform will all charge the merchant's fee[4], the advertising fee is an income of the third-party mobile payment platform.

The formula for calculating the advertising fee is: After analyzing the advertising fees of the major platforms, the payment methods of third-party payment platforms such as Alipay have been established, and the following relationship has been established:

$$x_2 = m \times CTR \times G \times CPM \times 365 \quad (4)$$

After checking the related click rate:

Table 4 Related CTR

APP	Ad clickthrough rate	Standard deviation
Baidu	0.19%	2.26E-04
Google	0.12%	1.14E-04
Yahoo	0.18%	3.09E-04
Sogou	0.16%	2.88E-04
Soso	0.27%	3.71E-04
WeChat	0.24%	2.65E-04
Alipay	0.21%	2.12E-04

Checked Aurora Big Data to get Alipay's daily active volume/million (ie daily traffic)

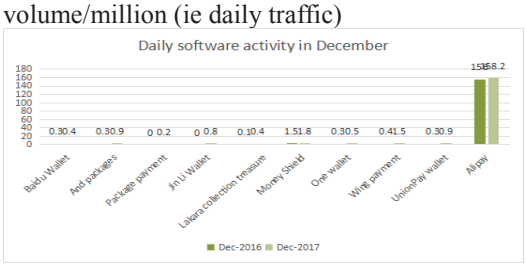

Figure 1 Software activity in December

By consulting and analyzing the data, a related model was established and the CPM was evaluated

$$CTR\ (a_i) = \frac{1}{m}\sum_{j=1}^{m}\delta(\mu_j, a_i) \quad (5)$$

$$\delta\ (\mu_j, a_j) = \begin{cases} 1, \text{If user } \mu_j \text{ clicks on the ad} a_j, \\ 0, \text{otherwise} \end{cases} \quad (6)$$

Table 5 Advertising CPM

Advertisement form	Regional orientation	Mobile terminal
SMD advertising	National	75 yuan/CPM
Pause ads	National	65 yuan/CPM

Through the analysis of auroral data, a linear regression equation was established, and the ad conversion rate was approximately 3%.

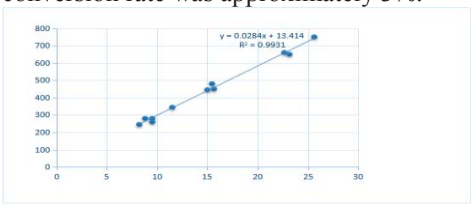

Figure 2 Linear regression

finally:

$$x_2 = 158.2 \times 10^6 \times 0.21\% \times 3\% \times 75 \times 365 = 272835675 \quad (7)$$

(3) Precipitation fund interest income calculation

From the data we can see that the use of sediment funds and integrated methods, as shown below:

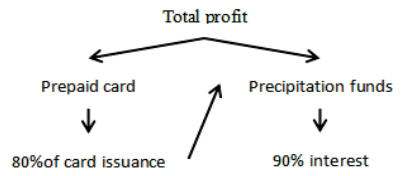

Figure 3 Return of deposited funds

Because data is required for analysis, data collection is conducted and a profit model of a third-party payment platform is sought. Therefore, data is collected and a related analysis model is established.

Part of the deposit funds will be huge, involving bank access issues. Therefore, the cooperation of a commercial bank and the Alipay platform will be used as an example to analyze the benefits of the precipitated funds. (Check the information disclosure agreement interest rate is 0.5%)Taking into account the fact that some users' funds are being withdrawn and accessed over a long period of time, we have established the following relationship models:

$$R_3 = \frac{M + M_1 + M_2 - N}{M + M_1 + M_2} \quad (8)$$

$$x_3 = \frac{0.9 + 0.9[[MR_2 + M_1(1 - R_3) - N]R + 0.5\%[M(1 - R_2) + M_1R_3] \times n - R_1(M_1 + M_2)]}{365} \quad (9)$$

Bring the data into solution:

Table 6 Data Results Table

Assets	Note No.	End of the period	End of last year
		2015.12.31	2014.12.31
assets			
Bank savings	7.4.7.1	434709276312.48	490,582,488,639.75
Prepaid card		65206391446.87	—
Automatic deposit		369502884865.61	
Cash reserve		110585.70	
Settlement provisions		107577.93	
Refundable deposits		3007.77	—
income		23731313749.69	

The final calculation of profit is:

$$x_3 = 23731313749 \quad (10)$$

(4) Service fee calculation

After searching and a large amount of literature read the formula for service fees:

$$F = \frac{N1}{2000} + 0.2ROUND(10\%N2) + 0.375\%N4 \quad (11)$$

Since the service fee requires a lot of data as a basis, after searching a large amount of data, the relationship between the page views and the number of purchases in Table 10 is obtained:

Table 7 Relationship between page views and purchases

Page views/1000	Page views	Clicks	Purchases	purchase amount	Service fee
8.8291	88291	53	5	5237090	1968423
102.677	1026770	544	54	2116800	8462.18
31.7955	317955	113	11	64454.4	402.88
7.6419	76419	38	4	128864	522.24
11.0142	110142	58	6	91188	398.22
40.6071	406071	117	12	860640	3432.83
19.7207	197207	82	8	502976	1986.36
31.7955	317955	113	11	64454.4	402.88
17.6098	176098	53	5	174594.8	743.77
45.5126	455126	41	4	83980	543.28
23.1622	231622	42	4	37640	257.76

Import data into MATLAB for the relationship between page views/1000 and purchases:

The least squares method is used to solve the fitting function of the target value and the index value.

After using MATLAB to fit the data：

SSE	R-square	Adjusted R-square	RMSE
285.5	0.9344	0.882	5.343

Table 8 Statistics

Get the relationship between the number of formula views/1000 and the number of purchases:

$$y = p_1 \times x^8 + p_2 \times x^7 + p_3 \times x^6 + p_4 \times x^5 + p_5 \times x^4 + p_6 \times x^3 + p_7 \times x^2 + p_8 \times x + p_9 \quad (12)$$

According to formulas 1, 11 and 12 can get the formula.

$$x_4 = F \cdot y \times 365 = 1502208003 \quad (13)$$

(5) Using the entropy weight method to calculate the index

Considering this system, there are four evaluation indicators, one evaluated program, and the raw data of the corresponding indicators of the evaluated object are represented by the following matrix.

$$F = (f_{11} f_{12} f_{13} f_{14}) \quad (14)$$

First, the original data is dimensionlessly processed. The best value for each column in S is:

$$f_j^* = \begin{cases} \max f_{ij}, \text{tndex } j \text{ is a profitabil ity index} \\ \min f_{ij}, \text{The j indicator is a cost indicator} \end{cases} i = 1, j = 1,2,3,4 \quad (15)$$

After the original data is dimensionless, it is recorded as a matrix $S = (s_{ij})_{m*n}$

$$S_{ij} = \frac{f_{ij}}{f_j^*} \quad (16)$$

Normalize S and mark it as

$$S_{ij}^* = \frac{S_{ij}}{\sum_j \sum_j S_{ij}} \quad (17)$$

The resulting $s_{ij}^* \in [0,1]$, and does not destroy the proportional relationship between the data.

Defining the entropy of the j evaluation index:

$$H_j = -k \sum_{i=1}^{m} t_{ij} In\ t_{ij} \quad (j = 1,2,3,4) \quad (18)$$

$$\text{Among } t_{ij} = \frac{S_{ij}^*}{\sum_{i=1}^{m} S_{ij}^*} (j = 1,2,3,4) \quad (19)$$

$$k = \frac{1}{In\ m}, \quad (\text{This choice of } k \text{ makes } 0 \le H \le 1, \text{ convenient for subsequent processing}) \quad (20)$$

The difference coefficient for defining the j evaluation index is:

$$a_j = 1 - H_j (j = 1,2,3,4) \quad (21)$$

Defining the entropy weight of the j evaluation index is $w_j = \frac{a_j}{\sum_{j=1}^{n} a_j}$ $j = (1,2,3,4)$ (22)

$$0 \le w_j \le 1 \text{ and } \sum_{j=1}^{n} w_j = 1 \quad (23)$$

finally: $W_j = (0.29, 0.08, 0.33, 0.30)$

$$X = (x_1 \times 0.29 + x_2 \times 0.08 + x_3 \times 0.33 + x_4 \times 0.30) \times 4 = 1\,6\,3\,4\,3\,3\,8\,4 \times 2\,1\,0\,6\,5\,3\,7\,3\,5\,2\,4\,4\,8\,1 \quad (24)$$

ACKNOWLEDGMENT

The calculation data of the revenue and expenditure of the third-party payment platform under the bus mobile payment comes from auroral data.

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Character Recognition Model based on BP Neural Network

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Abstract: Optical character recognition is the core of OCR. For many types of machine learning algorithms, using auxiliary information to improve recognition accuracy is the most important topic. In this paper, the principal component analysis method is used to obtain 10 principal components of a large number of known character features, and the BP neural network model is established to accurately identify the characters. This paper also proposes an adaptive learning rate algorithm to control the gradient descent rate of BP neural network algorithm, so as to improve the efficiency of model recognition.

Key words: principal component analysis; BP neural network; normalization; adaptive

1. PRINCIPAL COMPONENT ANALYSIS

PCA is a means to optimize the index of original data variables. The original regression independent variable is converted into another set of variables, and a few important principal components are selected as new independent variables to replace the original variable. The selected principal component contains as much information as possible in the original variables. When the principal component is extracted from the correlation coefficient matrix, Kaiser[1] will discard the principal component whose eigenvalue is less than 1.

(1) Normalization treatment

Because the magnitude of the data between the 16 variables is different, the data is normalized first, and a original value m is mapped to the value M' of the interval [0,1] through the maximum minimum standardization, and the normalized processing formula is as follows

$$M_{\mathrm{i}} = \frac{m_i - m_{\min}}{m_{\max} - m_{\min}} \quad (1)$$

In the formula, mmax and mmin are the maximum and minimum values of m respectively, i=1,2,... 16.

(2) Principal component

In the actual study, in order to achieve the goal of reducing the dimension, less than 10 principal components are generally selected. The selected principal components can explain more than 90% of the variation, and these principal components can be used as new variables to replace the original main components. SPSS software is used to calculate the contribution rate of the eigenvalues and select the number of principal components. The corresponding contribution rate is shown in Table 2. The cumulative contribution rate of the first 10 principal components has reached 91.5%, so the first 10 principal components are selected.

Tab.2 Variance contribution rate of principal component

component	Initial eigenvalue		
	Total	Percentage of variance	Accumulate %
1	4.295	26.846	26.846
2	2.625	16.409	43.255
3	1.721	10.757	54.012
4	1.369	8.557	62.569
5	1.051	6.571	69.140
6	0.980	6.125	75.265
7	0.889	5.558	80.823
8	0.626	3.912	84.735
9	0.595	3.722	88.456
10	0.492	3.074	91.531
11	0.426	2.666	94.196
12	0.266	1.664	95.860
13	0.254	1.587	97.447
14	0.215	1.341	98.788
15	0.119	0.744	99.532
16	0.075	0.468	100.00

The eigenvalues of the covariance matrix corresponding to the original data can be directly obtained by means of SPSS software[2]. The calculation of the score coefficient matrix of the related components is found. The principal components are extracted and the following 10 principal components are extracted:

n_1=0.161m_1+0.441m_2+0.087m_3+0.466m_4+0.040m_5-0.015m_6-0.048m_7-0.003m_8-0.061m_9-0.034m_{10}-0.035m_{11}+0.007m_{12} -0.191 m_{13+} 0.068 m_{14}-0.105m_{15+}0.010m_{16}

2. ESTABLISHMENT AND SOLUTION OF BP NEURAL NETWORK MODEL STRUCTURE

(1) Determination of model structure

The learning algorithm of BP network is a tutor learning algorithm: the actual output is compared to the expected output, and the weight is adjusted based on the size of the error to minimize the final error value until the precision is met. According to the Kolmogrov[4] theorem, a 3 layer network with N

input nodes, M intermediate nodes and 1 output nodes can express any mapping accurately, and simultaneously the capacity of the middle layer and the training time can be coordinated. This model is a BP neural network model with 3 layers of 10-15-1.

(2) Processing of sample sets

In order to avoid the influence of different input variables and absolute values on the neural network model, we need to normalize input data.

(3) Neural network

The purpose of BP neural network learning is to make the following calculation for each sample after entering the sample set by constantly adjusting the weight value obtained by the weight matrix.

calculate the actual output value of each node layer by layer.

For hidden layer nodes:

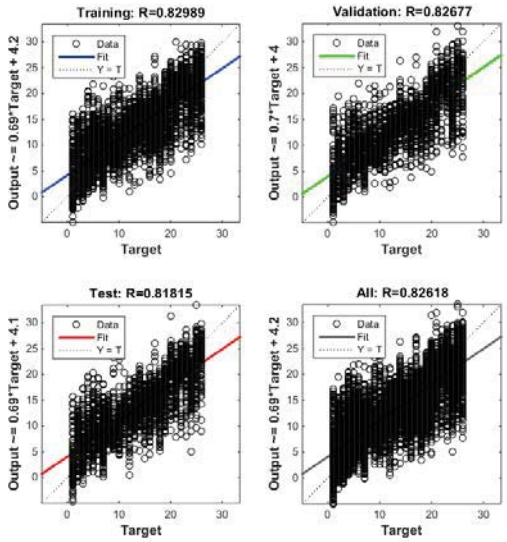
$$o_{pi} = f(net_j) = \frac{1}{1+\exp(\sum \omega_{ij} - \theta_j)} \tag{2}$$

To the output layer node:

$$o_{pk} = f(net_k) = \frac{1}{1+\exp(\sum \omega_{jk} o_{pj} - \theta_k)} \tag{3}$$

Calculating the output error of a single sample:

$$E_p = \frac{1}{2}\sum_{p-1}^{n}(t_{pk} - o_{pk})^2 \tag{4}$$



Average error of computing system:

$$E = \frac{1}{pe}\sum_{p=1}^{p\theta} E_p \tag{5}$$

Adjust the weight and threshold of the output layer:

$$\delta_k^p = o_k^p(1-o_k^p)(Y_{pk} - o_k^p) \tag{6}$$

$$\Delta\omega_{jk}(t) = \frac{1}{pe}\sum_{p=1}^{pe}\left\{\eta o_p^k + \alpha\left[\Delta\omega_{jk}(t-1) - \Delta\omega_{jk}(t-2)\right]\right\} \tag{7}$$

$$\Delta\theta_k(t) = \frac{1}{pe}\sum_{p=1}^{pe}\left\{\eta\delta_k^p + \alpha\left[\Delta\theta_k(t-1) - \Delta\theta_k(t-2)\right]\right\} \tag{8}$$

Adjust the weights and thresholds of the hidden layer:

$$\delta_j^p = \sum_k \delta_k^p \omega_{jk} o_{pj}(1-o_{pj}) \tag{9}$$

$$\Delta\omega_{jk}(t) = \frac{1}{pe}\sum_{p=1}^{pe}\left\{\eta\delta_p^k o_{pj} + \alpha\left[\Delta\omega_{jk}(t-1) - \Delta\omega_{jk}(t-2)\right]\right\} \tag{10}$$

$$\Delta\theta_j(t) = \frac{1}{pe}\sum_{p=1}^{pe}\left\{\eta\delta_j^p + \alpha\left[\Delta\theta_j(t-1) - \Delta\theta_j(t-2)\right]\right\} \tag{11}$$

After adjusting the weights and thresholds of the output and hidden layers, the next iteration is done.

3. PREDICTION SIMULATION OF MODEL

The MATLAB simulation software is used to simulate some data in the neural network model, so as to realize the prediction accuracy of the known character characteristics. The initial weights and thresholds of neural networks have been given. The predicted output and expected output of the BP neural network are shown in Fig.2, and the BP network prediction error is shown in Fig.3 .

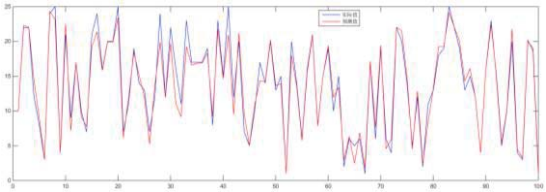


Figure 2 Comparison and analysis of predicted and expected output

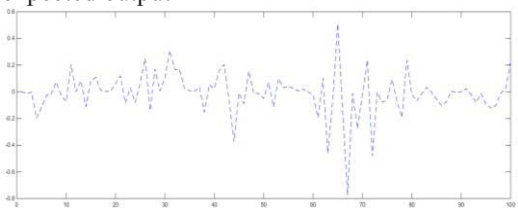


Figure 3 Error of BP network prediction

As shown in Fig. 2, the predicted value can well track the actual value; from Fig. 3, BP network predicts the error between the predicted value and the actual value of individual samples is larger, most of the sample prediction error is within 0.06, that is, the accuracy of prediction is 94%. It can be seen that the overall prediction effect is better.

Fig. 4 Regression analysis of BP neural network

Fig.4 is the BP network training and prediction regression graph, from which the value of R^2 in the test set regression is reached to 0.81429, which also shows that the predictive effect of the BP network is ideal[5].

4. AN IMPROVED MODEL OF MODEL

BP neural network algorithm uses gradient descent method to find the optimal weights and thresholds, and the objective function after optimization becomes more complicated. In a flat area, there is only a slight change in the weight error, which makes the training process close to the stop, making the neural network need to learn hundreds or even thousands of times to converge, which makes the efficiency of the algorithm lower. The adaptive algorithm adaptively [6]adjusts the learning speed of BP algorithm, controls the gradient descent rate of BP algorithm,

and further improves the convergence of BP algorithm. The formula of adaptive learning rate is as follows:

$$\eta(k+1)\begin{cases}1.05\eta(k)\Lambda\ E(k+1)<E(k)\\0.7\eta(k)\Lambda\ E(k+1)>1.04E(k)\\\eta(k)\Lambda\ \Lambda\ else\end{cases} \quad (12)$$

Among them, E (k) is the sum of square sum of the prediction error of the first k, and K is the learning rate of the first k. It can be seen that the output error of the algorithm is calculated first, and the learning rate will automatically decrease when the error of the present moment is greater than the multiple of the error, and the learning rate will be increased when the present moment is less than the multiple of the error. It keeps the learning rate unchanged.

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Seismic Waveform Signal Interception and Identification

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Abstract: The occurrence of earthquakes will cause catastrophic damage to human life. The use of seismic waveform signals to monitor seismic activity is currently the only means. How to accurately intercept and identify seismic waveform signals is very important. Because there is noise in the acquisition of seismic waveform signal data, the data is first denoised, and a wavelet denoising model based on wavelet transform principle is adopted. First analyze the noise signal characteristics, and then wavelet three-layer decomposition to remove the noise wavelet coefficients. The remaining wavelet coefficients are reconstructed, and then the wavelet threshold denoising algorithm is used. The coefficient of the noise in each layer coefficient obtained after wavelet decomposition is set to zero, and then the processed wavelet coefficients are inversely changed, so that effective signals are obtained. Remaining, and finally effective interception of seismic waveform signals.

Keywords: Wavelet threshold denoising; Stein Unbiased Likelihood Estimation Principle; EMD decomposition; Support Vector Machine Model

1. INTRODUCTION

Then the waveform data is normalized and centered. Then, based on the analysis of the time-domain and frequency-domain characteristics of the seismic waveform data, the waveform data feature extraction algorithm is used to perform EMD decomposition on the data to obtain several IMF components. Then the feature parameters are extracted from the first three internal model functions. The result shows that the maximum amplitude corresponds to the period, the cepstrum mean, and the maximum value of the autocorrelation function. The necessary preprocessing of the data sets of feature parameters is performed. Then, a support vector machine model is established based on natural seismic and artificial blasting earthquakes. A kernel function is expressed in the form of a radial basis kernel function, and a feature vector consisting of characteristic parameter data values is selected. As training samples, repeated identification experiments were performed. The results show that the extracted three characteristic parameters can well identify the waveform signals of the natural and artificial blasting sources.

The earthquake is a natural disaster with great destructive power. Once it occurs, it will cause great disasters to human life. Therefore, the prediction of earthquakes has become an urgent problem to be solved. During an earthquake, the earth's crust releases energy quickly and generates vibrations, which generate seismic waves. The only way to monitor seismic activity at present is to use seismic waveform signals. Seismic waveform signal interception and identification is the core task. According to the seismic waveform signal data, denoise it, establish a suitable mathematical model and use the algorithm to cut out a single complete waveform diagram of the seismic waveform. In order to allow waveforms to be better expressed, then from the analysis of the temporal and frequency domains of earthquakes, we search for feature parameters with high expressiveness and decompose them from the data, and decompose the data. Analysis and evaluation are performed to reflect the integrity of the expression waveform information. Then use the waveform information expressed by the waveform feature parameters to establish a mathematical model to classify and identify the source signal type.

(1) Wavelet threshold denoising

In the actual process of acquiring signals, the data of the seismic waveform signals that we have collected will be affected by the data acquisition instruments and the acquisition environment and various forms of external interference. During the process of propagation, tilt, drift, and waveform distortion will occur. Such phenomena, resulting in invalid data, that is, data noise. These noises will have a bad influence on the analysis and processing results of the data. Before the analysis of the data, denoising must be performed. The denoising method based on wavelet transform is a kind of denoising method which has been widely used for good performance.The signal of the hypothesis analysis is:

$$S(i) = f(i) + \sigma \cdot e(i), \quad i = 0, \mathrm{L}\ , n-1 \tag{1}$$

Among them, *S(i)* is a signal containing noise, *f(i)* is

a real signal, and *e(i)* is noise. In wavelet analysis, the standard deviation of the noise figure is σ, and the estimate is constant. In practice, the energy concentrated in the high frequency band is the noise energy, and it is evenly distributed on the wavelet coefficients with small amplitude. Therefore, wavelet coefficients can be used to remove noise to obtain the final effective seismic waveform signal. The noisy signal is preprocessed, and then the wavelet three-layer decomposition is performed. The wavelet coefficients corresponding to the signals at differe scales are preserved as much as possible, the wave coefficients of the noise are removed, and t remaining wavelet coefficients are reconstructed denoise. In Figure 1, *S* are noisy signals that ha been preprocessed. cA1, cA2, and cA3 are t decomposed low-frequency information. T

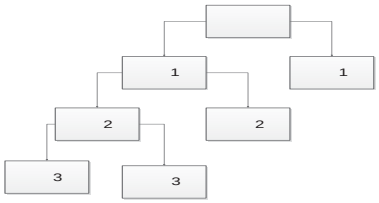

Figure 1 wavelet decomposition of noisy signals

The main idea of wavelet threshold denoising is separately deal with coefficients less than or great than a certain threshold in each layer of coefficier obtained after wavelet decomposition, that is, retain the effective signal, set the coefficient of noi to zero, and then reverse the processed wave coefficients. Change, get the denoised image. T resulting waveform signal before and after denoisi is as follows:

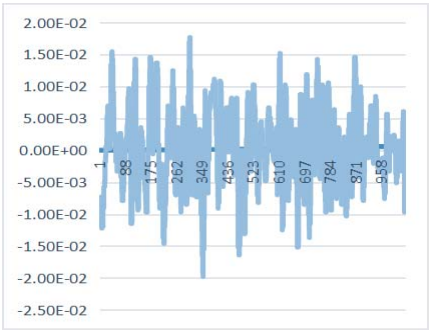

Figure 2 Denoising waveform information diagram

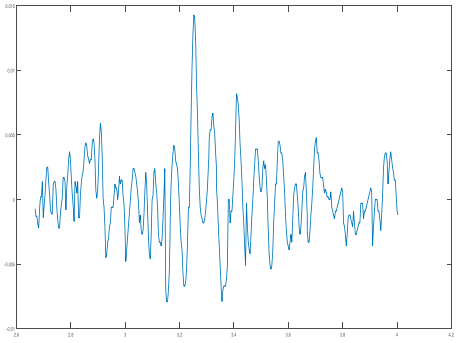

Figure 3 Denoise intercepted waveform information diagram

(2) Waveform signal decomposition and extraction

First, the data is normalized and centralized to prevent data from drifting and affecting the results. When the data is normalized and centralized, equations (3) and (4) are used, in which PX1 represents the amplitude of normalized waveform data. PX2 represents the magnitude of the centering processing, and X represents the original amplitude.

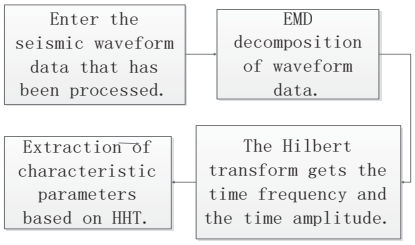

Figure 4 Feature extraction flow chart

In Matlab, the period (T_{Amax}), the mean of the cepstrum (C_{ave}), the autocorrelation function (M_{xc}), and finally the feature vector of the dimension can be derived.The three corresponding internal model functions are arranged in the table in order.

Table 1 Feature date sets

T_{AMX1}	C_{ave1}	M_{xc1}	T_{AMX2}	C_{ave2}	M_{xc2}	T_{AMX3}	C_{ave3}	M_{xc3}
7.4013	0.0024	20.1250	8.7135	0.0022	6.4176	23.4210	0.0019	2.3843
3.8279	0.0019	5.2122	6.5551	0.0018	3.0645	11.9500	0.0015	0.7621
...	...	...	...	...	...	...	...	...
8.5256	0.0027	29.1580	10.2700	0.0026	20.8680	18.0000	0.0023	5.9455

(3) Identification of natural earthquakes and artificial blasting

In seismology, the source is the starting point of the earthquake and where the fault begins to break. The sources of earthquakes caused by human factors are called artificial earthquakes. For example, artificial blasting, natural earthquake sources and the nature of artificial blasting sources are very different. In order to identify the natural and artificial blasting types of the source signals through the waveform information described by the characteristic parameters, the following processing is performed: The seismic waveform feature data is normalized. The normalization of eigenvectors is a feature transformation. Here, the eigenvectors extracted from the first three internal model components of the seismic waveform signal are transformed using the linear function transformation method. The expression is:

$$y = (x - \min(x)) / (\max(x) - \min(x)) \quad (4)$$

Where x, y are the feature vectors before and after processing.

The SVM method is an effective means to solve the function estimation and pattern recognition. Its main idea is to transform the input space into a high-dimensional space using a nonlinear transformation, and then construct a classification decision surface in this space to make different sample sets and this The distance to the plane reaches its maximum. The classification function obtained by the support vector machine resembles a neural network. Pictured:

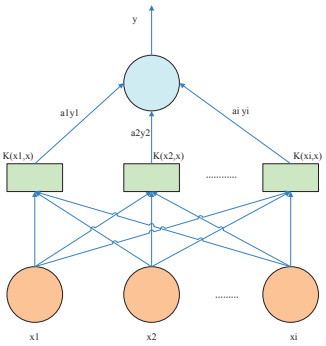

Figure 5 support vector network diagram

According to the theory of support vector machines, the identification of waveform signals requires the selection of an appropriate kernel function. The characteristics of the Sigmoid kernel function are similar to polynomial kernel functions in some respects, but may make the classification face of the training not have good generalization ability. It has been proved that the kernel function is expressed in the form of a radial basis kernel function:

$$K(x_i, x_j) = \exp(\|x_i - x_j\| / 2\sigma^2), \sigma > 0 \quad (5)$$

This adjusts the values to ensure that the training samples are linearly separable in the transform domain space. Therefore, a radial basis kernel function, a C-SVC type support vector machine are selected, and a support vector machine classifier model is established using the n-fold interaction verification mode.

Based on the repeated test method, the normalized feature parameter data set is normalized, and the classifier is designed by using the feature vector consisting of the three feature parameter data values determined by the second query as a training sample, and the n-fold interaction test is still performed. The mode, the loss function is set to 28, the gamma function of the kernel function is set to 14, continue to test the effect of the classifier with the same number of samples.with:

$$f(x) = \text{sgn}(\Sigma a_i y_i K(x_i \bullet x) + b) \quad (6)$$

Find the decision function value of the classifier model.The decision function values of the classifier model and T_{Amax1} are horizontal and vertical coordinates, and a sample identification chart is made. It can be seen from the figure that these three eigenvectors compose eigenvectors and then serve as training samples and test samples, and the recognition rate reaches 99.9%. It still objectively shows that the more feature vectors in the experiment, the higher the recognition rate.

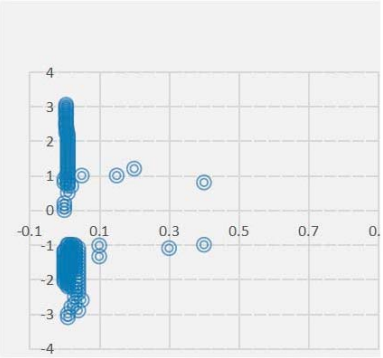

Figure 6 Recognition effect chart

It can be seen from the figure that the combination of these three eigenvectors is taken as the training sample and the test sample, and the recognition rate reaches 99.9%. It still objectively shows that the more feature vectors in the experiment, the higher the recognition rate, and obviously It can be seen that the type of the source signal is divided into two types of signals.

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Restoration of Fuzzy Image Based on Degraded Model

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Abstract: Under the background of "Internet plus", computer vision technology has received wide attention. In order to achieve a smoother experience with a lower frame rate, it is difficult to see the details of the dynamic fuzzy images through the simulation of the motion of the camera and the shooting landscape. Therefore, it is necessary to establish a reasonable mathematical model to restore the picture as clear as possible. In view of the above problems, this paper makes the following research:

First of all, using median filter method and mean filtering method for fuzzy image noise reduction processing, in addition to the noise interference of blurred image, by comparing the average filtering method of denoising and at the same time to do the image details, so that the image blur, not well remove the noise points, therefore, the median filtering method to deal with the fuzzy image more appropriate.

Secondly, the estimation of the fuzzy Angle and the fuzzy length is calculated by the Radon method and the backward spectrum method, and the fuzzy Angle and the fuzzy length are calculated, and the accuracy of the data is proved by the processing of known images. To use data to draw degradation model is established, respectively, using the method of constrained least squares filtering, wiener filtering algorithm and L-R algorithm of fuzzy image recovery operation, compared with constrained least twenty percent filtering method of image reduction is the most clear.

Therefore, by designing a reasonable mathematical model, it is ideal to restore the fuzzy image to the most clear picture, which provides a theoretical basis for dynamic fuzzy processing.

Key words: image restoration; Noise reduction treatment; Cepstrum method; Least-squares filtering method;

1. PREFACE

With the rapid development of science and technology, images become an important way for people to obtain information from the outside world[1]. In the process of image acquisition, the existence of various degenerate factors causes the existing image to have different degrees of fuzzy degeneration. The relative motion, shooting and the interference of different noises between the imaging sensor and the photographed scene are the important reasons for the blurred image motion. Important application in everyday life all need through the motion blur image restoration technology as far as possible to remove distortion, namely from the degraded image restoration to reflect the real images of the scene, so the motion blurred image restoration technology research has important practical significance. Aiming at this problem, this paper will discuss and find a better model of image restoration from the following aspects.

The key problem to recover the original image from the motion blur image is to obtain the point diffusion function. Fuzzy image denoising[2], fuzzy Angle and length identification are also very important.

The establishment and solution of the model:

2. SOLUTION METHOD FOR MODEL

(1) The descending equation of image is:

$$g(x,y)=\int_{-\infty}^{\infty} f(\alpha,\beta)h(x-\alpha,y-\beta)d\alpha d\beta+n(x,y)$$

The following assumptions are made for the health model:

£ is Linear:

$$H[k_1 f_1(x,y)+k_2 f_2(x,y)]=k_1 Hf_1(x,y)+k_2 Hf_2(x,y)$$

(2) £ is the space (linear displacement) invariant, for any f(x,y) and any constant alpha and beta are:

$$Hf(x-\alpha,y-\beta)=g(x-\alpha,y-\beta)$$

The result of any arbitrary point on the image depends only on the input value of the store, not the coordinates.Image restoration can be viewed as a process of predicting estimate, given by the degradation of the image g H (x, y) estimate the system parameters, and the approximate to restore the f (x, y), motion blur image degradation model can be described as a degradation function to add an additive noise n (x, y), so the mathematical expression of image degradation process can be written as[3]:

$$g(x,y)=H[(x,y)]*f(x,y)+n(x,y)$$

Without considering noise, the expression can be simplified as:

$$g(x,y)=H[(x,y)]*f(x,y)$$

(2) The solution of fuzzy direction and fuzzy scale

The fuzzy image generated by uniform motion is simulated with the convolution method. When the fuzzy direction is horizontal, the motion fuzzy point diffusion function can be expressed as:

$$h(x)=\begin{cases}0, & \text{其他}\\ \frac{1}{L}, & 0\le x\le L-1\end{cases}$$

L is the displacement of pixels. Its frequency domain transfer function is:

$$H(u)=\frac{\sin(\pi Lu)}{\pi Lu}$$

When the fuzzy direction is shown in any direction, the offset component of the deviation in the x direction and the y direction is n and m respectively.

When $m\le n$, the point diffusion function of motion blur is:

$$h(x,y)=\begin{cases}\frac{1}{m}, & 0\le x\le m-1; y=[\frac{n}{m}x]\\ 0, & \text{其他}\end{cases}$$

When $m\ge n$, the point diffusion function of motion blur is:

$$h(x,y)=\begin{cases}\frac{1}{n}, & 0\le x\le n-1; y=[\frac{m}{n}x]\\ 0, & \text{其他}\end{cases}$$

(3) Motion blur image denoising processing[5]

In addressing the problem of motion blurred image restoration, because the process such as image acquisition, transmission and output are more or less to images with noise interference, and mixed with the kinds of noise also is uncertain, this increases the noise of the complexity of the process. If the image of mixed noise is not processed directly, the effect is often not satisfactory. Therefore, it is an important step to remove noise before image restoration.

Median filter denoising method:

$$\hat{f}(x,y)=\underset{(s,t)\in S_{xy}}{median}\{g(s,t)\}$$

The grayscale values of all pixel points in the domain of the pixels of (x,y) are sorted, and the gray values in the middle are replaced by the gray values (x,y). Its flow chart is shown in fig.1.

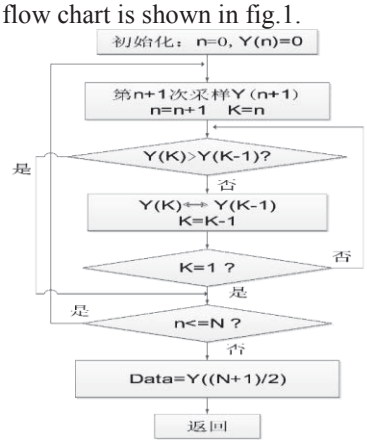

Figure 1 Median filter denotes noise.

Average filtering denoising method: dealing with the current pixel (x, y), choose a template, this template is composed of the neighbor number of pixels, strives for the average of all pixels in the template, and then gives the mean to the current pixel point (x, y), as a grayscale image at that point in g (x, y),

$$g(x,y)=\frac{1}{m}\sum_{i=0}^{n}f(x,y)$$

m is the total number of pixels in the template that contains the current pixel.

The three images in fig.2 are the original image, the mean filtering processed image and the median filter processing image.

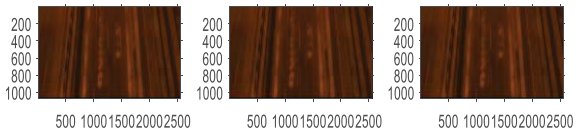

Figure 2 Renderings of different noise reduction methods

(4) The restoration of motion blur image

Under the condition of the degradation model and the prior knowledge of the point diffusion function, the fuzzy image is restored and the original image is restored. For motion blur image restoration, it has already been studied the motion blur length and Angle, and a method for determining parameters with the prior knowledge, again through the recovery algorithm can get restored image. Common image restoration algorithm has inverse filtering algorithm and wiener filtering algorithm and least squares filtering algorithm, based on the MATLAB tool, the motion blurred image is obtained under the condition of the prior knowledge of research on the effects of several kinds of algorithm for image restoration.

a. Estimation of prior knowledge of motion blur image:

Through the introduction of motion blurred image in front of the Angle and length of the estimates that in the above mentioned methods for fuzzy image recovery before the image fuzzy Angle and length of prior knowledge for sure.

(2) Fuzzy motion Angle and length detection

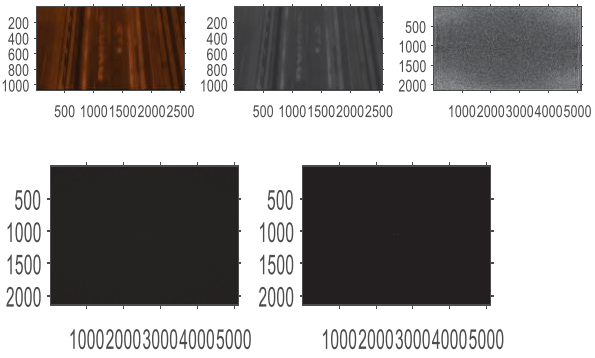

Figure 3 The Angle of motion and the solution of length

The Angle of motion is 0, and the length of motion is 51. To prove the accuracy of solving, this article

selects a known image to validate its prior condition, through the validation of fig.4 and table 1 shows that the algorithm of small error, high accuracy, can prove that the accuracy of the results[6].

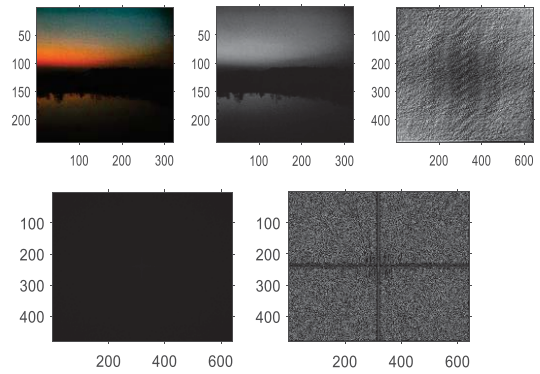

Figure 4 Other graphic detection

Tab.1 estimation of experimental results from the motion Angle.

True fuzzy Angle(0)	10	20	30	40	50	60
estimated(0)	10	19	30	40	49	61
error(0)	0	1	0	0	1	-1

Using the above conditions, the wiener filtering algorithm, the constraint minimum and the r-l algorithm[7] are the final results of the image restoration as shown in fig.5:

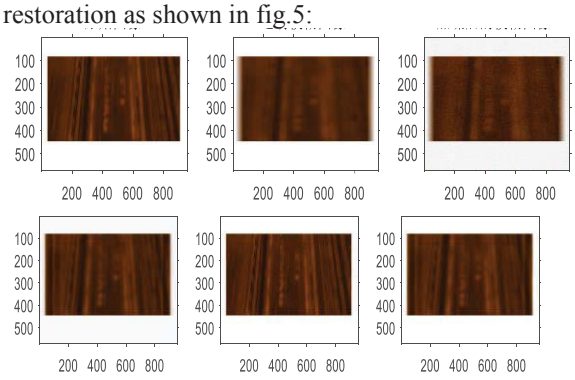

Figure 5 image restoration results

3. CONCLUSION

This paper studies the various image restoration method[8,9], facing different problems need to use different algorithms, when unknown a priori model, you first need to understand the blurred image of the parameter estimation, spectrum and cepstrum method after it is concluded that the fuzzy measure and fuzzy length of the original image, the same result program a fuzzy measure and fuzzy length can be obtained by the correctness of using median filtering noise reduction and average filtering noise reduction two kinds of method to solve the problem of image noise, by has the results in figure can see, median filtering noise reduction in denoising algorithm is superior to the average filtering noise reduction, with average filtering itself exists inherent defects, That is, it can't protect the image details well, and it also destroys the details of the image when the image is denoising, so that the image is blurred and the noise point can not be removed well.

Figure 6 Median filter denotes noise.

Figure 7 The mean filtering method reduces noise.

When known a priori knowledge, dealing with image restoration problems need to consider the image to the fuzzy and denoising, inverse filter and wiener filtering is not very ideal, in dealing with a noise Lucy - Richardson[9], after many iterations to make image is clear, but the noise will be increased in the process of iteration, derivation constraint least square wave algorithm is relatively complex, due to the specific value of the unknown parameters, so it is necessary to estimate unknown parameters. Although these algorithms can't completely restore the fuzzy image to the original image, it can be seen from the comparison between the reconstruction and fuzzy images that the fuzzy images can be clarified by these algorithms. As shown in the fig.8:

Figure 8 Different algorithm recovery graph

Integrated the derivation process of the four kinds of algorithms, and image display, we draw a constrained least squares filter algorithm processing blurred image is compared to other algorithms, the overall image is most clear, can be better restored image, keep the original image details, therefore, to solve the problem of fuzzy image processing in this paper, using constrained least squares method is more suitable.

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The Solution of Seismic Wave Signal Problem Based on Wavelet Transform Theory

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Abstract: Earthquake is a very destructive natural disaster, when a strong earthquake will cause great loss to people, for the safety of people's life and property, the prediction of earthquake becomes an urgent problem to be solved. Studies have shown that earthquakes are due to tectonic earthquake, will accompany during the seismic wave, which can be according to the seismic signal monitoring seismic activity to achieve the effect of the earthquake, and seismic wave signal is the only means of monitoring earthquake activity, tried to seismic signal monitoring is particularly important.

Key words: seismic wave signal wavelet threshold denoising principal component analysis method bp-adaboost algorithm.

1. INTRODUCTION

First of all, analyze the seismic data and processing, will transform of seismic records over time signals of Fourier transform, the frequency spectrum analysis, get the change with frequency and amplitude and phase of the function.Will happen then, due to the nature of some of the more severe influence on seismic wave collection factors, such as nuclear explosions, blasting, the noise of the equipment and so some man-made factors, there are similar to the landslides and other natural factors, the human factors and natural factors of information are likely to be of high precision seismic observation instrument to collect, lead to the study of seismic wave produces deviation.Therefore, it is extremely necessary to deal with seismic waves, and the wavelet analysis method has the characteristics of multi-scale and multi-resolution analysis, so it is more suitable for the analysis of seismic waves.In the process of denoising, the wavelet threshold denoising method is selected.After the wavelet denoising, a single signal is intercepted and a single complete signal is obtained.In the analysis of the intercepting signal error, the error is found in the flaw of the method itself in the process of wavelet threshold de-noising, which will be described in detail below.

Simple as much as possible in order to observe the waveform signal, using principal component analysis (pca), the characteristic parameters of dimension reduction effect, many indexes can be converted to a few comprehensive indexes, with less performance more specifically the waveform characteristic parameters information, so as to reduce amount of calculation and simplify the problem, the purpose of the first lists the three different individual characteristic parameters of seismic wave in the original data standardization, calculate the correlation coefficient, the characteristic root, finally will be standardized unit characteristic vector transformation is given priority to, finally calculate the characteristic parameters of cumulative contribution rate, and sorted, Finally, it is determined that the continuous time is the first principal component, the amplitude is the second principal component, and the ascending time is the third principal component, and these three characteristic parameters are the main characteristic parameters.

According to the data given in the problem, a suitable model and algorithm are established to intercept a single complete seismic wave signal similar to figure.

Considering the noise signal in the generated seismic wave signals, wavelet threshold denoising is required to obtain more accurate signal graphs.Is obtained by matlab seismic data respectively in the operating attachment 1 original seismic signals, forced de-noising signals, given the soft threshold denoising and the default threshold image de-noising, integrated all sorts of information, choose the more suitable for small range of threshold soft threshold denoising method of signal processing.

Using principal component analysis to achieve the effect of dimensionality reduction, the waveform information is presented with less characteristic parameters to simplify the problem and reduce the computation.Through the calculation, the cumulative contribution rate of each characteristic parameter is calculated, and the duration is finally determined as the first principal component, the amplitude is the second principal component, and the rising time is the third principal component. Namely these three characteristic parameters are the main characteristic parameters.

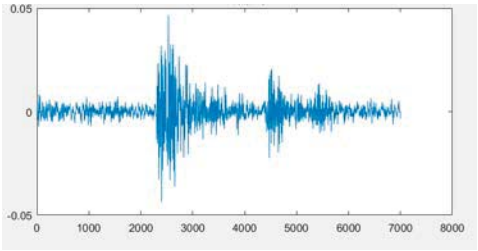
2. FUNDAMENTAL

The data given in the hypothesis is accurate and correct.

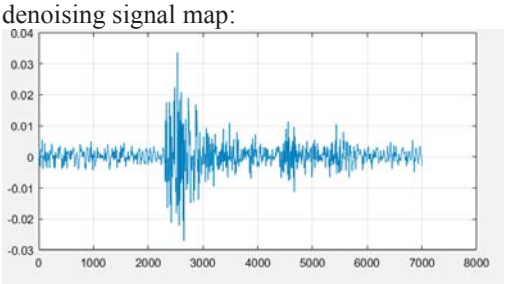
Ignore the disturbance factors surrounding the seismic monitoring facilities.
It is assumed that the attenuation of seismic wave amplitude varies with time.
Assume that external factors such as pressure and temperature remain unchanged for a short period of time.
Symbols
Key symbols of the problem:

Φ	The initial threshold
Total	comprehensive evaluation index
sgn(x)	The sign function indicates the sign of the parameter.
RMSE	Root mean square
R	evenness
SNR	Signal to Noise Ratio

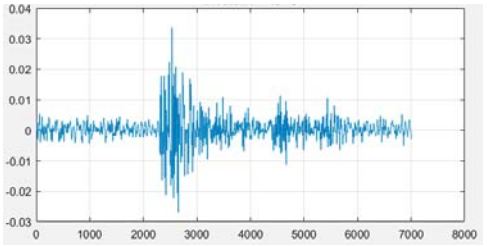
Model establishment and solution.
Based on the Fourier transform theory, the original seismic wave signals are obtained, as shown in FIG. 1-1.Due to the complexity of seismic signal monitoring place is located in the environmental field, such as noise background noise as well as the device itself will be instruments detected, the seismic signal with noise, has led to the relatively large error of signal monitoring, can bring needless trouble to follow-up work, so want to deal with the noise of original seismic signal, the q to wavelet denoising method.



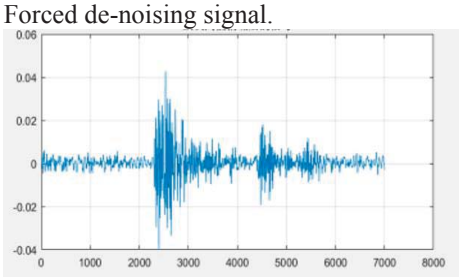
3. ORIGINAL SIGNAL
The original signal
In recent years, wavelet theory has been developed rapidly, and it is also valued in the field of noise.Here there are three kinds of wavelet denoising: hard threshold wavelet denoising, the wavelet soft threshold denoising and wavelet decomposition reconstruction denoising, use it for the same seismic signals, and compare the de-noising evaluation index to determine the final denoising effect Three methods denoising signal map:



Given the signal after the soft threshold denoising.



Forced de-noising signal.



The signal after the default threshold denoising.
The core of the wavelet threshold denoising is to set up an initial threshold ∅, when the wavelet coefficient is greater than the threshold, argues that the coefficient of the corresponding signal for the effective information, keep;On the contrary, the wavelet coefficients correspond to the noise signal and delete.The functions of the two thresholds are given below:
(1) hard threshold

$$f(x)= \begin{cases} x, |x| \geq \varphi \\ 0, |x| < \varphi \end{cases} \quad (1\text{-}5)$$

$$f(x)= \begin{cases} sgn(x)(|x| - \varphi), |x| \geq \varphi \\ 0, |x| < \varphi \end{cases} \quad (1\text{-}6)$$

$$sgn(x)= \begin{cases} 1, & x > 0 \\ -1, & x < 0 \end{cases} \quad (1\text{-}7)$$

The soft threshold method will reduce the coefficient of the threshold value to 0 and reduce the noise effect.According to the seismic signal map, the wavelet hard threshold denoising can remove more high frequency noise than the other two methods, but also use some useful signals as noise removal.For wavelet soft threshold denoising and hard threshold wavelet denoising, based on the denoising evaluation indexes: root mean square error (RMSE), smoothness (R), signal to noise ratio (SNR) and comprehensive evaluation index of Total (normalized sum after respectively each index, the bigger the value is the better denoising effect), as shown below:
Three kinds of wavelet denoising method evaluation index.

Denoising method	RMSE	R	SNR	Total
Wavelet hard thresholddenoising.	296.53	0.17	3.24	1.00
Wavelet soft threshold denoising	272.67	0.19	3.97	1.08

Note: since seismic waveform signal has no pure signal, the signal-to-noise ratio is only for reference
Therefore, the following conclusions can be obtained:
(1) the minimum denoising method of the wavelet

soft threshold denoising method is the minimum of the mean square root of the denoising method, indicating that the main components are retained to the maximum extent; (2) under the same experimental conditions, the higher the noise ratio is, the better the denoising effect will be. Therefore, the wavelet soft threshold denoising method is better for denoising. (3) for comprehensive evaluation indexes, it can be concluded that the effect of wavelet soft threshold denoising is better than that of hard threshold denoising method.

In summary, wavelet decomposition soft threshold denoising method is the best for seismic wave denoising.

Based on the principle of principal component analysis, multiple indexes are converted into a few comprehensive indexes, which is a way to reduce dimension, which is applied in many fields. In the calculation below, three more important main characteristic parameters are selected from five characteristic parameters, and the duration, amplitude and time of rise are the main characteristic parameters. Therefore, the seismic signal map can be accurately described by three characteristic variables, duration, amplitude and uptime.

The main component analysis method is used to select all characteristic parameter data of three seismic waves from the annex 1, and the cumulative contribution rate sequence is divided into four steps:

correlation coefficient matrix of characteristic parameters: $R=\begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1p} \\ r_{21} & r_{22} & \cdots & r_{2p} \\ \vdots & \vdots & \vdots & \vdots \\ r_{p1} & r_{p2} & \cdots & r_{pp} \end{bmatrix}$ formula2-1

In formula 2-1, r_{ij}(i,j=1,2,…,p) is the correlation coefficient between xi and xj of the original variable, and its calculation formula is as follows: $r_{ij}=\frac{\sum_{k=1}^{n}(x_{ki}-\overline{x_i})(x_{kj}-\overline{x_j})}{\sqrt{\sum_{k=1}^{n}(x_{ki}-\overline{x_i})^2\sum_{k=1}^{n}(x_{kj}-\overline{x_j})^2}}$ formula2-2

R is a real symmetric matrix., $r_{ij}=r_{ji}$

(2)Compute eigenvalues and eigenvectors.

First, the characteristic equation $\mu I-R=0$. The eigenvalues are usually obtained by the jacobian method μ_i (i=1, 2, …p), And make it in order of size

$\mu_1 \geq \mu_2 \geq \cdots, \geq \mu_p \geq 0$

Then the corresponding eigenvalues are calculated respectively μ_i The feature vectors e_i(i=1, 2, …, p).

Note: $\| e_i \|=1$, that is: $\sum_{j=1}^{p} e_{ij}^{\ 2}=1$. Where e_{ij} represents the j component of the vector e_i.

(3)calculate the contribution rate and cumulative contribution rate of principal components:

The contribution rate of principal component z_i is: $\frac{\mu_i}{\sum_{k=1}^{p}\mu_k}$(i=1, 2, …, p)formula 2-3

The cumulative contribution rate is: $\frac{\sum_{k=1}^{i}\mu_k}{\sum_{k=1}^{p}\mu_k}$(i=1, 2, …, p) formula 2-4.Generally, the cumulative contribution rate is 85%--95% of the eigenvalue $\mu_1, \mu_2, \cdots, \mu_m$ corresponds to the first and second... , the m (m is less than or equal to p) is the principal component.According to the matlab procedure in the attachment, the cumulative contribution rate of the duration, amplitude, rise time, energy and ringing count is 0.6263 0.2688 0.2569 0.0566 0.0004.

(4) calculate the load of the principal component.

The calculation formula is $I_{ij}=p(z_i, x_i)=\sqrt{\mu_i}e_{ij}$（i, j=1, 2, …, p） formula 2-5. After the load of each principal component was obtained, the score of each principal component was calculated as 1.7185 0.0499 0.2574 0.0031 0.0025.

Because duration, amplitude, rise time of the cumulative contribution rate and the load are ranked in the top three so think duration, amplitude, rise time can represent the entire graphics is the main characteristic parameters.

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Design of Urban Domestic Waste Treatment Charge Scheme Based on Factor Analysis

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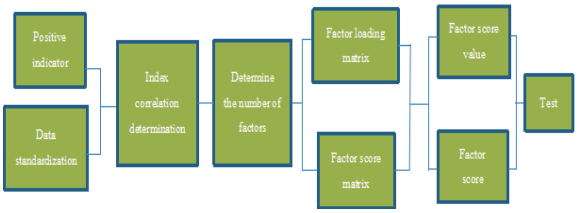
Abstract: The basic idea of the factor analysis method is to classify the observed variables and use the sum of the linear functions of the common factors and special factors to describe each component of the original observation. This article takes the urban residential waste treatment and charging standards as the research object which has proposed the design of fee plan based on factor analysis and embodies the advantages of factor analysis in the application of urban waste processing and billing processing. This article also carried out a Logistic population forecast on the growth of the number of urban residents, and made a test based on the grey theory prediction analysis of the corresponding municipal solid waste production.

Key words: Factor Analysis; Logistic population forecast; Grey theory prediction analysis; Urban Domestic Waste Billing

1 .INTRODUCTION

With the rapid development of urban economy and rapid population growth, domestic waste has also rapidly increased and has become a new source of pollution. Therefore, it is imperative to formulate a reasonable and effective classification standard for domestic garbage. For this issue, Factor analysis was used to extract common factors from a large number of garbage disposal data groups. Based on the correlation coefficient matrix, principal component analysis was used to extract components with a cumulative contribution of 80%. According to principal component analysis, After deciding to retain the n principal components, we then find the sum of the squares of the n feature vectors as commonalities, and use this value instead of the diagonal of the correlation matrix to form the approximate correlation matrix. On the basis of the correlation coefficient matrix, the number of factors and the coefficient of factors are further determined by the method of repeatedly finding eigenvalues and eigenvectors.



(1) Figure.1 Flow chart of factor analysis model solution

2. URBAN WASTE ACCOUNTING PROCESSING MODE

(1)Manage temporary fees

The urban waste treatment model needs to go through transit stations, collection and transportation stations, garbage disposal points and other processes. Based on this process, urban domestic waste is classified into the following payment items:

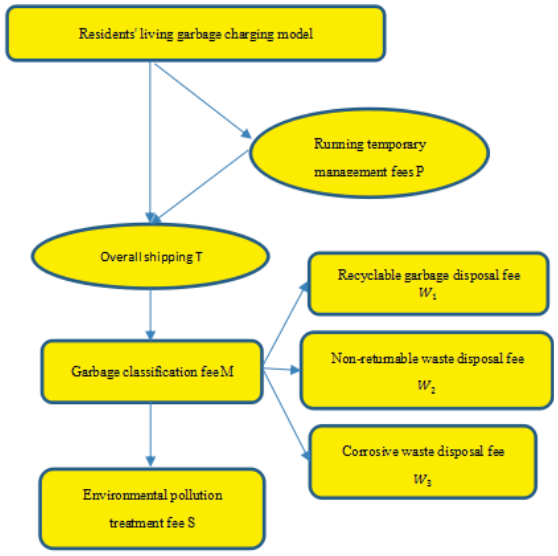


Figure 2 Residents' living garbage charging model

Residues of household garbage shall be set in temporary storage sites within a small area, and environmental protection measures such as anti-corrosion and anti-fungal protection shall be carried out at the temporary storage point. When the amount of domestic garbage reaches a certain amount, a unified garbage loading and transportation will be carried out. The temporary management fee for

kilograms of domestic garbage is:

$$P = Ma + Ca \quad (1)$$

(2) Overall freight

The overall distribution costs are related to the actual transportation costs. Different waste classification or treatment modes correspond to different waste disposal centers. Such as incineration plants, landfills, kitchen waste disposal centers, etc. Therefore, the transportation cost will change according to the number and location of the corresponding end processing centers according to different classification processing modes. The cost conversion rate per kilogram charge and actual transport cost is β.

$$T = \beta C \quad (2)$$

The majority of urban garbage collections follow the path model of "waste transfer station collection-total collection of collection points — delivery to end-of-site waste treatment plants". Transportation costs are mainly composed of fuel costs, total car value, and driver labor costs, which are denoted as Cf, Cr, and Cs, respectively. The total cost of transporting domestic waste can be expressed as:

$$C = Cf + \mathrm{Cr} + Cs \quad (3)$$

The fuel cost is related to the total length of the route:

$$Cf = PY \times LC \quad (4)$$

The total length of the route is related to the total amount of garbage removal, the capacity of garbage trucks and the average distance of single transportation:

$$L = \left(1 + \frac{H}{D}\right) S \quad (5)$$

The car value Cr is the current value of the car:

$$Cr = V \times m \times fn \quad (6)$$

The quantity of transport vehicles is usually fixed value. When the growth of garbage is stable, it will not be suddenly purchased in large quantities, and the total amount of garbage production does not dynamically float during calculation. The driver's labor cost Cs is the driver's insurance fee, monthly salary, and various tax items:

$$\mathrm{Cs} = Ta \times L \quad (7)$$

(3) Garbage classification fees

The collected large amount of urban domestic garbage is classified into two categories. The first smart machine assembly line sorting, and the second time the artificial assembly line sorting. The intelligent machine assembly line employs optical technology [1] to control the nozzles mounted on the conveyor belt by computer, and use the high-pressure gas to blow various useful materials on the conveyor belt into the collection container placed beside the conveyor belt. This process is very fast because the conveyor belt operates at 2.7 meters per second and each system can sort 14 tons of trash per hour.

The garbage sorting efficiency of this project should be 1.8-2.6 tons/person/day. In accordance with the manual sorting of garbage components, the requirements for bag breakage will be increased, and the sorting amount of recyclables will be increased, and the sorting efficiency will be reduced correspondingly. If each person works 8 hours per day, the manual sorting efficiency is revised to approximately 1 ton/person/day according to the survey practice [2].

According to sampling and analysis standards, the per-kg garbage collection fee is:

$$M = d\left(\frac{Q}{v}\right) + d'\left(\frac{Q'}{v'}\right) \quad (8)$$

(Q' is the number of garbage after sorting for the first time, v' is the number of sorting garbage during manual unit time, and d' is the sorting cost for manual unit time)

(4) All kinds of garbage disposal fees

Recyclable waste mainly refers to waste paper, waste plastics, used furniture, scrap metal, waste glass, etc., which can be directly recycled or reused and recycled. In the initial classification of domestic waste, perishable organic foods can be separated from domestic waste. Perishable garbage is mainly composed of organic substances such as starches, dietary fibers, and animal fats. The content of perishable garbage is between 60% and 85% of the total waste output. Non-returnable waste refers to heavy or toxic waste that poses a real or potential hazard to human health or the environment.

At present, there are three methods for sanitary waste disposal, composting, and incineration. China's landfill disposal, composting, and incineration accounted for 79.3%, 1.5%, and 18% of the total (other disposals were 1.2%) which accounted for 56.6%, 1.1%, and 12.9% of the volume of garbage transported [8].

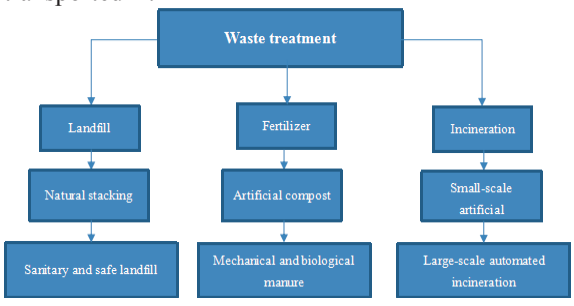


Figure.3 Waste treatment

The advantage of the sanitary filling method is that the amount of garbage is large and convenient. U1 per kilogram of landfill waste disposal fee is:

$$U1 = LA(b) + BU(b) + OP(b) \quad (9)$$

Two kinds of grate burning furnaces and fluidized beds for waste incineration treatment process are on the market in China. However, grate furnace

technology is the main method (most of which are imported equipment or imported technology).The market share of grate furnaces and fluidized bed incinerators is 64:36.The waste disposal cost per kilogram is:

$$U2 = LA(c) + BU(c) + OP(c) \quad (10)$$

That is, the fee U per kilogram of garbage disposal method is:

$$U = 0.75U_1 + 0.25U_2 \quad (11)$$

In addition, the weight of all kinds of domestic garbage weight W is:

$$W = W_1 + W_2 + W_3 \quad (12)$$

(5) Environmental pollution treatment fee

In addition, leachate produced by precipitation soaking or degradation of domestic wastes enters the soil to pollute groundwater, or directly into rivers, lakes and seas, causing water pollution. The fine particles and dust in the living garbage float in the wind and enter the air to pollute the environment. After biodegradation, some organic solid wastes release biogas, consume oxygen from the upper space, and rot the plants. The chemical reaction of the household waste produces toxic gases that pollute the atmosphere [3].

$$S = WL + LE + PO \quad (13)$$

(6) Comprehensive fees

$$K = U + M + T + P \quad (14)$$

$$K = 0.75\mathrm{U}_1 + 0.25U_2 + z + z' + \beta C + Ma \quad (15)$$

3. Fees Standard

Two standard pricing methods are used for the charging standards of urban domestic landfills. The two pricing methods consist of two parts: One part is the fixed fee paid by the consumer for the right to use a certain product or service, regardless of the amount of consumption and adopts a quantitative calculation method. The other part is directly related to the consumption of user fees, which is paid at a price equal to the marginal cost. In simple terms, its composition is to make up for the basic cost of fixed costs and the amount of fees to make up for variable costs. [4] In the urban household waste measurement and charging model, the pricing standards of the two departments are composed of basic expenses and unit use fees: The basic cost is based on the fixed investment and the corresponding capital gains of the initial construction of a municipal solid waste treatment facility, while the unit use cost is based on the daily operating costs of a municipal solid waste treatment facility. The total amount of payment for each item is summed up.

4. Prediction of Daily Production of Domestic Waste

The garbage system has both known and unknown information. It is an intrinsic grey system. Urban waste generation generally has the following characteristics: Monotonically increasing, and non -negative, the rate of change is non-uniform and conforms to the grey theory modeling conditions[5]. The original data is cumulatively generated for the purpose of weakening the randomness of the original time series. Let the time series x^0 have n observations, then

$$x^{(0)} = \left\{x^{(0)}(1), x^{(0)}(2), \Lambda\ x^{(0)}(n)\right\} \quad (16)$$

generated by accumulation New sequence:

$$x^{(1)} = \left\{x^{(1)}(1), x^{(1)}(2), \Lambda\ x^{(1)}(n)\right\} \quad (17)$$

Among :

$$x^{(1)} = \sum_{k=1}^{i} x^{(0)}(k)\ (i = 1,2\Lambda\ ,n) \quad (18)$$

$$x^{(0)}(k)(i = 1,2,\Lambda\ ,n) \quad (19)$$

Then the corresponding differential equation of the GM(1, 1) model is:

$$\frac{dx^{(1)}}{dt} + ax^{(1)} = u \quad (20)$$

Construct cumulative data matrix B and constant vector Yn, Using the Least Square Method to Obtain Gray Parametersα, μ, Among them: α is called developing grey number; μ is called endogenous control gray number. Let α^ be the parameter vector to be evaluated, which can be solved:

$$a^{\wedge} = \left(B^T B\right)^{-1} B^T Y_n \quad (21)$$

The grey parameters are brought into differential equations and the differential equations are solved to get the prediction model:

$$x^{(1)}(k+1) = \left[x^{(0)}(1) - \frac{u}{a}\right]e^{-ak} + \frac{u}{a} \quad (22)$$

$$(k = 0,1,2,\Lambda\ n)$$

Accuracy test, using the residual test, correlation test and post test error test and other common test methods for accuracy testing. If the accuracy meets the requirements, the model can be used for prediction. If the accuracy is not satisfactory, a residual correction model is still required to improve the accuracy, and then the model is used for prediction. Using the annual average amount of 5-year domestic garbage produced in Tangshan City as the original data series, the GM(1, 1) prediction model of annual domestic garbage production in Tangshan City can be obtained through gradual calculation according to the above-mentioned modeling steps:

$$x^{(1)}(t+1) = 337.67384\,e^{0.6517t} - 3160917 \quad (23)$$

As shown in the table, despite the implementation of garbage charging standards, there will be a trend of decreasing human waste output in a short period of time. If it can be implemented over a long period of time, it will promote the reduction of per capita living

garbage.

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Evaluation of Bus Mobile Payment Based on Utility Function

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Abstract: Data analysis and data processing. In response to question two, use the method of building an effect function model to quantitatively analyze the profitability of third-party payments. Firstly, the clustering analysis method is used to classify the advertising fees and fees into one category. After that, the monthly average bus movement payment Q and the third-party mobile payment platform transaction rate S are used as indicators to establish profitability with third-party platforms. The utility function:

For problem 3, a one-dimensional linear regression prediction model was established. Using the relationship between the amount of passengers and profits in question two and the results obtained, a one-dimensional linear relationship between two variables is established to use the passenger quantity Q of the mobile payment as an independent variable, the profit Was a dependent variable, and setting an unknown parameter, Obtain the linear regression equation: Bring the data obtained in Question 12 to SPSS 17 for regression, draw a scatter plot, and get the result.

For problem four, combined with data analysis, we can see that the number of occupants choosing mobile payment gradually increases, which shows that the investment environment for mobile payment is good. Then we can see from the second and third question model that if we want to increase profitability, we need to reduce costs and increase the transaction rate of the third platform.

Keywords: Bus mobile payment; effect function; data analysis; linear regression

1. INTRODUCTION

With the advancement of mobile payment technology, public transport has ushered in the era of mobile payment. How to realize smart public transport and correctly analyze the issue of public transport payment has become a social focus

1.1Big data preprocessing

The amount of travel payment data is large, among which the number of transactions exceeds 1 million times per day, and there are a large number of time periods. In order to speed up the data processing process and optimize the data processing steps, the data needs to be preprocessed in the following two aspects:

- Deletion of bus mobile payment error data. In the public mobile payment data, there is a constraint between the data in each field. When the constraint is not satisfied, it indicates that the data is wrong data.

Table 1 payment-month

payment month	2	5	8	11
Credit card	6898521	6258347	5675024	5463123
Mobile payment	7902966	8568966	9152289	9364190

- Travel times data repair. In view of this situation, during the process of processing the data on the working day, there are a large number of commuting trips in the morning and evening rush hour travel activities. When the same ID number is used for commuting trips, the travel route is relatively fixed and goes to the same place.
- There are also certain fixed times and times. Based on the characteristics of continuous similar travel payments, data from other months can be repaired based on data from consecutive days in February.

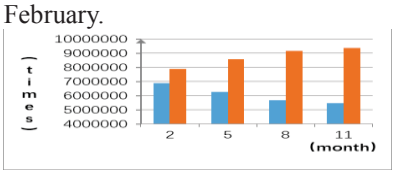


Figure 1 times-month

2 Data analysis

Observe the characteristics of the data. Then check the correctness of the data and delete the wrong data. Every day, the amount of data is more than a million, so the data is representative. The biggest feature of the data is that there are no rides in only three months after the number of rides in February. Because the data are sufficiently general and representative, you can directly compare data from February to other three months. Then proceed to process and filter out the same data for this payment method in February. Because the data is sufficiently general, the method handles the data reasonably.

After the screening of the data, the daily average obtained the following results.

The number of mobile payments continues to grow, while the number of people using public

transportation cards has gradually decreased. The use of public mobile payment may increase significantly in the next few years, and its popularity will increase.

3. CONCLUSION

After analyzing the above big data processing, use Excel to draw the image. The bar graph shows that the number of people using mobile payment continues to increase, while the number of people using the bus payment method gradually decreases. After data statistics, it can be seen that due to the shortcomings of the bus card and gradually being replaced by mobile payments, mobile payment has gradually emerged with its advantages of convenience and speed.2. By plotting the line graph of the number of times of traveling at different times in different periods of time, it can be seen that the number of times the occupant selects a bus to travel has increased significantly, and the number of times of choosing a subway to travel has gradually decreased. The analysis of the data shows that with the rise of new bus payment methods, the occupants are more inclined to choose bus travel, which has also led to the development of bus rides. 4.2 Solving problem two

3.1 Model preparation

Here, the utility function model is used to consider the function of the relationship between the cost of the patronage and the profitability of the third party in order to measure the extent to which the consumer can obtain satisfaction from the consumption of a given combination of commodities.

3.2 The establishment of a model

The indicator of third-party revenue and expenditure and profitability is passenger volume Q, a passenger's payment once. The utility function is U, then the passenger amount can be expressed as Q=A(U), where A(.) is an increasing The function of U. Assume that the transaction amount between the third-party platform and the passenger is P, S is the average transaction rate paid by the passenger on the platform, and α represents the fee for a passenger to travel once.

we can conclude that the utility function is:

$$U = AQ - PSQ \tag{1}$$

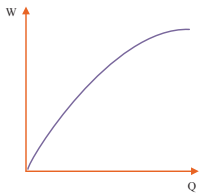
The transaction rate of a third-party mobile payment platform can be expressed as：

$$S = \frac{(\alpha Q - U)}{PQ} \tag{2}$$

Assume that the third-party mobile payment platform has a cost of F and a platform profit of W.

$$W = PSQ - F \tag{3}$$

The diagram can be expressed as:



Figuer2: Function Model of Passenger Flow and Profitability

The literature [15] shows that the utility function, even if it is a function of actual wealth, is to gradually increase Q in formula (3) in order to increase actual wealth, but the number of people in a certain place is limited, so when mobile payment is used by most people After accepting and using it, it will be difficult to increase the number of people to improve the utility. Therefore, there will be a trend of gradual flattening of

Table 2 Third-party platform transaction rates

Third-party platform transaction rates			
Turnover	Tariff	Turnove	Tariff
0—6	1.20%	100—200	0.80%
6—50	1.00%	200—500	0.70%
50—100	0.90%	500over	Personalized tariff plan

the final utility. At this time, in order to obtain higher utility, it is necessary to start P and S to increase P and S. Although overall efficiency will increase, the overall trend is the same as above.

4. PREPARATION AND ESTABLISHMENT OF THE MODEL

In order to use the passenger volume of mobile payment as the independent variable, profit W is the dependent variable, with multiple test points. , the linear regression equation can be expressed as follows:

W = bQ + a

As long as a is determined, the regression equation of b is determined. Parameter a, b determines that the data in table 5 can be solved by bringing the data into SPSS.

5. SOLUTION OF THE MODEL

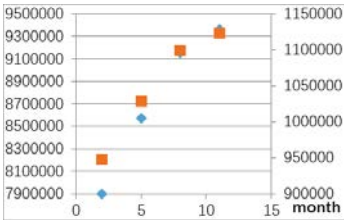


Figure 2 Bring data into SPSS: Input/remove

a. all requested variables have been entered.

b. dependent variableVAR0000

From table analysis, R=1, standard error is 0.708, and the correlation between profit and passenger volume is excellent. The regression coefficient is 0.120, so.

The regression equation for the above table is

W=0.120 q-1.662.

After realizing the payment of the third-party

platform of the bus, the total passenger quantity will be brought into the total profit.

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Analysis and Evaluation of Bus Mobile Payment

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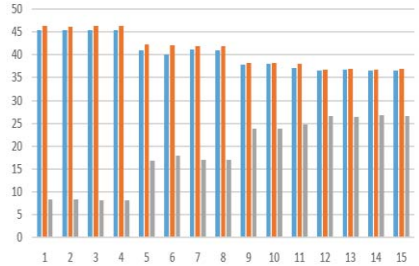
Absrtact: This paper aims at the analysis and evaluation of the public transportation mobile payment project, based on the BP neural network optimized by the analytic hierarchy process (AHP), fuzzy comprehensive evaluation and genetic algorithm. Firstly, using SPSS software to analyze the data and draw the graph with Matlab. The paper intuitively reflects the characteristics of the data, then establishes the contrast matrix, uses AHP and fuzzy comprehensive evaluation to determine the weight of the four profit modes, and obtains the final profit by using the mathematical formula. The model of BP neural network optimized by genetic algorithm is reasonable. Finally, it can increase the profit of mobile company and save the cost.

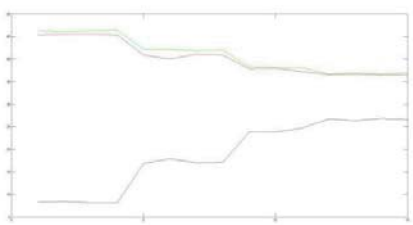
Keywords: SPSS Mathematical; Statistics Analytic; hierarchy process; Fuzzy Comprehensive; Evaluation genetic algorithm; BP Neural Network

1. INTRODUCTION

To solve the problem is to establish the model:

Through attachment 1 / 2, it is found that there are three types of travel payment characteristics in the city: the first is mobile payment, the second is bus card payment, and the third is other payment. SPSS analysis software is used to process data and Matiab is used to map.





The left is a bar chart of the percentages of the three forms of payment. Among them, series 1 stands for 0 payment mode (mobile payment mode), series 2 for 1 payment mode (bus card payment method), series 3 for other payment mode. The right picture shows three payment modes arranged in chronological order. Results the histogram showed that the proportion of other payment methods (blue) was small, while the proportion of 0 payment (red) and 1 (green) payment was higher and more or less the same. By analyzing the three payment methods alone, it is clear that the other payment methods are on the rise and have the potential for development.

2. SIGNAL ACQUISITION

Based on the analytic hierarchy process (AHP) and the fuzzy comprehensive evaluation method, the mathematical model is established to calculate the weight of the four profit ways. The final profit is to multiply the profit model with the weight after the addition. Below will establish the mathematical model separately, solves the income situation of four kinds of profit ways.

(1)Fee income and expenditure, profit model establishment

The handling fee is a third-party payment to the user charge fee and the bank to pay only the difference in handling fees. Taking POS credit card as an example, the transaction has network effect. Therefore, it is necessary to further study the network effect response. Rochet and Tirole make use of Schmalensee hypothesis first.

$$Q = D^B(P^B)\ D^S(P^S) \tag{1}$$

The maximum profit of the total price level determined by the bank card organization is $R = (P^B + P^S - C)D^B(P^S)D^S(P^S)$, derived from which the inverse proportional elastic pricing formula is obtained as follows:

$$\frac{(P^B + P^S) - C}{P^B + P^S} = \frac{1}{\eta^B + \eta^S} \tag{2}$$

When the price is optimal, the derivatives at both ends are equal.

$$\frac{\partial D^B}{\partial P^B}\frac{}{D^B} + \frac{\partial D^B \partial D^S}{\partial P^B \partial D^B}\frac{}{D^S} = \frac{\partial D^S}{\partial P^S}\frac{}{D^S} + \frac{\partial D^S \partial D^B}{\partial P^S \partial D^S}\frac{}{D^B} \tag{3}$$

assuming $PB = C^B - a + m^B, P^S = C^S + a + m^S$ that the card

issuing ,market and the market fare increase are accepted, the best exchange fee can be obtained:

$$a = \frac{(m^B + C^B)\eta^S - (m^S + C^S)\eta^B}{\eta^S + \eta^B} \tag{4}$$

Through the analysis of the above two models, it can be concluded that the cross network effect of transaction must be considered in the POS transaction network. Increase the amount of revenue by increasing the amount used by the user.

(2)Establishment of advertising revenue and expenditure and profit model

In the case of considering the cost of advertising, the model may assume that the increase factor in the use of advertising is a factor . After the cost of advertising is put in , the amount of usage increases from the cost of advertising to the amount of income X as a result of the increase in the amount of money used, and the expenditure is as a result of the increase in the cost of advertising, so the profit is as follows:

$$L(p,y) = R(p,y) - C(p,y) = Kpf(p) - Kqf(p) - y \tag{5}$$

This model is

$$\underset{p,y}{MaxL(p,y)} = Kpf(p) - Kqf(p) - y \tag{6}$$

When the profit is maximized when the marginal income equals the marginal expenditure, the price is p0, that is,

$$\frac{\partial L(p,y)}{\partial p}|_{p=p^*} = K\left[f'(p)(p-q) + f(p)(1 - \frac{dq}{dp}) \right]|_{p=p^*} = 0 \tag{7}$$

Due to the increase of factor K > 0, the price p* is satisfied.

$$f'(p)(p-q) + f(p)(1 - \frac{dq}{dp})|_{p=p^*} = 0 \tag{8}$$

In the same way, using the method of calculating the extreme value of the function, we can know that the advertisement expense that satisfies the demand is the optimal advertisement expense, that is,

$$\frac{\partial L(p^*,y)}{\partial \mathrm{y}}|_{y=y^*} = K' f(p^*)(p^* - p) - 1|_{y=y^*} = 0 \tag{9}$$

Or

$$\frac{dK(y)}{dy} f(p^*)(p-q)\big|_{y=y^*} = 1 \tag{10}$$

The relation between the function of Kand the function of the Y

$$K = \alpha_0 y^2 + \alpha_1 y + \alpha_2, \alpha_0 < 0 \tag{11}$$

After putting in the advertising fee, the amount of money used will increase from one to the next, so the profit will be as follows: $(\alpha_0 y^2 + \alpha_1 y + \alpha_2)\ x$

This model is

$$\underset{p,y}{MaxL(p,y)} = (\alpha_0 y^2 + \alpha_1 y + \alpha_2)(p-q)f(p) - y \tag{12}$$

Finally, let's assume that the price is constant, and the absolute demand (a very small amount of demand) indicates the extent of the decrease in usage when the price rises by one unit (the sensitivity of the demand to the price, so the optimal advertising fee is as follows:

$$y^* = \frac{1}{2\alpha_0 (p-q)(a-bp)} - \frac{\alpha_1}{2\alpha_0} \tag{13}$$

Therefore, when paying the optimal advertising fee to the third party, the third party pays the platform the most.

(3) interest income and expenditure of precipitation fund and profit model

The deposit fund is also the reserve fund. The income of deposit portfolio can be expressed by comprehensive rate of return. Various deposit rates are expressed separately. Assuming that the present value of an asset is P, according to the present value model, where n is the last time the asset generates cash flow, and the cash flow. R is the market interest rate generated by the asset in t period.

The partial derivative of the present value of the asset to the interest rate is that the sensitivity of the present value of the asset to the change of interest rate is negative proportional to the change of interest rate. The ratio coefficient is 0. Under the same interest rate, the longer the duration, the greater the change in the present value of assets, so use duration to quantify the interest rate risk to which assets are exposed.

In the formula, the formula is 1 / D ~ (-1) / D ~ (-1). The comprehensive duration is expressed as "Con". By controlling the interest rate risk of the deposit portfolio and combining with the comprehensive income, the multi-objective programming model based on the duration can be used to maximize the income. In the end:

$$\begin{aligned} &\max \sum_{i=1}^{\partial} \omega_i R_i \\ &\min \sum_{i=1}^{\partial} \omega_i D_i \\ &\sum_{i=1}^{\partial} \omega_i = 1, \omega_i \geq 0 \end{aligned} \tag{14}$$

Under the premise of ensuring the safety of funds, the problem of this study is to maximize the income of third-party payment platform through regular deposits. According to the model, it is concluded that the third party platform with prepaid card can better realize the deposit of funds.

(4)Service charge income and expenditure, profit model

Service charge is the core of the third-party payment platform profit model.The formula of integrated pricing model of third-party Internet trading platform:

$$\begin{aligned} \mathrm{P} = &\beta_1 \times (N_1/1000) \times \mathrm{CPM} + \beta_2 \times (N_2/1000) \times \mathrm{CPC} \\ &+ \beta_3 \times N_3 \times \mathrm{CPR} + \beta_4 \times N_4 \times \mathrm{CPA} \end{aligned} \tag{15}$$

In highly involved functional services, the weights of CPM 、 CPC 、 CPR 、 CPA were as follows: β1=β4=1/4、 β3=1/2、 β2=0。. By adding it to the integrated pricing model of third-party Internet trading platform, the pricing formula of platform service charge for highly involved functional products or services by third-party Internet trading platform

can be obtained .

evaluating indicator;		evaluate			
First index	levelTwo level index	Very high	higher	commonly	Lower
Service benefit	ServiceChargeSe	0.18	0.19	0.40	0.23
	rvice charge	0.26	0.50	0.14	0.10
Other interests					
	deposit funds	0.09	0.19	0.20	0.52
	Advertising fee	0.60	0.28	0.10	0.02

For services with low involvement. Therefore, the weight distribution of CPM、CPC、CPR、CPA。β_1=0、$\beta_2=\beta_3$=1/4、β_4=1/2 Into the model formula, we can get:

P=1/4×（N/1000）×CPC+1/4×CPR+1/2×N× CP (16)

The weight distribution of CPMU / CPR / CPA index is 1 / 2 / 1 / 2, P = 0. Bring into the formula:

P=1/2×（N1-[1000）×CPM+1/2×N_3×CPR (17)

When the weight of CPMU / CPR / CPA index is equal to one / four / four, the maximum profit of service charge is obtained.

$$P=0.25\times(N_1/1000)\times CPM+0.25\times(N_2/1000)\times CPC+$$
$$0.25\times N_3\times CPR+0.25\times N_4\times CPA$$

3. QUESTION

A fuzzy comprehensive evaluation method is adopted to evaluate the profitability of the third party payment. The attribution degree of each single factor to each review grade is calculated, then the weight distribution of each factor in the evaluation target is calculated, and the quantitative solution value of the evaluation is obtained by calculation.

Let U be the set of factors U = {service income; other benefits}; where service benefit = {handling fee; service charge}; other benefits = {precipitate fund; advertising fee}. V is the comment set V = {v1 / v2 / v3 / v4}, where: v1 means excellent / v2 indicates good / bad / v3 / V4.

Through the big data investigation, the degree of being subordinate to the comment is obtained, and the judgment matrix is constructed. The weight of X-layer U-layer is obtained by using the analytic hierarchy process (AHP). Third party profits.

$$R_1=\begin{bmatrix}0.18 & 0.19 & 0.40 & 0.23\\ 0.26 & 0.50 & 0.14 & 0.10\end{bmatrix}$$

$$R_2=\begin{bmatrix}0.09 & 0.19 & 0.44 & 0.52\\ 0.60 & 0.28 & 0.10 & 0.02\end{bmatrix} \quad (18)$$

The weight of each index is established by AHP method, and the contrast matrix of weight is determined as follows:

$$A=\begin{bmatrix}3.018 & 1.11\\ 1.11 & 3.018\end{bmatrix}$$

Then the maximum eigenvalue of matrix A is 2.0185, and the eigenvector of matrix A is {0.37 0.63};

$$CI=\frac{max}{n-1}=\frac{0.0185}{1}=0.0185 \quad (19)$$

And: RII 0.58, so

$$CR=\frac{CI}{RI}=\frac{0.0185}{0.58}=0.032 \quad (20)$$

The degree of inconsistency of matrix A is within the allowable range and the consistency test is passed. Use AHP method to establish the weight of each index, see the table below.

First level index	weight	Two level index	weight
Service benefit		poundage	0.35
Other	0.37	service charge	0.65
interests	0.63	Accumulation of deposit funds	0.14
		Advertising fee	0.86

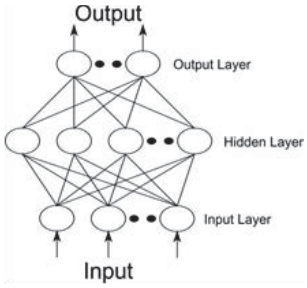
Using fuzzy mathematics and analytic hierarchy process to calculate the weight and calculate the total profit.

$$Y=(0.35\sum_{36}^{i}\beta_i\times\omega\times y+0.65\mathrm{P})\times 0.37+(0.86y^*+0.14C_tR_P)\times 0.63$$

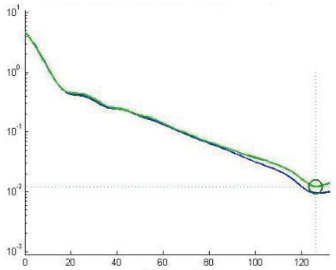
Bring the data into the above formula to get the final daily third-party payoff of Y = 13.2658 million yuan

Genetic algorithm is used to optimize BP neural network test. BP neural network is a highly parallel nonlinear system composed of a large number of simple processing units. It is famous for dealing with nonlinear problems. However, the error function of standard BP neural network is a nonlinear function, and the change of initial value will affect the convergence speed and accuracy of the network. Once this value is not suitable, it will cause the network to oscillate and easily fall into a local minimum. Genetic algorithm (GA) is a global search and optimization algorithm based on biological mechanisms such as natural selection and genetic mutation. It can control the search process adaptively to obtain the optimal solution, and has the advantages of high efficiency, parallelism and The characteristics of global search.

In this paper, BP neural network is combined with genetic algorithm to optimize the initial weight and threshold of BP neural network, that is, to search for the optimal solution of the problem, and then to find the optimal solution by error back-propagation method. The general algorithm of BP algorithm is as follows:



The essence of optimizing BP neural network by genetic algorithm is to output the norm of test error of BP neural network as the objective function of prediction sample by using the initial weight and threshold of the individual representing the network. Then the fitness value of the individual is calculated by genetic operation to find the best individual, that is, the initial weight and threshold of the optimal BP neural network. Finally, the neural network can be obtained by Matlab and compared with the established model graph line, as shown in the following figure:



From the comparison between the original model curve and the neural network in fig. 5 Matlab, it can be seen that the designed mathematical model is basically consistent with the BP neural network curve optimized by genetic algorithm, so the established mathematical model is established.

4. CONCLUSION

Through the analysis of the above problems, we can see that there is still room for improvement of the four profit ways of mobile payment companies, and consider saving costs to increase profits. Third-party payment platforms can minimize online and UnionPay fees and POS card printing fees by increasing cooperation with banks to reduce costs. Moreover, can in the early stage massive investment. Third party platforms need to improve their own safety management mechanism, reduce the investment in other platforms, and ensure the authenticity and reliability of advertising.

The third party payment platform is needed to control the risk when the capital scale is enlarged. And according to the operation, size to collect the interest on precipitation funds to increase the platform's profits. Service charge is the core of the third-party platform profit model. It should provide customers with accurate and efficient solutions to help them solve the problem of real-time transaction query. It can also tap service innovation from the traditional trading market. It can develop various service terminals and collect service fees.

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Campus Logistic Driverless Car Design

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Abstract: Nowadays, there are still many problems in the logistics of school life. For example, the logistics station is far away from the school living area, and personal information is leaked. To solve these problems, this design uses the SCM as the core to develop a logistic driverless car. This article takes the multifunctional smart car as the research object, and its design provides technical guidance for the design and research of the driverless logistic car. Through the modularization of design ideas, combined with software programming and hardware circuit design, we designed and manufactured a smart car that uses the STC12C5A60S2 microcontroller as the core and uses the Bluetooth control of the mobile phone to implement functions such as tracking, obstacle avoidance, switch lock, and Bluetooth remote control. In order to ensure the multi-functional free switching of the car, the Bluetooth slave module HC-05 is selected for the slave of the design, and the host selects the mobile phone Bluetooth.
Key words: smart car; microcontroller; Bluetooth; tracking; obstacle avoidance

1. INTRODUCTION

The speed of campus logistics has a great influence on students' time and energy and their life happiness. Faced with the arduous work of campus logistics, it is very difficult to send express delivery to individual students. Because the campus area is too large, students will waste time on picking up the express route, and there are many hidden dangers in picking up express delivery. In general, the system consists of seven parts: a microcontroller, a power supply module, a motor drive module, a Bluetooth module, an electromagnetic lock, a tracking module, and an obstacle avoidance module. The overall system structure is shown in Figure 1.

The unmanned logistics vehicle adopts the STC12C5A60S2 microcontroller as the core. It first detects the signal input of the sensor module and the Bluetooth module, and then the motor drive module controls four DC motors. The power module supplies power to the SCM and other modules; the ultrasonic obstacle avoidance module is used as a sensor module to implement the automatic obstacle avoidance function of the car; and the infrared two-way tracking module is used to implement the control of the car on a predetermined track; the Bluetooth module is used to implement wireless communication between the car and the mobile phone; the electromagnetic lock is used to automatically open and close the door when a control signal is received.

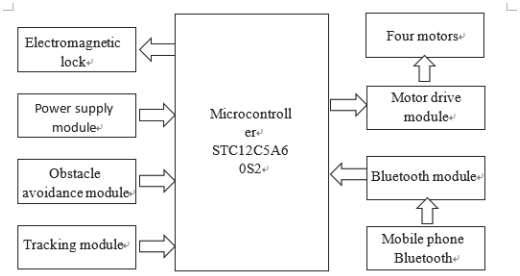

Fig 1 overall system structure

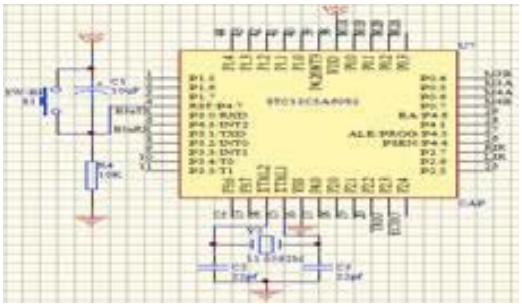

Fig 2 Microcontroller minimum system and I/O allocation

2. SYSTEM HARDWARE DESIGN

MCU minimum system design

The main control chip chooses STC12C5A60S2 microcontroller, its performance is stable, implementation speed is quick, and it's economical and affordable, I/O mouth meets the designing requirement. Figure 2 shows the minimum system and I/O allocation for the microcontroller.

Bit circuit

Power and reset: As shown in the circuit, the resistance of the resistor is 10KΩ and the capacitance of the capacitor is 10uF. The formula calculation shows that when the capacitor is charged to 0.7 times (3.5V) of the power supply voltage, it takes about 0.1S. Within 0.1 seconds of the microcontroller starting, the voltage across the capacitor increases from 0V to 3.5V, so the voltage across the resistor is reduced from 5V to 1.5V. For a microcontroller connected to a 5V supply, it is generally specified that the voltage of the low-level signal is less than 1.5V, and the voltage of the high-level signal is greater than 1.5V. It can be said that within 0.1S, when the 9-pin is reduced from 5V to 1.5V, the microcontroller system automatically resets.

Press the button to reset: After the microcontroller starts up, the capacitor continues to charge, keeping the voltage across it at 5V. At this time, the resistance of the resistance of 10kΩ is 0V, RST is active high, and the system operates normally, so the system will

not be reset at this time. As shown in the figure, set the reset button, then press Vcc (5V) high for one section of the button, and then connect the microcontroller reset pin to the other section. The switch is turned on and the capacitor is short-circuited. This is equivalent to connecting a wire in parallel and the capacitor discharges. The voltage of the capacitor is within 0.1S, decreasing from 5V to 1.5V or even less. According to the theorem that the voltage of each component is the series circuit voltage, the resistance of the 10KΩ resistor is increased from 0V to 3.5V, or even greater than 3.5V, and the input voltage of the 9-pin is changed to the high level, so this time the microcontroller system is automatically reset.

Vibration circuit

Use internal R/C oscillator clock (5V microcontroller room temperature: 11MHz~17MHz), the XTAL1 and XTAL2 pins float. When the external clock frequency exceeds 27MHz, the nominal frequency does not require the use of a tri-dominant crystal. Otherwise, if the parameters are incorrectly collocated, the fundamental frequency may be oscillated. At this time, the nominal frequency is three times the actual frequency; or directly uses the external active crystal, input from the XTAL1 pin, and XTAL2 pin floating. The harmonics are generated in the oscillation circuit formed by the XTAL1 and XTAL2 pins of the crystal oscillator and the microcontroller. The influence of the generated wave on the circuit is not great, but the stability of the clock oscillator in the circuit is reduced, therefore it is necessary to eliminate harmonics. For the stability of the circuit, two 10pf-50pf grounded capacitors are connected at the two pins of the crystal, so that the adverse effects of the harmonics on the stability of the circuit are weakened.

Path Planning Module Design

Considering that compared to the off-campus environment, the school environment is relatively simple, and the students' main location is relatively clear (dormitory). The dormitory area of our school is mainly divided into four areas, and the living area is relatively concentrated. For this situation, the tracking module and obstacle avoidance module are designed to simulate the function of transporting items to a specified location:

TCRT5000 infrared reflection sensor is used in the two-way tracking module, its working voltage is 3.5~5V, detection distance is between 2~9mm, comparator output is used, the signal is not messy, the waveform is good, and the driving capacity is strong, exceeding 15mA. It is equipped with multi-turn adjustable precision potentiometer to adjust the sensitivity, at the same time, and its sending end and receiving end are together, so the working performance is reliable.

The obstacle avoidance module uses the ultrasonic distance measurement module HC-SR04 to achieve the distance measurement. The module can provide 2~400cm non-contact distance sensing function, measuring accuracy up to 3mm, including the main control circuit, ultrasonic receiver and transmitter three parts. Use I/O port TRIG to measure distance and input a high level signal of not less than 10us. The module will automatically send out 8 40 kHz square waves to automatically detect whether the signal returns, if a signal return is detected, the module outputs a high level through the I/O port ECHO, and the time of the ultrasonic signal back and forth is the duration of the high level. Knowing the time of the ultrasonic signal back and forth and the speed of sound (340m/s) can calculate the measurement distance (measurement distance = (high duration x speed)/2) to meet the design requirements.

Encryption logistics warehouse module design

This design is mainly based on Bluetooth-controlled smart cars. As the express delivery vehicle, its main function is to deliver express delivery. In consideration of the security of express delivery, an encrypted logistics warehouse is designed. It has the main function of the switch lock sent to the single-chip microcomputer through the mobile phone APP and the Bluetooth module. The auxiliary function has the password change, power-off protection, and early warning.

The relay uses a 5V single-circuit module. The module adopts a double-sided FR-4 circuit board design and uses a relay mode. It has a power supply and relay action indicator. When the pull-in is enabled, the light is on, and when off, the light is off. When a low-level signal appears on the signal terminal, the common terminal and the normally-open contact conduct, and each have a normally-open contact and a normally-closed contact, and the blue KF301 terminal is easy to connect with the control line.

Electromagnetic lock selected LY-031 miniature solenoid valve lock, working voltage DC12V, and operating current 0.4A/5W. Energized unlocked, power off and locked; among them, the energization action time is less than 1S, allowing continuous energization less than 10S. It can be used in a variety of cabinet locations and self-selected mall safes, meets design requirements.

Power module design

The microcontroller of this system needs the supply voltage 5V, the working voltage of the DC motor is 3~6V, the voltage of the driving module is 2.5~12V, the sensor module includes: the infrared tracking module (2.3~5V), the ultrasonic obstacle avoidance module (5V), Bluetooth module (3.3~5V), relay module (5V), electromagnetic lock (12V). This design uses a total of four sections of 18650 lithium battery (3.7V per section), and provides power for each module directly as a power supply for the 12V electromagnetic lock, and uses the 5V DC power generated by the LM2596S adjustable buck module to provide a stable voltage for other modules, when the current is less than 2.5A, the LM2596S can work for a

long time. In addition, it has a heat sink (more than 10W output), the input DC voltage range is between 3~40V, and the output DC voltage range is continuously adjustable within 2~35V, With the advantages of current protection, overheat protection, power supply reverse connection protection, etc. The input and output of the module are connected in parallel with a 10uf electrolytic capacitor to regulate and a 0.1uF common capacitor to filter. Connect a light emitting diode and a resistor at the output and the ground to show whether the circuit works normally, it has stable performance, strong reliability and meets design requirements.

Motor drive module

The microcontroller cannot directly drive a DC motor because of its limited load capacity. This system selects HG7881 four-way driving DC motor driver board with four L9110S chips, It can drive four DC motors at the same time with a 2.5 to 12V supply voltage, and It is suitable for DC motors with a working voltage of 2.5 to 12V and a maximum operating current of 0.8A. The 4-channel PWM output from the P0 port of the microcomputer is used as a control signal. When the ENA and ENB enable terminals are connected to a high level, the pulse width is modulated. The approach is to input the corresponding PWM, and the constant switching period is fixed, at the same time adjust the switch on time. When the PWM signal duty ratio (the ratio of the switch-on time to the switching period) is larger (smaller), the motor speed increases (decreases) as the average voltage applied to the motor increases (decreases), Therefore, the voltage regulation and speed regulation of the motor can be realized, thereby achieving the smooth operation of the car and meeting the design requirements.

Communication module design

This design uses the HC-05 Bluetooth module.

HC-05 Bluetooth module description

①Select CSR mainstream Bluetooth chip, Bluetooth V2.0 protocol standard;

②Input voltage: 3.6V~6V, maximum no more than 7V;

③ The baud rate is divided into 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 (bit/s). According to the needs, users can set on their own;

④ LEDs in the connected state: Flashing light (2 times per second) indicates that power is on, but Bluetooth is not connected; The indicator light flashes slowly (1 second) indicating that the AT command mode is enabled; Double flashing of the indicator lamp (2 seconds, 1 second) indicates that the module is paired successfully.

⑥HC-05 embedded Bluetooth serial communication module has two working modes of command response working mode and automatic connection working mode; In the automatic connection working mode, it can be divided into two working modes: Master and Slave. When the module is in the automatic connection working mode, the data connected according to the preset mode is automatically transmitted; when the module is in the command response working mode, all the following AT commands can be executed: the user sets the control parameters of the module, Various AT commands sent to the module, or issuing control commands.

⑦ The default baud rate of the module is 9600 bit/s, the default pairing password is 1234, and the default name is HC-05.

HC-05 Bluetooth module settings

To set the parameters and status of the Bluetooth module, you must first enter the AT mode (command response mode). The specific procedure is as follows:

① Module port connection: STATE——Connect any MCU I/O, RX——Connect RX end P3^0 of USB to serial port, TX——Connect the TX end of USB to serial port P3^1, GND——Grounding, VCC——Connect 5V power supply, EN - connect any microcontroller I / O, high.

② Enter AT mode: Need to turn on EN and give a high level; The communication line is: computer -> USB tie station -> HC-05 Bluetooth module (computer and Bluetooth module for serial transmission); Hold down the KEY button of the Bluetooth module and the MCU development board is powered on. The Bluetooth module indicator will enter the slow-flash status (1 second per second), indicating that the AT mode has been entered.

③ Detect communication: Perform the computer serial port tool SSCOM3.2, set the bit rate 38400, 8 bits of data, 1 stop bit; send the test command AT\r\n, if return OK means the communication is normal.

④ Set the baud rate: Set the baud rate 9600bit/s to match the microcontroller serial port, 1 stop bit, 0 parity bit; execute AT+UART=9600,1,0\r\n. Return OK.

⑤ Check the status: Check if the status of the UART is changed successfully, execute AT+UART?, return +UART:9600,1,0 OK.

⑥Password and name: The password and name have not changed. The password is the initial password "1234"; the name is "HC-05".

After the parameter status is set, power is off and ready to enter the work mode. In the working mode, each port of the module connection is: STATE - any I/O connected to the microcontroller, RX - connected to the TX port of the USB to serial port P3^1, TX - connected to the RX port of the USB to serial port P3^0, GND - Grounding, VCC - 5V power supply, EN - no connection.

3. SOFTWARE DESIGN

System function requirement analysis

Tracking function: The main function of this design is to deliver the express to a designated location on the campus under driverless conditions. Considering that the place where students and teachers accept express

delivery is mainly offices and dormitories, the runway can be designed in advance. The smart car only needs to follow the runway and arrive at the designated place. The campus has a large area and a long route, so the tracking module has selected dual infrared tracking, which has relatively low power consumption, can work for a long time, and has a stable performance.

Ultrasonic obstacle avoidance: The track is laid outdoors. Pedestrians and vehicles will inevitably appear on the track. Therefore, obstacle avoidance is essential for the logistics car. The car travels along the track. If obstacles are encountered, the car is required to stop at a safe distance, wait for the disappearance of the obstacle and then proceed forward. If it is detected that the obstacle exists for longer than the time range, the car is required to be able to avoid the obstacle and follow the advance The track continues to travel. If it is detected that the obstacle has existed for longer than the time range, it is required that the car can continue to travel on the advance track after being able to avoid the obstacle.

Bluetooth control: Mainly simulates the remote control of the car. If an unexpected situation occurs during the running of the car, for example, if the tracking module runs out of control and deviates from the preset runway, the obstacle avoidance module malfunctions and hits an obstacle, etc. The car will alarm and send an alarm signal to the host; the host can remotely control the car to avoid other accidents according to the actual situation.

Encrypted Logistics Warehouse: The main function of the car is transporting the express. In consideration of the safety of express, the logistics warehouse needs to be designed. Put the express into the logistics warehouse to set the password. The password lock is locked. The express is sent to the designated place. The picker inputs the correct password and the lock opens. After the lock is opened, whether the picker takes the express or not must also be checked. After the door is closed, the lock is locked. If the express is not taken out, the car waits until the express is taken and the door is closed.

System flow chart

This system adopts C language programming, debugs its function in Keil environment. The software idea adopts the modular idea, mainly including: automatic tracking, obstacle avoidance, Bluetooth control, and password lock.

Bluetooth remote control car: Press the forward button of the mobile phone's APP interface, the car moves forward, and the car stops after it is released; pressing the left-turn button, the car will drive backwards in the left two rounds and the right two wheels will drive forward to realize the left turn of the car. The same applies to other keys (turn right, backward).

Infrared tracking: The TCRT5000 dual-channel sensor continuously emits and receives infrared signals, allowing the car to run smoothly on the intended track. When the left side detects a high level, the car turns right, when the right side detects a high level, the car turns left, when both the left and right sides are at a low level, the car goes straight.

Ultrasonic obstacle avoidance: The ultrasonic signal is transmitted and received by the sensor, and the microcontroller processes the detected return information and determines whether there is an obstacle in front of the car, whether the distance between the obstacle and the car is less than the preset value (30cm). When the distance is less than 30cm, the car turns 90 degrees to the left and is detected again. If the distance is greater than 30cm, the car will go straight.

Smart lock: The default initial password is "123456". After pressing the restore key (in the middle of the direction keys), the password lock is restored to the initial password; press the Change Password button and enter 6 digits, and click OK to finish modifying the password operation; enter correctly 6 digits Password, electromagnetic lock open.

4. ANALYSIS OF EXPERIMENTAL RESULTS

Through actual debugging on the simulation track laid in the laboratory, the smart car with the STC12C5A60S2 microcontroller as the core can operate stably and realize the four functions required by the design.

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The Comparative Study of BP Neural Network and Logistic Regression Risk Prediction Models on Hemorrhagic Transformation

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Abstract: Objective To study the prediction performance of BP neural network and Logistic regression risk prediction models on hemorrhagic transformation and make a comparison between them. Methods A case-control study of hemorrhagic transformation patients after acute cerebral infarction was conducted, with all cases hospitalized in the Affiliated Hospital of North China University of Science Technology from January 2014 to January 2017.Using the data to establish Logistic regression and BP neural network prediction models of hemorrhagic transformation by SPSS 17.0 software, then applied Sensitivity, Specific, Positive likelihood ratio, Negative likelihood ratio and areas under the ROC curve to evaluate the prediction performance of the two models, finally, made a comparison between them. Results There was no significantly difference between the true value and the predicted value in the BP neural network model and Logistic regression model (χ2LR=0.925, PLR=0.410; χ2BP=0.667, PBP=0.687). The prediction performance of BP neural network model was better than that of Logistics regression model (χ2=6.852, P=0.009). Sensitivity, Specific, Positive likelihood ratio, Negative likelihood ratio, Kappa index and AUC of Logistic regression model respectively were 76.0%, 90.7%, 8.172, 0.265, 0.676 and 0.833(0.785~0.882); Sensitivity, Specific, Positive likelihood ratio, Negative likelihood ratio, Kappa index and AUC of BP neural network model respectively were 94.9%, 94.9%, 18.25, 0.05, 0.886 and 0.956 (0.929 ~ 0.983). Sensitivity, Specific, Positive likelihood ratio, Negative likelihood ratio and AUC of BP neural network model were much higher than those in Logistic regression model. Conclusion The study shows that the prediction performance of the BP neural network model was superior to Logistic regression model on the prediction of hemorrhagic transformation after acute cerebral infarction, and the prediction results were reliable, which could be used for early prevention of hemorrhagic transformation.

Key words: Logistic regression, BP neural network, Prediction model

1. INTRODUCTION

China is the major country of stroke in the world, and the incidence rate of stroke increased year by year, which has occupied the first cause of death, and its high incidence, high mortality and high disability have brought a heavy burden to people all over the world[1]. Acute ischemic stroke is the most common type of stroke, accounting for 60-80% of stroke[2].Hemorrhagic transformation (HT) is a natural outcome of ischemic stroke or even serious complications of clinical treatment such as thrombolysis, accounting for 10% of the etiology of early neurological deterioration (END) in acute stroke patients[3]. Therefore, the study of risk factors and risk prediction models on hemorrhagic transformation has become a hotspot in the research area of stroke's prognosis. Logistic regression is often used to establish the risk model previously, nevertheless, it is difficult for it to solve the collinearity of the data and it might need more samples to establish a stable model[4].

As an emerging data mining technology, BP neural network has highly nonlinear mapping ability, which could excavate the main influencing factor of the disease quickly and effectively. Moreover, through the sensitivity analysis, BP neural network could find independent variables which had significant effect on output variable. In this study, we used Logistic regression analysis and BP neural network to establish risk prediction models of hemorrhagic transformation after acute ischemic stroke, and then compared the prediction performance of them to provide a scientific reference for clinical prevention and treatment[5].

2. METHODOLOGY

A case-control study of hemorrhagic transformation patients after acute cerebral infarction was conducted, with all cases were hospitalized in the Affiliated Hospital of North China University of Science Technology from January 2014 to January 2017. All cases and controls had to meet the corresponding inclusion and exclusion criteria. Inclusion criteria was

that all selected cases must be in line with the "various cerebrovascular disease diagnosis points" (1995) adopted by the Fourth National Cerebrovascular Disease Conference and confirmed by head CT or MRI, admission within 48 hours after stroke, and cases data must be integrity. Exclusion criteria was patients with coagulopathy, severe liver and kidney dysfunction. After professional uniform training, questionnaire contained basic information, clinical data, laboratory examination data and imaging materials would be surveyed.

SPSS17.0 statistical analysis software was used for univariate analysis and establishment of risk prediction models. Count data were presented with rate, while normal distribution data were presented with($\bar{x} \pm s$)non-normal distribution data were presented with M (Q25 ~ Q75). The comparisons of count data, parametric data and non-parametric data were performed with $\chi 2$ test, t test and Mann-Whitney U test, respectively. Test level was 0.05.Variables screened by univariate analysis would be used to establish the Logistic regression analysis and BP neural network risk prediction models.

Using the normalization formula, the input layer covariates were all normalized to the variables of [0, 1] interval. BP neural network model was established with online training and gradient descent algorithm. With the initial learning rate was set to 0.1, the kinetic energy was set to 0.9, correspondingly, the interval center point was 0 and the interval offset was ± 0.5. The sample was randomly divided into training set and test set. Training set, consist of 85 cases and 171 controls, was used for the establishment of BP neural network model; Test set ,consist of 39 cases and 77 controls, was used to verify the model accuracy. Sensitivity, Specificity, Positive likelihood ratio(+ LR), Negative likelihood ratio(- LR), Kappa index and areas under the ROC curve (AUC) were calculated to evaluate the prediction performance of the risk prediction models.

3. RESULTS

The univariate analysis was performed on the HT group and the non-HT group, and then the results showed that there were a total of sixteen variables had statistically significant difference between the two groups (P <0.05). These variables respectively were atrial fibrillation (AF), leukoaraiosis (LA), massive cerebral infarction (MCI), early CT low density imaging (LDI), prothrombin time (PT), white blood cell (WBC), platelet (PLT), high-density lipoprotein cholesterol (HDL-C), albumin (ALB), diastolic blood pressure (DBP), fasting blood glucose (FBG), fibrinogen (Fib), NIHSS score, thrombolysis therapy (TMT), anticoagulation therapy (ACT) and antiplatelet therapy (APT).

Table 1 Univariate analysis of HT［n(%), ($\bar{x} \pm s$), M(Q25~Q75)］

variable	non-HT group (n=247)	HT group(n=125)	t /χ2/Z	P
AF	47(19.0)	38(30.4)	6.008	0.014
LA	33(13.4)	33(26.4)	9.670	0.002
ACT	53(21.5)	42(33.6)	6.435	0.011
APT	211(85.4)	96(76.8)	4.282	0.039
LDI	27(10.9)	30(24.0)	10.952	0.001
MCI	19(7.7)	21(16.8)	7.174	0.007
TMT	13(5.3)	16(12.8)	6.559	0.010
PT	12.80±0.81	13.90±1.09	10.009	＜0.001
Fib	3.51±1.05	3.87±1.38	2.692	0.008
PLT	222.32±66.23	193.60±69.18	3.891	＜0.001
WBC	6.90±1.66	9.25±2.75	8.785	＜0.001
ALB	42.92±4.74	40.43±4.07	5.001	＜0.001
HDL-C	1.19±0.28	1.10±0.30	3.095	0.002
DBP	87.66±13.11	92.64±14.79	2.545	0.012
FBG	6.48±2.80	7.27±2.80	2.559	0.011
NIHSS	3(1~5)	8(3~11)	7.260	＜0.001

The accuracy of Logistic regression prediction model was 85.8% with 372 samples were predicted, and there was no significant difference compared with the actual observed value ($\chi 2$ = 0.925, P = 0.410). The result of Logistic regression analysis showed that the risk factors were leukopenia (LA), prothrombin time (PT), white blood cell (WBC), NIHSS and low density imaging, while the protective factors were albumin (ALB) ,platelet (PLT) and antiplatelet therapy (APT). The regression model was expressed as Logit (P) = 1.444pt + 0.414wbc + 0.115nihss + 1.048lds + 1.373la-0.010plt-0.114alb-1.146apt-18.466, $\chi 2$ = 315.903, P <0.001, R2 = 0.794, indicating that the model had statistically significance, and the fitting effect was good.

Table 2 The accuracy result of test set in theLogistic regression model

predictive value	observed value(%)		χ2	P
	yes	no		
yes	95	23	0.925	0.410
no	30	224		

Table 3 Logistic Regression Analysis of HT

variable	B	SE	Wald χ2	P	OR	OR 95%CL	
						Lower	Upper
LA	1.373	0.418	10.796	0.001	3.947	1.740	8.954
PT	1.444	0.210	47.502	0.000	4.238	2.811	6.390
ALB	-0.114	0.038	9.158	0.002	0.893	0.829	0.961
PLT	-0.010	0.003	15.097	0.000	0.990	0.985	0.995
WBC	0.414	0.082	25.549	0.000	1.513	1.288	1.776
NIHSS	0.115	0.033	11.953	0.001	1.122	1.051	1.197
antiplatelet therapy	-1.146	0.424	7.286	0.007	0.318	0.138	0.731
low density imaging	1.048	0.458	5.228	0.022	2.852	1.161	7.003
constant	-18.466	3.452	28.621	0.000	0.000		

With the import of sixteen variables screened by univariate analysis, the BP neural network model was established, which had one hidden layer and seven hidden layer neurons. Using the model to forecast the training set, the accuracy was 93.8%, so we could draw a conclusion that there was no statistically

significant difference compared with observed values ($\chi2$ = 0.250, P=0.804).Then using the model to forecast the test set, the accuracy was 94.8%, similarly, there was no statistically significant difference compared with observed values (($\chi2$ =0.667，P=0.687).

Table 4 The accuracy result of training set in the BP neural network model

predictive value	observed value (%)		$\chi2$	P
	yes	no		
yes	78	9	0.250	0.804
no	7	162		

Table 5 The accuracy result of test set in the BP neural network model

prediction values	observed value (%)		$\chi2$	P
	yes	no		
yes	37	4	0.667	0.687
no	2	73		

For the categorical dependent variable, the Predicted by observed chart was a combinatorial cluster box diagram showed predictive probability of the training and test sets. The X-axis was corresponded to the observed response category, while the legend corresponded to the forecast category. The first box diagram showed the probability that the non-HT patients were correctly judged as non-HT; the second box indicated that the non-HT patients were misjudged as the HT; the third box indicates the probability that the HT patients were misidentified as non-HT; finally, the fourth box indicated the probability that the HT patient is correctly judged as the HT. The first and fourth boxes were symmetrical respectively with the second and third box graphs at the horizontal of 0.5. The part above 0.5 represented the probability of proper classification, while the rest marked the probability of misjudgment. As can be seen from the figure 1, using 0.5 as a classification boundary of predict ive quasi-probability, the prediction classification results of the BP neural network model were ideal, only several deviated cases misjudged. (see Figure 1)

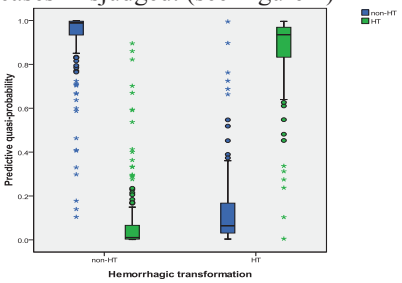

Figure 1 Predicted by observed chart

Sensitivity analysis of the independent variables indicated that the significantly impacting factor of HT successively were PT (100%), WBC (80.2%), PLT (72.1%) albumin (69.3%), NIHSS score (58.1%), massive cerebral infarction (49.5 %%), low density (46.6%), HDL-C (46.0%), fasting blood glucose (35.4%), atrial fibrillation (33.9%), DBP (31.4%) and so on. (see Figure 2)

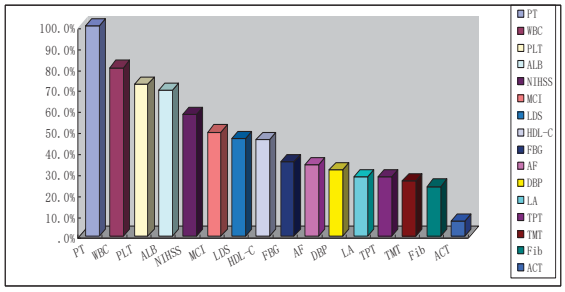

Figure 2 Sensitivity analysis of the independent variables

Paired $\chi2$ test was performed on the predicting results of Logistic regression model and BP neural network model, and then the test results showed that there was statistically significance between the predicting results of two groups ($\chi2$ = 6.852, P = 0.009), in consequence, it could be concluded that accuracy of BP neural network model (94.8%) was higher than Logistic regression model (85.8%). Sensitivity of Logistic regression model was 76.0%; Specificity was 90.7%; Positive likelihood ratio was 8.172; Negative likelihood ratio was 0.265; Kappa index was 0.676; and AUC was 0.833 (95% CI: 0.785~0.88). In contrast, Sensitivity of BP neural network model was 94.9%; Specificity was 94.8%; Positive likelihood ratio was 18.25; Negative likelihood ratio was 0.05; Kappa index was 0.886 (> 0.75);and AUC was 0.956 (95% CI: 0.929~ 0.983). The AUC of the two models was compared by Z-test, and the result showed that there was statistically significance in AUC of the two models (Z = 4.293, P <0.001).Therefore, the conclusion could be made that Sensitivity, Positive likelihood ratio, Kappa index and AUC of BP neural network model were much higher than that of Logistic regression model.

Table 6 Predictive ability of the risk model

evaluation indicators	Sensitivity(%)	Specificity(%)	+ LR	- LR	Kappa	AUC	SE	AUC 95%CI	Z	P
Logistic regression	76.0	90.7	8.172	0.265	0.676	0.833	0.025	0.785~0.882	4.293	<0.001
BP neural network	94.9	94.8	18.250	0.054	0.886	0.956	0.014	0.929~0.983		

4. DISCUSSION

BP neural network is a multilayer feedforward neural network based on the error back-propagation algorithm, which composed of input layer, hidden layer and output layer.Forward-propagating of the signal is the first phase.The data enter the network by the input layer, processed in the hidden layer, then output in the output layer.If the output of the network is not expected,the output error of output layer would be back propagation as a adjustment signal of network parameters , and then the signal of data error would adjust connection weights and threshold value

in the network until the network output achieve an acceptable accuracy[6].

As an emerging data mining technology, BP neural network had been widely used in Medical and health fields,such as the prediction of the incidence of acute infectious diseases and treatment and prognosis study of chronic diseases[7-10].In this study, Logistic regression model and BP neural network was used to predict the risk of hemorrhagic transformation in patients with acute ischemic stroke, to establish the related risk prediction model and to analyze the influencing factors or make a sensitivity analysis.The study found that screening factors of the two models were roughly same, mainly were PT, WBC, PLT, albumin, NIHSS score and low density. In addition to these common factors, there were eukoaraiosis and antiplatelet therapy screened in Logistic regression model while massive cerebral infarction, HDL-C and so on in BP neural network. Previous studies have shown that[11-15], NIHSS score, massive cerebral infarction, leukoaraiosis, and early CT low-density imaging were risk factors for hemorrhagic transformation, whereas albumin, HDL-C, and antiplatelet therapy are protective factors, which were consistently with the results of this study. This study found that both PT and WBC were risk factors for hemorrhagic transformation, and the effects of atrial fibrillation were not significant , which could be related to sample size and data sources, so large sample and multicentre studies were required to validate it. The factors selected by the two models could be complementary to some extent, therefore, the two models could be combined to analyze risk factors for the disease. In the risk prediction study of hemorrhagic transformation, Sensitivity, Specificity, Positive likelihood ratio, Kappa index and area under the ROC curve (AUC) of BP regression model were higher than those of Logistic regression model. It could be indicated that BP neural network model had better predictive performance than Logistics regression model, so further research and application could be carried out.

The results of model predictive performance in this study showed that the BP neural network model was superior to the traditional Logistic regression model, and its sensitivity, specificity and area under the ROC curve are higher. Moreover, the Kappa value of the BP neural network was more than 0.75, which indicated that it could be used to assist the clinical diagnosis. The BP neural network as an artificial intelligence system, could be further developed to smart medical tools to assist clinicians in disease prevention, diagnosis and treatment, even prognosis.

The predictive performance of BP neural network model had been gradually recognized in the medical field, however, some functions might need to be improved, such as the choice of input variables, the parameter estimation and hypothesis test,of the weight coefficient and the medical explanation of the predictive variables and so on[16]. Logistic regression model could explain the correlation intension between the independent variables by the OR value and find out the risk factors and protective factors. Actually, BP neural network could be combined with Logistics regression to improve the practical application value.

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Research on the Design of Virtual Network Experiment System from the Perspective of Ubiquitous Learning

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Abstract: As a kind of brand-new teaching thought, the generation of ubiquitous learning theory is closely related to the development of educational informationization. Especially with the growing maturity of virtual simulation technology, virtual networks have largely replaced actual networks and are widely used in scientific research and academic fields. Under the background of the deep integration of the two, the virtual network experiment system based on ubiquitous learning has also been formally proposed. Its development has very important significance, and it can help solve the many problems facing the current network experimental teaching. Significantly increase the diversity, flexibility, ubiquity, and interaction of the virtual network experiment platform.

Keywords: Ubiquitous Learning; Virtual Network; Experiment System

1. UBIQUITOUS LEARNING CONCEPT

The so-called ubiquitous learning refers to the emerging "natural" learning method based on information technology, with the learner as the main body, the knowledge building as the goal, and the learning task as the focus. This kind of study insists on taking actual problems as the starting point, and pays attention to constructing effective learning situations so that learners can integrate into real life, enhance students' autonomy and interest in learning, and help students acquire a comprehensive knowledge system. Moreover, for the learner, in the process of applying ubiquitous learning, the technology only serves as an auxiliary function to improve the learning environment and does not increase the extra learning pressure, which can ensure that the learner concentrates on learning.

As early as the late 1980s, the famous American scholar Mark Weiser described the relevant definitions of ubiquitous computing. He pointed out that the core concept of ubiquitous computing is to separate users and computing technologies, while services are integrated into the surrounding environment. Users only need to be in this specific environment, and they can subconsciously interact with the environment and obtain The corresponding service, but the user himself knows the source of the service. Ubiquitous learning is a new method of learning. It emphasizes respecting the subjective status of students. Through the organic integration of computer information technology and education, it creates a favorable situation for meeting the needs of learning. In this context, students can deeply understand the nature of the problem and integrate it with the real world to form a systematic knowledge structure.

2. THE COMPOSITION OF EXPERIMENTAL TEACHING SYSTEM BASED ON UBIQUITOUS LEARNING CONCEPT

With regard to the composition of an experimental teaching system based on the ubiquitous learning concept, people generally recognize that it includes three aspects: First, the communication network. This is the basis of the entire teaching environment. It is at the lowest level. Its main role is to satisfy the data transmission needs of teaching and provide the necessary software and hardware support. Therefore, it can also be said that it is the basis of various online course materials. The second is resources and service networks. In short, it is based on the Internet communication technology to realize the interconnection of network resource nodes and service nodes, and forms a curriculum resource network based on semantic relevance, carrying various learning resources. The third is the network of people. It is the direct service object of the online curriculum resources, and it is also the core of the entire teaching system. It refers to the organization of the relationships formed by learners. figure 1 intuitively describes the structural relationship of this basic model.

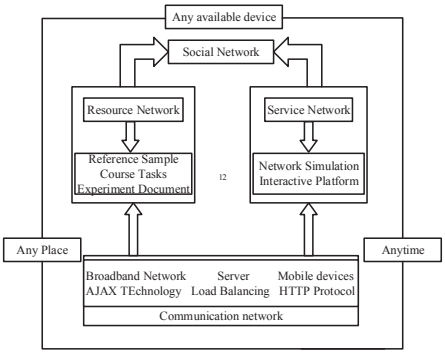

Figure 1 Basic model of experimental teaching system

Compared with the traditional teaching model, fundamental subjects such as the subjects, resources, and environment involved in this basic model have been fundamentally changed. For example, learners are no longer limited by classroom courses and teachers, and they can search for their own desired knowledge content according to their own needs. Moreover, these knowledge contents are rich, scattered, and flexible, and they are of great value to students. Convenience; based on this teaching model, learners can better interact and share knowledge, and its mobility is very obvious. In addition, during the learning period, the educators can systematically analyze and share the knowledge content in order to take task teaching and module classification. Ways to scientifically design experimental programs, learning content, and teaching methods to meet the needs of different learners.

3. ANALYSIS OF DEMAND OF VIRTUAL EXPERIMENT SYSTEM BASED ON UBIQUITOUS LEARNING

As a new teaching method that combines modern information technology and teaching concepts, the ubiquitous learning virtual experiment system must first focus on the user, and correspond to the traditional teaching. The users here include both teachers and students. . Among them, in order to meet the learning needs of students and enhance the learning initiative and comprehensive experience, the key to the design of the system is to ensure the transparency of the bottom layer, that is, the user does not need to understand the technical parameters and data processing principles of various modules, etc. Do not participate in the preparation of experimental scripts. They can use the topology map to automatically generate and modify the script. After executing the script, they can intuitively view the data statistics and easily complete the experimental procedures. In addition, the experimental system also needs to meet different teaching needs, for example, through the development of resource management functions to achieve flexible storage and use of resources, and to meet the needs of multiple points of exchange, the system should also have online interactive, independent evaluation and other functions.

4. VIRTUAL EXPERIMENT SYSTEM DESIGN

4.1 Overall system design

Based on the concept of ubiquitous learning, demand analysis can be conducted against its basic characteristics, so that workers can differentiate different modules based on differences. This allows the experimental system to be divided into the following types of modules:

(1) The user management module mainly performs user's initial registration, login, data modification and other operations.

(2) Experimental management and communication module. This module mainly meets the needs of the educators' experimental tasks, method teaching, resource management and other functions. It also meets the needs of students' online communication, interactive teaching, and evaluation feedback.

(3) Experiment generation module, mainly used for drawing topological maps, generating and revising experimental scripts, etc.

(4) The experimental platform module, through the integration of simulation software, is used to execute scripts, process data, and output experimental results and analysis reports.

4.2 Experiment generation module design

According to the ubiquitous learning concept, its main advantage lies in satisfying the user's ubiquitous needs and adaptive requirements, that is, users can easily intervene in the system to learn whenever and wherever. However, because the simulation software selected by the system has high professional requirements for script editing, it is difficult for learners to master and use. Therefore, with the method of drawing topological maps, we can meet the visual requirements required for experimental construction. In order to meet the interactive requirements of ubiquitous learning, the related topology map must be stored as a resource management object for a long time, so the system has developed a topology map generation program. Moreover, in order to realize the transparency of the system, the user is not required to pay attention to the relevant technical details, so a unified data structure should be designed to make the business logic layer and the presentation layer to hide the transformation between the script and the topology map.

When generating a topology map, you need to focus on the two target objects, the node or the link. Among them, nodes refer to physical objects such as network protocols, equipment, and equipment; links represent related elements between nodes, such as physical connections between different devices, and network-based data transmission and reception. Because there are many types of nodes and links, in order to better distinguish the system, the system is designed with matching elementality at the UI layer. For example, links, text, color, connection points, etc., related to the nodes are text, color, graphics, size and so on.

The generation of the topological map is based on the main data structure. It is defined in the system presentation layer using the dynamic prototype of Javascript, thus ensuring that all common functions are applicable to all instances of the class. At the same time, for various types of instance variables, a special global variable data is also defined. Its role is to store all instance variable references. For example, proxy instance instances are all stored in the AgentNodeArray. In addition, in order to record the number of generated instances, the system also has a

set of global variables, id, whose purpose is to identify the existing topology in order to make a reasonable number of new element nodes. The final step in generating the topology map is to convert the instantiated objects into JSON strings.

4.3 Experimental platform module design

To meet the needs of system transparency, that is, users can not see the simulation, analysis and other programs, which requires the implementation of the script, data processing and analysis of the invisibility. For the user, the execution of the script is asynchronous. When different tasks are submitted at the same time, the task queuing problem needs to be solved. The system adopts the producer-consumer mode. That is, the related task is written into the task queue through the request thread, and at the same time, it reminds the daemon thread to complete the task forwarding operation. After the middleware receives the task, it will be further distributed to the application server. Daemon threads automatically switch to wait state when there is no task to process.

Users' feedback on experimental teaching systems needs to be based on experimental results. It should be said that the biggest advantage of Dynamips is that it can achieve complete simulation. This can meet the experimental needs of different networking simulations. However, its disadvantages are obvious. That is, users need to configure their own virtual network devices. The experimental results of NS2 and NS3 cover almost all the details of the protocol simulation. Therefore, in the functional design of this paper, the NS module is mainly analyzed.

4.4 Experiment Management and AC Module Design

4.4.1 Message and File Transfer Design

For the experimental management module, its central function is to achieve data and information transfer. When the user is connected to the web server, the business logic layer of the module automatically instantiates a corresponding Socket management class. At this time, the user uses the account number and password to perform login identification. During use, the information sent by the user needs to pass through the Socket container to match the receiver, thus completing the information transfer.

When users transfer files, they can not only do it manually but also submit them asynchronously. The system's Upload Handler class can be used to complete an asynchronous submission. The submitted objects include automatic storage when editing experimental texts, pictures in documents, attachment uploads when communicating with others, and so on. According to the different parameters submitted by AJAX, the system can select the file type, upload size, storage location, upload code, and other requirements as required.

4.4.2 Instant Communication Design

Interactivity is based on the requirement of a ubiquitous learning laboratory that learners can freely communicate during use. Obviously, the instant messaging module becomes the first choice for Web applications.

Generally speaking, chat rooms generally use two methods to implement chat functions. One is polling. The so-called polling refers to using AJAX to send instructions to the server for a fixed period of time to get information. However, the polling interval mainly depends on the network load. If the polling frequency is low, the information may lack timeliness, but the high-frequency polling will increase the operating pressure of the server. The second is long polling. It refers to maintaining a long connection between the server and the browser, ensuring that the browser can send instruction requests, and the server feeds back messages. So based on this approach, you need a dedicated HTTP connection. However, compared to polling, long polling performance is poor when the amount of information is too large.

4.5 Middleware Design

4.5.1 Middleware Functional Design

Based on the ubiquitous learning needs of scalability and openness, the virtual network experiment system should meet the following requirements:

(1) When the functional requirements increase, the system modules must also be adjusted synchronously, and the relevant simulation software must also be well integrated. Therefore, a standardized data transmission interface needs to be designed.

(2) Because different software is suitable for different systems, such as NS can only run on Linux system, and Dynamips has both Windows version and Linux version. In this regard, it should be considered how to separate the system from the server, and at the same time study the communication mode that suits both.

(3) When the system is operating in a ubiquitous environment, the user's access is unpredictable, and there may be a large number of visits, multiple sources of access, and so on. Through experiments, it can be seen that when using an NS module, when an ordinary computer corresponds to a network with up to tens of nodes, the simulation time is more than ten seconds, and sometimes it may even reach several minutes. If many users concentrate their tasks at the same time, the operating pressure of the server will rapidly increase. Tasks cannot be processed at the same time, but only queuing, and waiting time may be very long. Therefore, this is a key problem that the system must solve.

In this regard, the system is configured with middleware. For the information transmission that occurs between the presentation layer and the business logic layer, a unified interface standard can achieve a very good expansion of the functional modules, and realize the information exchange with the server through remote technology. Remote operations and file sending and receiving can be completed. During the performance bottleneck problem, you can use the load balancing strategy to crack.

4.5.2 Data Exchange Interface Design

For the presentation layer and the business logic layer, in order to satisfy the data exchange between the two, it is necessary to standardize the interface to call the standard through the middleware, and then to separate the system from the front end and the rear end, which is conducive to the continued expansion of the system module. To this end, a unified interface definition should be designed to ensure that the presentation layer of all modules must comply with interface standards when communicating information with the business logic layer. When it is still necessary to further expand the system functions, it is only necessary to conduct information transfer based on a unified interface standard. At the same time, the required processing programs are written, and new modules can be easily integrated into the system.

5. CONCLUSION

Ubiquitous learning-based virtual network experimental teaching system is a combination of technological development and educational needs. On the basis of expounding the relevant theories and concepts, the article systematically designed the system and explained the different modules that make up the system. There are mainly experimental generating modules, platform modules, and resource management and communication modules, which are based on functional requirements. Design analysis, the final article also conducted an in-depth analysis of the middleware design. Through the study of the article, it can be seen that as a new teaching mode in the new era, this experimental system can meet most of the current experimental teaching needs. It is based on the effective integration of various software, through reliable resource management and teaching. The control can realize the users' needs of flexible use, interaction and self-selection, and fully demonstrate their diversity and practicality. Moreover, the system has a strong extension function, can be further optimized and integrated according to the needs of the future curriculum, its structure and modules to adapt to the needs of the new era of teaching, thereby promoting teaching efficiency and teaching quality.

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The Progress of Non-Viral Vectors in the Treatment of Bone Defects by Using Bone Morphogenetic Protein 2

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Abstract: Bone morphogenetic proteins (BMPs), more specifically BMP-2, are being increasingly used in orthopaedic surgery due to advanced research into osteoinductive factors that may enhance and improve bone therapy. The U.S. Food and Drug Administration (FDA) has approved the possibility of using BMP-2 for the treatment of tibial fractures and nonunion. With the development of molecular biology and cell biology, the application of transgenic technology in the treatment of bone destruction is becoming a hot spot in the world, and the choice of vector is very important for the transgenic technology in the treatment of bone defects. In this article, the research of non-viral vectors is reviewed.
Keywords: BMP-2; gene therapy; bone defect; non-viral vectors

1. INTRODUCTION

Bone loss of various etiologies is one of the most common clinical problems in stomatology. It not only affects the patient's facial appearance, chewing, pronunciation, feeding capabilities and the subsequent denture, but also his or her psychological health. Current treatments for alveolar bone loss and atrophy include bone or bone substitute grafts, application of bone morphogenetic protein, chemical drugs, and stem cell tissue engineering. In such cases, the use of autologous bone is still regarded as the golden standard. The transplantation of autologous bone, however, is limited by its quantitative availability, loss of vascularity, invasion of normal tissue, and risk of infection during harvesting[1-4]. Hence, there is an urgent need to find a safe, effective and convenient way to achieve the increased alveolar volume. BMP-2 is a member of the transforming growth factor-β super family. BMP-2 induces undifferentiated mesenchymal stem cells into chondrocytes and osteoblasts. The protein is involved in the growth and development of bone and the cartilage reconstruction process by promoting osteoblasts differentiation and maturation, thus accelerating the repair of bone defects. BMP-2 can help the ectopic bone formation and has been approved for the clinical applications. However, the use of the bone morphogenetic protein is associated with short duration of action and high cost[5]. So we intend to use gene therapy techniques to delivery BMP gene into cells. The expression of bone morphogenetic protein in the cells is expected to overcome the disadvantages of exogenous BMP such as short half-life, the need to use large amounts of protein, and low potency. Commonly used gene vectors include viral and non-viral vectors. Viral vectors have high transfection effciency, but immunogenicity limits its application, so many scholars gradually put attention to the non-viral vectors. This article describes the progress of non-viral vectors in the treatment of bone defects by using BMP-2.

2. TYPES OF NON-VIRAL VECTORS

(1) Liposomes

Liposomes, a synthetic lipid bilayer, were first reported by Bangham and Horne in 1964[6]. Structurally, they resemble the lipid membrane of living cells. Therefore, they have been widely investigated, as models to study the cell membrane, and as vectors for protection and/or delivery of bioactive agents. It is the most commonly used non-viral vectors. Plasmid DNA, in combination with cationic liposomes is capable of converting its charge to a positive charge, thereby facilitating its binding to negatively charged cell membranes. It not only enhances gene transfection efficiency, but also the encapsulated DNA is protected from being degraded by nucleases[7]. Park et al.[8] applied liposomal vectors carrying BMP-2 cDNA directly into freshly created peri-implant bone defects of pig calvariae. The study found that the BMP-2 gene was efficiently introduced into immigrating cells and trabecular cells lining the marginal bone surrounding the bony defect, so we can draw the conclusion that BMP-2 gene delivery using a liposomal vector in the chosen model efficiently transfected immigrating cells as well as neighbouring cells, and enhanced bone regeneration of the defect.

(2) Cationic polymers

Cationic polymers have good ability of DNA binding and protection. They also have the advantages of good biocompatibility, low toxicity and easy chemical modification to improve their targeting ability. So they became new directions in the research of gene vectors. Cationic polymers currently used as gene vectors included: poly-L-lysine (PLL),

Polyethyleneimine (PEI), polypropylenimine(PPI) , polyamidoamine(PAMAM) and so on. Among them PEI is the most effective non-viral gene vector at present. Lü et al.[9]explored the effects of BMP-2 gene modified canine bone marrow stromal cells (bMSCs) mediated by a non-viral PEI derivative (GenEscort™ II) in promoting bone formation in vitro and in vivo. The vitro study found that the ALP activity and the gene expression of BMP-2, Runx-2, OPN of the transfected group were significantly higher than non-transfected group and they also found ectopic new bone formation in nude mice. So we can say that PEI appears to be a safe and effective non-viral vector for gene enhanced bone tissue engineering. Due to a large number of positive charges, PEI has high cytotoxicity, so Jin et al.[10]used negatively charged alginate(al) to form a complex of PEI-al to reduce its toxicity, then the research found that PEI–al nanocomposites carrying BMP-2 gene could efficiently transfect BMSCs, above all the expression of osteogenesis-related gene was increased. These studies suggested that PEI is an effective vector for gene therapy.

(3) Gene gun

Sanford and Klein pioneered a gunpowder-driven gene importing device that can import thousands of cells at a time[11]. Gene gun technology also known as bio-ballistic technology or particle bombardment technology. Its basic principle is to wrap foreign genes into micron-level gold or tungsten with stable chemical properties. Li et al. [12]created the segmental bone defect model at the middle part of the radius bone of the New Zealand white rabbits and then either BMP-2 gene or control without BMP-2 gene was injected into the tissues around the fracture site through gene gun, the study found that the radiographic score and bone consolidation rates were significantly higher in animals injected with BMP-2 gene group as compared with control group. Western-blot and RT-PCR showed BMP-2 expression was significantly increased in the tissues around the site of bone defects in comparison with the control group. So we can draw a conclusion that: BMP-2 gene transferred by gene gun could increase the expression of BMP-2 protein and improve the bone callus formation therefore shortened the time of bone defect healing.

(4) Electroporation

Electroporation refers to the use of high-intensity electron fields to cause temporary opening of the cell membrane pores, thereby facilitating the entry of exogenous DNA into the interior of the cell. Kawai et al. [13]in order to use non-surgical methods to solve the problem of alveolar bone defect, the BMP-2 gene was introduced via electroporation into the target site in the periodontal tissues of the first molar of the rat maxilla. The results found that exogenous BMP-2 was detected in the target areas, and the growth of new alveolar bone tissue was observed five days after gene transfer. On day seven, the new alveolar bone tissues were found to connect to the original bone tissues. Moreover, the mineral apposition rates of the alveolar bone following BMP-2 gene transfer were significantly higher than those in the control group following lacZ gene transfer. In a study, BMP-2 gene was transferred into rabbit BMSCs by electroporation, RT-PCR test showed that the expression of BMP-2 mRNA in transfected cells was significantly increased, Elisa test found that the expression of BMP-2 protein also showed a significant increase trend and the ALP activity of the transfection group was also significantly enhanced. The study showed that BMP-2 gene can be effectively transfected into BMSCs by electroporation, and the transfection results were stable[14]. This method is effective for vitro application, but its required high-intensity current significantly damaged the tissue, limiting its application in vivo.

E. Ultrasound method

To explore whether ultrasound-mediated microbubble destruction can enhance the expression efficiency of plasmid pIRES -rhBMP2 -EGFP for bone morphogenetic protein -2（BMP -2） in mice skeletal muscle, the recombinant BMP-2 plasmid containing enhanced GFP was transfected into mouse hindlimb skeletal muscle by ultrasound microbubble destruction method and at the same time, the corresponding control group was set up to observe the expression. Then the cells were counted under a fluorescence microscope and detected by immunohistochemistry. The result found that ultrasound-mediated microbubble destruction could enhance the transfection and expression efficiency of rhBMP-2 gene in skeletal muscle of mouse in vivo. It is a new gene therapy method for periodontal regeneration[15].

3. OUTLOOK

Non-viral vectors have the advantages of low toxicity, no immunogenicity, no tumorigenicity and it is easy to preparation. However, the transfection efficiency is usually lower than the viral vectors. It is firmly believed that with further research, vectors with better performance will play a better role in the field of gene therapy for bone repair so that gene therapy for bone defects can produce satisfactory results for both doctors and patients.

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China's Double-debt Issuing Practice and Thinking

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Abstract: Recent years, China has vigorously promoted "mass entrepreneurship and innovation," and many "dual-creators" entities' potential has been released to stimulate the vitality of the financial market and build a new mechanism for the innovation and entrepreneurship market. Double-debt bonds have gradually become a special way for "double creation." While China's double-debt bond transactions are increasingly active in the secondary market, lacking policy incentives, inadequate regulatory systems, and information disclosure and letter-creating measures to be improved by issuance agencies have gradually emerged, hindering dual-credibility bonds development. Based on a brief review of the double-debt bond market, this article discusses the practice of double-debt bond market issuance, focuses on the analyzing issues from double-debt bonds development, and provides relevant recommendations for the steady promotion of double-debt bonds in China.

Keywords: double-bonds bank practice problems and suggestions

1. OVERVIEW OF DOUBLE-DEBT

(1) Background on the issuance of double-debt bonds

Before the innovative financing tools like double-debt debt, SME private-bond financing was an important way for SMEs to finance, relying on their issuance conditions, speed of approval, and audit methods. In January 2015, the "Administrative Measures for the Issuance and Transaction of Corporate Bonds" promulgated by the China Securities Regulatory Commission (SFC) made SME Private Equity Bonds not have advantages and they have withdrawn from the stage. However, China's small, medium and micro enterprises are still in difficulties in financing. This has led to the emergence of dual-debt bonds with distinct policies and well-defined positions.

Meanwhile, with the government vigorously promoting "popular entrepreneurial innovation", the number of innovative and entrepreneurial enterprises (hereinafter referred to as "double-creating enterprises") increasing quickly. Since the first batch of dual-invented enterprises were successfully launched on the Shanghai Stock Exchange in March 2016, the State Council and the Securities Regulatory Commission have issued new measures to coordinate the double-debt loans' pilot development. The State Council's executive meeting, highlighting that it was necessary to "expand innovative start-up company bonds pilot steadily." The government's multiple policies support the effective increase of the financial supply of the dual-creating enterprises, improving the market financial supply structure, and the promotion of dual-credential bond pilot development.

(2) The Basic Profile of Double-Created Debt

Double-insurance bonds, collectively referred to as "innovative and corporate bonds," refer to eligible innovative start-up companies [1], venture capital companies, and corporate bonds issued under relevant laws. "Double-tracking bonds" have the dual advantages of general corporate bonds and SME private-equity bonds. They not only have government policy protection, but can ease the urgent needs of SMEs' financing. Meanwhile, investors can also obtain higher returns but they are the issuers, the policy environment .The financing channels are different from the existing bonds:

Issuing main body. The issuance subjects of the double-debt bond include: innovation and start-up companies, company-owned venture capital funds and venture capital fund management institutions, and companies that have supported the registration and operation of the national "double-creation" demonstration bases and other innovation and entrepreneurship resource aggregation areas and have included the new three board innovative companies listed companies.

The policy environment. The government leads in preventing and diverting the risk of default on dual-credential bonds by market-based measures and stipulates many safeguard mechanisms such as mortgages, guarantees, and payments, and guarantees the solvency of issuers. The China Securities Regulatory Commission is responsible for overall coordination, strengthening market supervision and creating a good environment. The stock exchange

[1] Innovation and start-up companies refer to small and medium-sized companies that are engaged in the research, development, production, and service of high-tech products or have innovative business models and innovative business models.

promote relevant facilities construction and guide the dual-credential debts' issuance by risk identification and solvency capabilities intermediaries, such as commercial banks, securities companies , guarantee agencies.

Financing methods. Double-debt debts effectively avoid equity dilution, reducing the impact on the company's existing shareholder's controlling proportion, preventing the further decline in the proportion of shares held, affecting the equity of the company's shareholders, and improving the capital composition and proportion of the enterprise. Reduce additional financial costs.

2. CHINA'S DOUBLE-DEBT BOND ISSUANCE PRACTICE

(1) Successful piloting of double-debt issuers

In June 2015, the government has begun to build a market trading platform and financial market environment for the dual-creating enterprises in order to promote the steady start of the double-debt bond market in China. Since 2016, the trial operation of China's double-debt bond market has achieved a breakthrough: There are five dual-creating companies as the first batch of pilot bonds, and the successful issuance of dual-credential bonds at the Shanghai Stock Exchange totaled RMB 115 million. As of July 31, 2017, 12 companies across the country have successfully issued "double-debt bonds" with a total issue size of 1.588 billion yuan (see Table 1 for details of the issuance).

Table 1 Successfully issued double-debt bonds as of July 31, 2017[2]

Bond abbreviation	Bond code	Distribution method	Total issue amount ten thousand yuan	Listing date	Bond maturity	Issue rate	Debt rating
16Su Fanglin	135288	Non-public offering	2,000	2016/03/08	1 year	5.35%	None
16 Pu Lvde	135287	Non-public offering	1,000	2016/03/08	1 year	5.35%	None
16 Su Jinhong	135223	Non-public offering	3,000	2016/03/08	1 year	5.35%	None
16Long Teng01	145074.SH	Non-public offering	5,000	2016/10/28	1	3.88%	None
16' TDG Debt	14073.SH	Non-public offering	500	2016/10/28	3	8%+ Increase Rate	None
17 Guangsha Debt	145324.SH	Non-public offering	2,500	2017/02/06	2	7.10%	None
16Chuan ShiS1	114042.SZ	Non-public offering	2,000	2016/12/05	3	7.00%	None
17Xv Jie Debt	145628.SH	Non-public offering	1,560	2017/07/20	3	7%+Increase Rate	None
17Zhou Tian Debt	145367.SH	Non-public offering	1,200	2017/03/06	2	6.50%	None
17Tian Tu 01	143124.SH	Public Offering	100,000	2017/06/05	5	6.5%+ Increase Rate	AAA
17Pu Tai 01	143119.SH	Public Offering	20,000	2017/06/01	3	5.30%	AA+
17 Yang Pu S1	112522.SZ	Public Offering	30,000	2017/05/26	5	5.65%+ Increase Rate	AAA

[2] Source: Shanghai Stock Exchange website

(2) Double-debt performance is still acceptable

At present, the main issuer of the double-debt bond is private enterprises. The key industries for pilot projects are strategic emerging industries such as energy conservation and environmental protection, new generation information technology, and biotechnology. From the main body, the issuance scale of the initial stage of double-debt bond is generally small, with no more than 50 million yuan. In 2017, the number of major issuers began to liberalize, and the total issuing scale exceeded RMB 1.5 billion. In view of profitability, most of the double-debt bond issuance subject profitability indicators are relatively good, and its operating net profit can repay the interest expense of the current bond, becoming a new bright spot for the profit growth of the issuer.

(3) Local policies help boost double-debt bond development

In July 2016, the State Council issued the “Opinions on Strengthening the Implementation of Innovation-Driven Development Strategies and Further Promoting the Development of Popular Innovations for People-to-Business Ventures” demanding to develop creditor's rights and equity in the financial markets, highlighting the innovative and entrepreneurial service products-Double Debt. On July 4, 2017, the China Securities Regulatory Commission issued the “Guidance Opinion on Launching Pilot Projects for Innovation and Start-up Company Bonds”, and requested the improvement of policy supply to effectively guide the local government's financial support policy.

In the area of the first batch of double-debt creation pilots, Beijing Zhongguancun has the advantage of issuing costs: The successfully issues dual-debt bonds company will receive a 30% coupon interest subsidy, while third-party intermediary agencies will reduce the underwriting fees and guarantee fees for debt-issuing projects. The Suzhou municipal government grants 2% and up to 1 million yuan in companies that have successfully issued dual-debt bonds according to the actual financing scale, and to 2,000% of the double-credit debt underwriting institutions in branches in Suzhou according to the actual financing scale. Up to 300,000 yuan reward, to promote the transformation of traditional manufacturing to innovation and technology. In addition, Hangzhou Binjiang District provides 1-3% subsidies for corporate financing, and total subsidies of no more than 2 million yuan, and other favorable policies to promote the development of double-debt loans.

3. THE PROBLEMS IN THE PROCESS OF THE ISSUE OF CHINA'S DOUBLE-CREDIBILITY BONDS

The tendency of the double-debt bonds is good, the market operation mechanism and policy guidance are gradually being promoted, but still lacking government incentives and regulatory agency constraints, problems with the issuer's own code of conduct, and so on, resulting in double-debt creation. The degree of market participation is still low. Therefore, some bottlenecks still in the double-debt debt development. It need to continuously explore and study.

(1) Government incentive policies are still insufficient

The policy guidelines issued by China are limited to the “Guidance Opinions on Launching Pilot Projects for Innovation and Pioneering Company Bonds”. Our policy environment related to the double-debt bond industry only points to the CSRC's overall guidance which is directed and the third-party agencies coordinate and cooperate, did not elaborate on the division of labor and initiatives of government departments. The relevant supporting market operating mechanisms are not well-established, and the special audit and incentive mechanisms that are encouraged are not detailed in every dual issuance bonds aspect in the specific issuance practice.

Meanwhile, compared with ordinary corporate bonds, the degree of differentiation of double-debt bonds is not high and they are in the initial stage. The issuance requirements are more stringent and the scale is relatively small. The investors do not match the income and risks during the bond duration, limiting the investment so the willingness is less. The external incentives of government departments are limited. Substantial concessions are not in place at the time of issuance. It is more difficult to rely solely on the market for issuing private capital into dual-creating debts. This is the main reason that restricts the promotion and issuance of dual-credentials.

(2) Regulators lack effective supervision and control mechanisms

China's supervisory agencies do not have detailed procedures for the supervision of dual-creditor debts. In the current dual-issuance bond issuance document, the CSRC is required to coordinate and strengthen supervision, and the stock exchanges shall uniformly identify and prevent risks. However, in the actual issuance process, the requirements for the “dual-creation” accreditation procedure are not exhaustive. Only those companies with a willingness to finance will conduct self-examination on whether they meet the bond issuance conditions, and whether the underwriter institution with project reserves is in compliance with the issuance of bonds for debt-issuing enterprises. Pre-judgment of conditions, "pseudo-double-creation" companies can still use the "double creation" in the name of debt financing, resulting in double-debt may eventually exist in name only.And the stock exchanges are guiding the third party institutions to legally invest in compliance and

reduce the risk of credit violations. They are only general measures involving debt repayment security measures, and rarely provide protection clauses for the interests of creditors. This will not only weaken the attractiveness of the dual-debt bonds.

(3) Issuer information disclosure and credit enhancement measures to be improved

Since double-debt bonds are mostly private placements, the dual-debt issuers are not standard in the special disclosure of company information. The issuer has made a brief disclosure of the basic information of pre-issuance bonds. The disclosure of the use of funds such as the duration of debts and major issues has been insufficient. The qualitative analysis of the quantitative description of the company's operations and the possible financial risks has been even more inadequate. The existing dual-issued bond issuance specifications do not place excessive demands on information disclosure. Instead, the issuer deliberately neglects the normative and time-sensitive nature of information disclosure due to concerns about additional disclosure costs, and affects the credibility of dual-credential issuers rating.

Meanwhile, the qualifications of China's assessment agencies are uneven, and the credit rating standards have not been strictly regulated in the existing double-debt bond documents. The assessment agencies themselves have flaws in their professional standards, resulting in the evaluation results issued by the assessment agencies cannot be obtained by investors. In trusting the existing double-debt bond market, either the issuing entity does not employ credit ratings and guarantee agencies for debts, or even if a credit rating agency and guarantee company are hired as guarantees, due to the independence of the third-party intermediary agencies, the guarantees. And the rating may only be “face time”, which has caused investors to dare not easily engage in risky double-debt bonds.

4. THE DEVELOPMENT OF CHINA'S DOUBLE-DEBT BOND PROPOSAL

(1) Government's policy support

a. The government should increase support for double-debt policy

Faced with the failure to promote dual-debt loans, the development of the dual-debt bond market will require the government to increase policy support. Therefore, in order to provide a good financial environment for the issuance of double-debt bonds, local governments and relevant departments must play a leading role. In relieving the financial pressures of the dual-venture companies, they can give a certain percentage of fiscal fund subsidies to the dual-creation enterprises. Tax concessions should be made to appropriately reduce the risk weights and capital supervision requirements for financial institutions' double-debt-backed loans. In the aspect of providing relevant supporting coordination for the creation of double-debt bonds, a special acceptance review mechanism can be implemented to establish a green channel for the review and issuance of the double-debt debts, so as to improve the auditing efficiency, facilitate the relevant issuing organizations to select the best issuance timing, and improve market feedback timely.

b. The government should encourage issuers to issue dual-birth bonds to foster public participation

In the immature double-debt bond market environment, the market activity of the issuing institutions and investors should be vigorously improved. Therefore, the China Securities Regulatory Commission should establish an external incentive mechanism to encourage issuers to issue dual-income bonds, and encourage the use of bond discounts and fund injections to guide the issuance of dual-debt issuance agencies, and actively seek to accumulate the previous SME private-equity bonds during the issuance process. Experience, appropriately broadening the range of issuers, including a variety of different terms, different issuance sizes, profitable project bonds, etc., promote the diversification of issuers. At the same time, it increased investors’ understanding of the dual-credential information, gradually supported the market mechanism to close to the issuance configuration of the dual-birth bonds, gradually fostered the investment market for dual-credual bonds, and extended institutional investors to legal persons, and small and medium-sized retail investors. Which stimulates the investment potential of more investors.

(2) Supervisory Supervision and Guarantee Mechanism

a. Regulators improve investor protection system

Regulatory agencies should timely introduce regulations that are in line with the new phenomenon in the current dual-debt bond market to prevent default risk, and mandate that the dual-issuance issuer should set an effective creditor interest protection clause in its issuance document. The setting of the terms should comprehensively consider the company's own operating risks, financial status, industry competition and other factors. After the occurrence of the breach of contract, a good mechanism for remediating breaches of contract will be established, and related laws and regulations such as mortgages, guarantees, reimbursement, etc. will be established to protect the legitimate rights and interests of investors in the future when the guarantee is repaid.

b. Regulators should strictly regulate the "double creation" qualification certification

Regulators need to further standardize the issuer’s "double-creation" qualification procedure, and quantify the information disclosure of it. If the

assessment results are inconsistent with the actual situation, apart from the termination of issuance, the bonds should also be compared with the issue materials of the lead underwriter, guarantee institution, and assessment agency, and be aware of the existence of false operations that deceive investors. Administrative penalties such as market bans should be imposed for the corresponding period of time, the supervision and guidance services of the supervisory institutions for the dual-debt market should be truly brought into play.

(3) Code of Conduct of the Relevant Issuer

a. Strictly control the quality of information disclosure and improve credit rating

The related issuers of the double-debt bond should pay more attention to the mandatory, normative and fairness of information disclosure and credit rating. In terms of information disclosure, the pre-issuance information of Shuangduo Debt should pay attention to the full disclosure of the type of debt, the use of funds, and the economic effects of debts; during the existence of debts, the use of funds should be regularly disclosed, while paying attention to recurring Information Disclosure and Information Disclosure of Major Events. In the aspect of credit rating, the assessment agency of the dual-credential bond can adopt various organizational structures to guarantee the independence of the dual-debt bond assessment agency; it infringes investors on major omissions, false records, and misleading statements in the rating process. In the case of legitimate rights and interests, a risk compensation mechanism was established and efforts were made to increase investor trust in the assessment agency.

b. Advocating the development of the company's own ability

The issuing company of double-debt debt should strengthen the cultivation of its own capabilities. Strengthen the cultivation of professional and technical capabilities, enhance the competitiveness of their products, and obtain investors' favor from the source. At the same time, they should reasonably select the method and type of bond issuance, clarify the market demand and policy dividends, and encourage financial institutions and large enterprises with strong capabilities. Actively participate in the creation of double-debt bonds, promote the development of small and medium-sized enterprises through demonstration effects, ultimately raise the financing environment of the entire industry chain, strengthen the self-discipline of issuing companies, and strengthen social responsibility, which helps issuing companies to reap a good social reputation and develop dual-debt bonds. Play a multiplier effect.

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Research on the Strategy of Enterprise Crisis Public Relations under the New Media Era

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Abstract: The new media, represented by the micro-blog and WeChat Official Account, has not only become an important source of information and data for enterprises, media and government decisions, but also has a wider and deeper impact on the survival and development of the enterprise. The characteristics of new media era, including the difficulty in distinguishing truth and rumor, the mixture of rational and irrational factors and the fission dissemination of information, have added fuel to the fire of enterprise crisis and increased the uncertainty of its management. Take the two typical cases of “Baidu Wei Ze Xi” and “Torts of Wang Yi Yan Xuan”, this paper will studies the coping strategy of enterprise crisis management from the point of enterprise crisis public relations. The strategy will be as follow: timely response: respond intermediately; reciprocal communication: make full use of the new media platform; emotional resonance: find opportunities in the crisis; attention shift: set the agenda and distract focus; advanced precautions: establish a normalized response plan.
Keywords: new media; enterprise; crisis public relations; strategy

1. INTRODUCTION

With the development and popularization of the internet technology, new media, represented by micro-blog, has become the important tool for people to obtain information, express opinion, and spread information instantly. The new media (New Media) is translated into "the new medium", derived from the concept of "media", which belongs to a kind of "media" and has the characteristics of media.

In 1985, UNESCO formally proposed the concept of "new media" in the Information Committee, which is "the medium of information dissemination based on digital technology and network as the carrier"(Stan International Forum, 2006). New media like micro-blog and wechat have attracted lots of netizen. According to the result of A Statistical Report on the Development of China's Internet Network from China Internet Network Information Center(CNNIC), by December 2016, the proportion of enterprises that using Internet to work around the country was 95.6%. It can be seen from the enterprise crisis that new media has played an increasingly important role in its exposure. Therefore, modern enterprises need to grasp the developing characteristics of crisis events urgently in the new media era, and take some measures to reduce or avoid the occurrence of crisis events, and take effective measures timely for the outbreak of crisis events to maintain the reputation and interests of the enterprises.

The research on crisis public relations came from crisis management. Foreign Studies on crisis management originated in the United States in the late nineteenth century and early twentieth century. The first person who practiced crisis public relations was Ivy Lee, “the father of public relations", but he did not carry out systematic research on enterprise crisis public relations. Til 1970s, crisis management research is still in the initial stage of exploration. It was not until the early 1980s that crisis management research gradually extended to enterprises and business. The research contents of enterprise crisis management enriched constantly, and the theory of crisis management expanded further. Domestic research on crisis public relations started relatively late, and it started in 1980s. At first, the research on crisis public was mainly translated works of foreign crisis management. In 1990s, due to the decline of several famous enterprises in crisis events, crisis public relations gradually entered into the research field of relevant scholars in China. (Wang Fei, 2015) After the SARS incident in 2008, the research on crisis public relations in domestic academia increased rapidly, and the related research results increased year by year.

On the whole, the study of crisis public relations has achieved relatively rich research results and has the following three characteristics: first, with the pass of times, the object of study is changing and more concerned about the new situation of social development; second, research methods are varied and comprehensive, including data analysis, case study and induction；third, many disciplines are involved, such as public relations, communication, social psychology, management and so on. But there are also shortcomings in this kind of research, one is that the research content is concentrated more in the perspective of the government and the media, and the attention to the enterprise is relatively less. The other is the strong timeliness of this kind of research achievement. Although it has the guiding significance in a certain period, it is lack of systematically theoretical construction in the long run.

2. RESEARCH METHOD

In order to learn about enterprise crisis public relations strategy under new media era, this paper will analyze from the following aspects by comparing research and analyzing cases:

First, the Theoretical Basis of the Enterprise Crisis

Phase Analysis Theory. This theory was carried out by Steven Fink, who thought that the life cycle of enterprise crisis can be divided into crisis potential period, crisis burst period, crisis extension period and crisis recovery period.(MBAlib encyclopedia, 2016) Crisis is difficult to be detected in the potential period, but if we can take precautions in time, it will be the best time to solve crisis. Crisis burst period is a stage of outbreak. If we can not control it in time, the crisis will further expand. Crisis extension period is the stage of crisis spreading, and its duration is usually determined by the effectiveness of enterprise measurement. During the crisis recovery period, the crisis has basically been solved, but if there is a mistake, it will cause another outbreak of the crisis.

Second, Cases Study of Enterprise Crisis

The advent of the new media era has brought both great opportunities and challenges to the enterprise in the crisis public relations. Any small event may be magnified by the Internet, so that the enterprise is facing a crisis. In recent years, crisis occurs to many brands. Some enterprises get reputation lost and image damaged due to their making little use of the principle of crisis public relations and character of internet new media platform, such as the typical “Baidu Wei Zexi” in 2016. However, some enterprises make good use of crisis public relations and combine with internet spreading characteristics to defuse crisis like“Torts of Wang Yi Yan Xuan” in 2017.

(1) Crisis Management of “Baidu Wei Zexi”

The death of Wei Zexi has made the public realize that search engine will imperceptibly affect the choice and judgment of every Internet user, and may be the next Wei Zexi himself. As a result, netizen were continuously supporting and the major media were following up the report. As the largest Internet search engine company in China, Baidu has fallen into a serious brand crisis. From the crisis response, following problems in Baidu's coping style exist:

a. The response was not in time and thus lost the best time to cope with the crisis. Baidu responded to the public for the first time on April 28th,2016, half a month after Wei's death. In the statement, Baidu said that Wei Zexi's family had been consoled, and that the The Second Hospital of Beijing Armed Force was a fully- qualified public first-class hospital. Supervision of all parties was welcomed. However, this statement has already missed the golden time of crisis public relations. The event has been continuously fermented on the Internet, and public opinion has long been formed. According to the "primacy effect" of public psychology, Baidu has missed the best time to save the situation.

b. Evading responsibility and thus missing the opportunity to rebuild its image. Although Baidu issued a statement, it is not difficult to see that Baidu is in fact shirking responsibility and pushing the responsibility of Wei's departure to the hospital, which violates the crisis public relations principle of taking responsibility bravely. As a result, the more Baidu wants to clarify itself and leave it behind, the worse it is. Subsequently, Baidu's massive deletion of Posts and titles led to further deterioration of the event. The angry netizen set off second waves of public opinion against Baidu.

(2) Crisis Management of “Torts of Wang Yi Yan Xuan”

On the night of May 23rd, 2017, a passage,To Ding Lei: Can You Give an Entrepreneur A Way?, was released in a wechat official account “Zui Shenghuo Maojin”. It is from Zhu Jun, a post-80s entrepreneur who calls himself "towel elder brother". The passage was read by more than 100000 people in a short time. On May 24th, Wang Yi Yan Xuan post a passage,"I Have An Entrepreneur's Story. Do You Want to Hear It?", in its own wechat official account Wang Yi Yan Xuan Subscription in response. The use of "towel brother’s" storytelling technique clearly pointed out the loopholes and false of the passage from“towel brother”. And the passage reasonably showed that their own e-commerce platform did not violate the law. This is a timely solution to solve the enterprise crisis. The way it defuses the crisis is shown as below:

a. Use new media platform to fight back instead of normal methods. The issue of "towel brother’s passage is actually a borrowing effect. In the public relations, the most common is the small broad scolding war. In the Internet age, the access of information communication is lower, and thus small companies usually use this kind of way to borrow the potential to make the "negative image" of large companies, which often gets good results. When a big company meets such a curse, its usual choice is not to respond. If it is necessary to respond, it will be a very short official reply. Wang Yi Yan Xuan did not follow the conventional way but applied the new media platform to respond quickly. The article first shows that "towel brother" has a tortuous "not glorious history" in his early period, and then pointed out that there is a logical loophole in his paper, which is containing contradictory components. Finally, it is pointed out that "towel brother’s accusation that Wang Yi Yan Xuan’s “selling towels especially for G20” is illegal is wrong. On the relevant website of Wang Yi Yan Xuan, the statement of "the same type of especially for G20" is consistent with the fact and does not cause infringement on other brands. It is such an article that, in a short time, the amount of reading has also broken through more than 100000. A lot of praise was harvested in the forwarding of wechat.

b. Mastering the essence of public relations and communicating sincerely. Wang Yi Yan Xuan used the same kind of storytelling technique with vivid words and positive attitude, which shapes a responsible enterprise image. The expressions are consistent with the reading habits of the new media platform. In fact, the audience is more likely to have a public communication with the enterprises with temperature and its own characteristics, even if with some flaws. Because such communication may be closer to the truth and itself, so it has been recognized by the public.

c. Combining with other methods to divert attention of netizen. After the response in new media platform, Wang Yi Yan Xuan did not continue their conflict with “towel brother”, which avoid the fermentation. Instead, Wang Yi Yan Xuan carried out the towel promotion with the help of the heat in its e-commerce platform. And as a result, this type of towel was sold out of stock in a short time. Meanwhile, Wang Yi Cloud Music posted the song Wang Yi Yan Xuan Giving Money Back, which was full of humorous ridicule and got increasing amount of playing and comment. The combination of Wang Yi Group managed to divert the attention of netizen to diffuse the crisis and at the same time increase the profit.

3. RESULT ANALYSIS

By analyzing and comparing the two typical cases, it can be easily seen that new media era bring not only challenges but also opportunities to enterprises. Technology is a "double-edged sword" and the person who uses it will be empowered. If any individual or organizations such as government, enterprise or the public can attach importance to the use of technology, it will give himself an advantage in competition. According to the new characteristics of crisis public relations in the new media era, the following strategies for crisis public relations are put forward.

First, timely response: respond intermediately. In the related research of crisis management, FHL company has put forward the "golden rule", which points out that enterprises should responding to problems firstly when they face a crisis. It is best to be the first time. With the rise of the new media platform, the appearance to the outbreak of crisis can be short as few hours. When one thing enters the public view, it will pass through a brief process of development before the growing public opinion fermentation. In this period, because of the asymmetry of information, it is also an important period of rumour breeding. Generally speaking, the response within 24 hours can minimize the negative impact of Internet rumors on enterprises. However, some enterprises do not pay attention to the negative comments on the Internet, or the enterprise manager thinks that an ant is not able to shake the tree and ignore the problems. But they will normally regret when the large public opinion is difficult to control.

Second, reciprocal communication: make full use of the new media platform. In the Internet era, new media platform has become the main battle field for the formation of enterprise brand crisis and crisis public relations. Therefore, it is of great significance for enterprises to own and operate their new media platforms. The official account of the new media platform can't be the nominal. It is necessary to shape a good enterprise image in daily operation, and improve the influence of the official account and increase its fans number at the same time. On the new media platform, enterprises should pay more attention to the interaction with fans so that the fans may feel friendly and thus improve the fans' participation and viscosity. By this method, enterprises can respond to the official new media platform in time when crisis appear and achieve better communication results. In the process of crisis management, the contradiction between enterprises and media should be well handled. Some enterprises assume that media should take the responsibility of the crisis, and regard the media as a "flood beast". This attitude is not conducive to the solution of the problem, but will aggravate the contradiction between the enterprise and the media, causing much more serious consequences. In the new media era, enterprises should properly handle the relationship with the new media. When crisis arise, they should make their own voice through the media force, communicate with the public equally, listen and communicate with each other, and pardon multiple voices.

Third, emotional resonance: find opportunities in the crisis. When facing public relation crisis, enterprises cannot take themselves as the opposite of netizen, but to find the "common sense space" with them, which is to find the common point between the enterprise and the netizen in values, emotions and demands. This is the basis for dialogue between the two sides rather than "war of words". At this level, as an enterprise, it should acutely capture the consensual space between the netizen and the enterprise. On this basis, enterprises should reflect the humanistic care as much as possible and respond with warmth, attitude, and the true feelings, so as to maximize the understanding and support of the netizen. While the excessive use of the official language will give the audience psychological antipathy.

Fourth, attention shift: set the agenda and distract focus. Traditional media will guide the order and key point of readers by setting up topics actively. In the new media era, the function of agenda setting has been strengthened, and netizen’s attention has been shifted more rapidly. The subject of agenda setting also extends from the original media to enterprises or even individuals. Therefore, when dealing with crisis, enterprises can give full play to their initiative and actively set up new agenda to distract netizen’s attention from the negative information. Generally speaking, people’s attention will be transferred to another event with higher attention, and then the crisis

of the former enterprise will be desalinated.

4. CONCLUSION

The rapid development of new media brings many new characteristics to the public relations crisis that enterprises are facing. It is embodied in the following aspects:

Firstly, the source of crisis is everywhere. In the traditional media era, the media report attaches great importance to the authenticity of news. A piece of news needs to be strictly interviewed, verified, edited, reviewed before release so as to ensure the authenticity of news. While in the new media age, anyone can register accounts and publish information on micro-blog or WeChat. This process does not require anyone to check. So anyone can trigger a crisis. According to The Public Opinion Analysis Report in the first half of 2017 from Public Opinion Monitoring Room of People's Net, from the outbreak to spread of public opinion, micro-blog, WeChat, Zhihu and other social media are still important information sources of public opinion and the key channel of public opinion fermentation. Social media has discussed hot issues such as emergencies, social livelihood and environmental protection, and many hot events have been spread out in the form of "billion".(Public Opinion Monitoring Room of People's Net, 2017)

Secondly, the outbreak of crisis is speeding up. In the new media era, information dissemination has a strong timeliness, which accelerates the speed of exposing of enterprise crisis. On the one hand, the negative news on the new media platform is often more attractive to the public than the positive information. Therefore, the negative news of enterprises is often more likely to cause the Internet users to pay attention to and spread. On the other hand, some WeChat public or micro-blog users attract fans by releasing sensational untrue information at the beginning of the business crisis or to incite popular sentiment which boosts the crisis. To a certain extent, it will greatly shorten the responding time of enterprises to deal with crisis and puts forward higher requirements for crisis handling capability.

Thirdly, the impact of the crisis is wider. Due to the limitation of time and space, the scope of dissemination of traditional media has certain limit, and the readership of that is relatively stable.

While in the new media era, technological progress enables information to reach any corner of the world in the shortest possible time. Information transmission is no longer limited by time and space. Enterprise crisis information can be spread all over the world through micro-blog, WeChat and so on, which makes the impact wider. And the new media users are scattered, mixed. They have different backgrounds, but are interested in the same information on the network platform to carry out information dissemination. The coverage of such a communication network is larger and wider than before.

Lastly, the crisis is more destructive. In the new media era, events of enterprise crisis has the characteristics of high frequency, fast propagation speed, wide range of influence.While the enterprise responding time is short and the control difficulty is great, which enhance the destructiveness of enterprise crisis. On the other hand, on the new media platform, the formation, development and extinction of public opinion are complex, which makes it difficult for the enterprise to conduct effective public opinion guidance in crisis public relations. Using wrong measurement, many companies get negative effects when facing crisis public relations, which causes Internet users to denounce and condemn again. For example, in the "Wei Zexi" incident, Baidu issued a statement after half a month, which led to the further deterioration of the incident. The angry netizen set off second waves of public opinion against Baidu.

Therefore, crisis public relations faced by the enterprise possess many new characteristics. After the emergence of crisis public relations, with the rapid spread of news in the new media era and the slow response of the enterprise itself, the public opinion of this kind of event will be brought to an unknowable direction. At this level, it is of great significance for enterprise to make a timely, effective and continuous public opinion guidance. At the same time, I find that in the previous research, many theories and models do not fully adapt to the characteristics of the new media era, thus I will pay more attention to this kind of event, and try to improve the model of the predecessors, and expect to help enterprises to deal with the crisis public relations with the overall solution, and thus have a coping strategy for such events.

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Moral Education and Law-related Education: the Best Choice of Chinese Social Governance

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Abstract: Since the reform and opening up, severe social pathological phenomena appeared in Chinese society, characterized by serious lack of business credibility in economic field, serious official corruption in political field and serious moral anomie ideological field. To solve pathological phenomenon in Chinese society, it is essential to seek the way of fundamental governance. The best choice of Chinese social governance is the close combination of moral education and law-related education. Through moral education and law-related education, the goal of business integrity, corruption punishment and good morals establishment will be achieved.
Keywords: social symptom, moral education, law-related education, social governance

1. INTRODUCTION

A good social order is the premise for people's healthy and joyful development. Honesty, justice, rule of law, morality and so on are the basic requirements of a good social order. Since the reform and opening up, Chinese society has entered a period of rapid development, but also entered a period of rapid social transformation. There are a series of social problems in this period, and various social morbid phenomena appear gradually. Various social pathological phenomena have greatly damaged the healthy operation of China's social order. By analyzing the main manifestations and the major solutions of the social pathological phenomena in China as basis, a reasonable suggestion of social governance in China is proposed, which will help to build a harmonious social order.

The academics put forward two views to solve these social morbid phenomena:

The first view is that social pathological phenomena are mainly caused by excessive marketization, so we should prevent excessive marketization. This view holds that Excessive marketization has led to the growing division of social poverty and wealth. On the one hand, capital owners accumulate wealth. On the other hand, working class accumulate poverty. To solve these problems, the government should carry out the planned economy in larger and more field, and even the planned economy should be restored.

The other is that the primary cause of social morbid phenomena is the lack of rule of law. Therefore, we must strengthen the establishment of rule of law. This view holds that if the public power held by officials is out of control, it will seriously damage the legitimate rights and interests of citizens and affect social harmony and stability. Once the rule of law is destroyed, power will be abused, and the abuse of power will seriously infringe upon personal property rights and freedoms and rights of the people. Therefore, we must govern the country with law, strengthen the law-related education, and restrict the power by law.

The third idea is that the root cause of social morbid phenomenon is moral anomie, so it should be solved by strengthening morality. This view, Chinese traditional social moral values, and the new social morality has not yet fully formed, and integrity is a principle of people for moral, ethical value of a firm commitment. It is the need of social order governance to guide and regulate people's social behavior through the moral values and moral codes that people identify with.

In fact, the establishment of business integrity, punishment of corruption and the formation of good morals can not be solved by only one means. The close combination of moral education and law-related education is the best choice to solve the pathological phenomenon in Chinese society.

Therefore, this study indicates that the main manifestations of social morbid phenomena in China are lack of business integrity, serious corruption and moral anomie, and points out the serious harm of these pathological phenomena. This study summarizes the main views of Chinese academia on solving these pathological phenomena, analyzes the major basis of each view, and points out the unreasonableness of them. It also suggests that the combination of moral education and law-related education is the best choice to solve the phenomenon of Chinese social morbid conditions, which will help to establish business integrity, punish corruption, and form a good moral trend.

2. RESEARCHING METHOD

In order to improve social governance, the following aspects are studied through literature analysis, logical analysis and inductive analysis.

Firstly, it is to point out what social pathological phenomena exactly is in China.

Through literature analysis, there are three kinds of pathological phenomena in Chinese society:

There is a serious lack of business integrity in economic activities. Business integrity is an important part of the social credit system and an important foundation for the healthy development of the market economy. In the development of market economy, business integrity is seriously missing in China. In August 10, 2017, the Chinese Consumer Association issued An Analysis of the Cases of Complaints Of National Consumer Association in the First Half of 2017, which showed that 285992 consumer complaints were accepted by the National Consumer Association in the first half of 2017. Typical examples are: there are many pitfalls for elderly people; the problem of health consumption is serious; and the problem of food and drug safety is outstanding. The serious lack of business integrity not only hinders the healthy development of China's economy, but also destroys the whole social credit system, and makes the whole society lack of basic integrity.

Government officials corruption is fearful. Svensson points out that corruption is the abuse of public positions for personal gain (Svensson, 2005). Rose Ackerman indicates that corruption hinders investment and economic growth, and developing countries are particularly at risk. (Rose Ackerman, 1999). Official corruption has corrupted the whole social atmosphere, lost the people's heart, reduced the social credibility of the government, and weakened the ruling foundation of the Communist Party of China. In order to establish a good political ecological environment and make government truly for the people, since the eighteenth National Congress of the Communist Party of China, the Communist Party of China and the Chinese government have carried out a series of measures to punish corruption severely, which help restrain the corruption of officials , but it is still very prominent. According to the Corruption Perceptions Index in 2016 issued by "Transparency International", China and the other three countries ranked seventy-ninth in 2016.

TABLE I.

The National Summary of Violating the Spirit of the Eight Provisions of the Central Committee (since 2017, by July 31st)

Content	Item	Totality	Type								
			Violation of public funds for eating and drinking	Public fund for national traveling	Public fund for international traveling	Violations of equipping with and using public vehicles	Violations of buildings	Violations of releasing subsidies or bonus	Violations of receiving presents and gifts	Wedding and funeral celebrations	Others
Since 2017	problems	25106	3023	1195	95	5153	830	5729	4532	2956	1593
	violators	35399	4942	2117	161	6534	971	8942	5673	3476	2583
	Punishment of party and government	24364	3536	1537	127	3430	524	6571	4491	2633	1515
Remarks	"Other" issues include: providing or accepting super standard reception, accepting or using public funds to participate in high consumption recreational and fitness activities, illegal entering and exiting private clubs, and the housing violations of leading cadres.										
Data source: Party and Political Discipline Supervision Room of Central Commission for Discipline.											

From the data above, we can see that: first, anti-corruption efforts and punishment of violations is strengthened at present. Second, the current situation of frequent corruption of Chinese officials is still not completely contained, corruption are still very serious, and the task of anti-corruption is still very difficult.

Moral anomie is serious in the field of ideology. Any unified and stable society must have a correct moral concept to support it. China has always emphasized the role of morality in the governance of social order. However, since the reform and opening up, the traditional moral system has been impacted by various wrong ideas, which has led to the moral anomie of some members of the society, which is mainly manifested as: the lack of public moral consciousness, such as making loud noise in public places, crossing the street when red lights are on, and so on; weak professional ethics, such as the fraudulent management and administration in the economic field, unfairness in the political field, abusing students in educational field etc. What is worst is that when some people violate the morality, they do not feel guilty, and even openly show off. These moral anomie problems have seriously damaged the social atmosphere and destroyed the health and stability of the whole society.

Second is to analyze several viewpoints of solving the pathological phenomenon in Chinese society and point out the deficiency of these views. By logical analysis, it can be found that each view has its shortcomings.

Deficiency exists in the first viewpoint. If people assume that excessive marketization cause people’s working only for interest and lack of integrity and then oppose the market economic system and opposing the market economy system is to return to

the planned economy era, it is clearly not the true choice of economic development in China. It is bound to conflict with the new idea that "makes the market play a decisive role in the allocation of resources", and deviate from the theoretical development and practical performance. In theory, the market economy and planned economy are both economic means of resource allocation and play important regulatory role. In practice, the market economy is true. It has greatly aroused people's enthusiasm and initiative, and has made great contribution to China's economy.

Deficiency also exists in the second viewpoint. The rule of law is to create and play a role in a top-down way, and that can only be restricted to the external behavior of people, but not to control the inner thoughts of people. Therefore, the rule of law requires people's external behavior to conform to the existing legal norms, but can not force people's inner obedience to legal norms. In fact, human behavior is determined by human thought. Obviously, only by paying attention to the rule of law can not help solve the social morbid phenomenon completely, and can not make the whole social order run orderly.

Deficiency also exists in the third viewpoint. The rule of virtue is to influence people's behavior from interior to exterior, so as to adjust and restrain people's behavior. But the moral that comes from heart and observation without external specification, at the same time, the formation of the code of ethics and the operation of the moral order still need to confirm and maintain with some certain external specification, to form the moral order in line with the ruling class need, that is to say, virtue is dependent on the rule of law.

Finally, at the basis of the analysis of the three academic solutions, it is to find measurements which are conforming to the national conditions of China.

By summary analysis, we can find the measurements that are conforming to the national conditions of China.To solve the pathological condition in Chinese society and improve the social governing order in China, it is necessary to find a basic plan for social governance. Therefore, we must take the social pathological phenomenon as the object of management, and take the strategy of China's national and social governance as the basis, so as to find the way of governing the Chinese social order. This fundamental governance should be achieved through moral education and law-related education, so as to realize the close combination of rule by virtue and rule by law.

3. RESULT ANALYSIS

The social pathological phenomenon in Chinese society has greatly destroyed the healthy operation of the Chinese social order, and it is necessary to strengthen moral education and law-related education in order to control the pathological phenomenon in China. The moral education and law-related education can achieve business integrity and promote the healthy and orderly development of the market economy, condemn and punish corruption, create a good political ecology, make everyone moral and establish a good moral fashion. In this way, the good governance of the society can be realized.

On the basis of the analysis of Chinese social morbid phenomena, the academia put forward three schemes to govern the pathological phenomenon and this study proposes that the combination of moral education and law-related education is helpful to realize social governance and the organic combination of self-discipline and heteronomy, which is more reasonable and scientific than the three schemes in academia. As the main pathological phenomena in Chinese society are the lack of business integrity, corruption of government officials, and moral anomie, so the solution to these sick social phenomena must be needed to solve the above three kinds of pathological phenomena at the same time. While the three kinds of solutions in the academic community can not fundamentally solve the social morbid phenomenon. For example, the first view is that the social morbid phenomenon is mainly caused by over-marketization, so the government should carry out the planned economy in larger and more field, and even think that the planned economy should be restored. This view is obviously against the development of China's productive forces and violates China's basic national conditions. The second view assumes that the root cause of social morbid phenomena is the lack of rule of law. Therefore, we must strengthen the rule of law. This view does not allow people to consciously identify with the law and obey the law. The third view is moral anomie is the root of pathological phenomenon in Chinese society. Therefore, moral construction must be strengthened. However, without the restriction of external laws, moral norms can not be recognized and respected by people. It is put forward that moral education and law-related education are combined to achieve social governance. Fundamentally, it is to improve both the moral quality and legal quality of people, and make everyone abide by the rules of moral norms and legal system, thus ensuring the healthy operation of the social order.

4. CONCLUSION

Chinese social pathological phenomena reflect that the moral quality and the quality of the rule of law are not high, and both of them can be improved by the combination of moral education and law-related education Therefore, the close combination of moral education and law-related education is the best choice for Chinese social governance.

First is to achieve business integrity through moral education and law-related education.

Business integrity needs moral education. Morality plays an advanced role in a positive way. On the one hand, morality can avoid the excessive cruelty of competitive means in the market economy, and avoid

the excessive pursuit of personal and partial interests. On the other hand, morality contributes to the formation of business integrity. Market economy is not only a rule of law economy, but also a credit economy. If all the main body that participating in the market economy activities own integrity, it will reduce disputes, fraud and lawsuits.

Business integrity also needs the rule of law education. Only through the rule of law education can people realize the importance of the rule of law for business integrity. Marx pointed out: "the relationship of law is just as the form of state, neither from their own understanding,nor from the so-called human spirit to understand the general development, on the contrary, they are rooted in material life." (Marx, 1979)This shows that the principle of law is the legal manifestation of economic relations, and economic relations are the basis for the existence of law principles. While promoting economic development and social progress, the market economy also has some negative influences, such as: the first one is induces the ugly phenomenon that harm others to benefit oneself. The second one is money worship, which leads to money is everything. The third one is to cause the interests of the main body to cheat, swindle and swindle for economic benefit, and even the risk. Therefore, in order to overcome the disadvantages of market economy, we must promote the construction of business integrity through law education.

Second is to punish corruption through moral education and law-related education. Human greed and selfish nature lead to abuse of public power and then corruption. As president James Madison said in the speech of *Mortal and Angel*, "any government is built by people, not by angels, and not governed by angels. Angels are impartial and rational, while human beings are selfish and political animals. Human nature is characterized by depravity, selfishness, greed and conceit, and is keen to use the power of the government to expand the private interests. (Garrett Ward Sheldon, 2001)

Corruption punishment needs the help of moral education. Morality can curb greed and evil thoughts, and make all kinds of evil thoughts constantly condemned by conscience. The moral trend of society depends on the official style. Therefore, the rule of virtue is to make officials have official virtue. Xi Jinping once pointed out: "in the long river of history, the collapse of those empires, the destruction of the dynasties, and the downfall of the ruling party are normally related to the rulers'not setting moral norms, not learning morality and not following morality, and also caused by the rulers'negative behavior,prevalence of corruption and loss of people's heart " (Xi Jinping, 2007). Therefore, in order to make the society clean and upright, we must grasp the key minority of leading cadres and strengthen the morality and conduct of officials.

Corruption punishment also needs the help of law-related education. Through law-related education, people can aware that the rule of law is sharp sword to punish corruption, and the rule of law is to govern power and officials by law. Those countries and areas that are incorruptible all have strict rule of law. For example, according to *2016 Corruption Perceptions Index,* Denmark ranked first.

Third is to establish good morals through moral education and law-related education. Morality has a lasting influence on social order. Good morality is the inherent requirement to cure social morbid phenomena.

To set up a good moral fashion needs moral education. Good social order needs high moral ethics and cultural spirit to support. First of all, we should give full play to the exemplary role of moral models and stimulate the positive energy of society. Xu Jingyue and Sui Xiaofei put forward: "moral model is an important flag of social moral construction." (Xu Jingyue, Sui Xiaofei, 2013)It is to combine the typical advanced nature with the universality, and to guide the social customs through the moral model of the emotional deeds; secondly, it is to propagate the excellent moral norms of Chinese traditional culture. Han Zhenfeng indicates: "for the historic culture, especially values and moral norms inherited by the ancestors, we must persist in making the past serve the present and bring forth the new to the old". (Han Zhenfeng, 2014)

It also requires the rule of law education to establish good morals. The rule of law education is a reliable guarantee for moral construction. The application of the rule of law to solve the outstanding problems in the moral field requires the followings: The legislation should be strengthened and improved, and the disciplinary measures should be clearly defined in violation of moral behavior. Increase the intensity of strict law enforcement, and let the violation of moral behavior be punished and pay the price; The promotion of moral principles and the requirements of legalization make it a code of conduct and fundamental principles for social members to observe. In a word, only when the close combination of moral education and law-related education is realized can help to improve people's moral quality and law-related quality and solve the social pathological phenomena problems in China. Therefore, the close combination of moral education and law-related education is the best choice for Chinese social governance.

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An Empirical Analysis of Government Procurement to Promote Independent Innovation of Enterprises

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Abstract: This passage uses empirical analysis to study the positive relationship between government procurement and independent innovation of enterprises. It draws a conclusion that the incentive effect of government procurement is more significant than that of the research and development personnel for the effective number of large and medium-sized enterprises. And after that are some suggestions on the problem.
Keywords: Government Procurement; Independent Innovation of Enterprises; Empirical Analysis

1. INTRODUCTION

Independent innovation of enterprises is an important engine to promote national economic and social development. At the same time, government procurement plays a role in starting new market and sharing risk of enterprises innovation that the perfectly competitive market cannot replace. As every link in the process of innovation is full of risk, only a few enterprises can persist in achieving successful innovation after the break even point. In particular, small and medium-sized enterprises with the most innovative driving force in the market are difficult to go through the various risks that exist in the process of innovation. Thus government procurement can provide strong support for potential new products and new technologies to achieve a "breathtaking leap" and increase the chances of successful innovation for enterprises.

2. DEFINITION AND CONTEMPORARY MEANING OF INDEPENDENT INNOVATION OF ENTERPRISES

(1) Definition of Independent Innovation

Innovation involves every fields of social life, including theoretical innovation, scientific and technological innovation, cultural innovation, institutional innovation and other aspects of innovation. Innovation, in this article, mainly refers to the creative activities in the field of science and technology. There are three aspects: first is the original innovation, which is aiming at attaining scientific discoveries and technological inventions. Second is integrated innovation, which is integrating various related technologies into new products and new industries. And the third is to import and absorb and then innovate. Independent innovation is a process that realizing the value of new products on the basis of owning independent intellectual property rights of the unique core technology.

(2) Definition of Independent Innovation of Enterprises

Enterprises are the main party in both marketing competition and technology innovation. In order to improve the independent innovation ability, enterprises are the key points. Independent innovation of enterprises refers to speeding up the construction of the marketing oriented technology innovation system where enterprises are the main body and production, learning and research are all in one. More innovative enterprises with independent intellectual property rights and strong competitiveness should be cultivated to be the real main body of research and development, technological innovation and the application of scientific and technological achievements.

(3) Significance of Independent Innovation of Enterprises in New Era

Since the reform and opening up, China's economy has achieved a sustained and rapid development, and its comprehensive strength has been greatly enhanced. However, the main way to achieve those is extensive, and economic and technical content is quite low, especially the content of independent intellectual property rights. In fact, although the initial cost of independent innovation is relatively high, it avoids the high cost of importing technology and the need to transfer most of the profits to the foreign party after production. In the long run, independent innovation is of great significance to the formation and sustainable development of the core competitiveness of enterprises. Only by research and development investment and independent innovation can enterprises truly grasp their own destiny of development. From a higher level, the independent innovation, though high in cost, is related to the economic development of the country.

3. THE RELATIONSHIP BETWEEN INDEPENDENT INNOVATION OF ENTERPRISES AND GOVERNMENT PROCUREMENT

(1) Needs of Support and Help from Government to Independent Innovation of Enterprises

The independent innovation of enterprises should make a good "business card" and it needs the support of national policy. The huge market resources should

become the strategic resources of independent innovation. Government should make good use of this resource and mike it the booster of independent innovation of enterprises. At the national science and technology conference held in early 2006, China proposed to construct an innovative country for the first time, and formulated The Outline of The National Medium and Long Term Science and Technology Development Plan. And after that, the relevant ministries and commissions issued a large number of supporting policies and implementation methods. Government's support and guide are very crucial in promoting independent innovation.

(2) Protecting and Promoting Independent Innovation of Enterprises with Government Procurement

The function that government procurement can promote independent innovation is decided by the essence of government procurement. As a typical "public procurement", government procurement takes government as the main body and meets the social public need. "As a mode of public procurement, government procurement is responsible for encouraging the development of independent innovation from the perspective of public interest through preferential, favorable and compulsive procurement of independent innovation and products and services with independent intellectual property rights." Government procurement can stimulate independent innovation and promote the development of independent intellectual property products.

4. THE MECHANISM OF GOVERNMENT PROCUREMENT TO PROMOTE THE TECHNOLOGICAL INNOVATION OF ENTERPRISES

Government procurement can not only help enterprises to solve the problems of capital, risk and ability from the inside, which provides a very good supporting environment for the enterprise to carry out the initial innovation and has a great effect on the start-up and continuous innovation of the enterprise. Moreover, the commercial application of enterprise innovation products cannot be separated from the help of the government procurement policy. It is because of market demand that enterprises have the power to carry out technological innovation. How to transform technological innovation achievements into profits is the primary factor for technological innovation of enterprises. The government procurement to the innovative achievements of enterprises, on the one hand, enables enterprises to commercialize their innovative achievements and achieve business benefits. On the other hand, it is also a driving force for enlarging the scale of production and promoting innovation and re innovation.

(1) The Internal Driving Effect of Government Procurement on Enterprises

Government procurement is an important driving force to influence the technological innovation of the internal elements of an enterprise. First is the element of capital. The government can give a part of the purchase funds in advance as the start-up capital for the enterprise to carry out the innovation activities. Meanwhile, with the credit of government as the guarantee, enterprises can finance from banks and other financing institutions to ensure the funds needed for technological innovation. With the capital accumulation from the initial innovation, enterprises can expand production scale, promote innovative products, and carry out more extensive innovation. Second is the risk. Many enterprises have failed to carry out technological innovation because of the great risk. According to the statistics of the innovation activities in many countries from the relevant research institutions, the number of innovation output of enterprises that can eventually going into market is less than 10% of the total innovative products, not to say innovative products that can take a large share in the market is less. A lot of innovation activities will be stopped before completing. This shows that innovation is having great risk. Through government procurement, the enthusiasm of enterprises in technological innovation activities can be stimulated, and simultaneously, with government organization as a market buyer, the early entry of enterprise innovation will not be aborted. The last is the ability. Government puts forward specific requirements for the products in terms of technology and appearance through the products procurement from enterprises, which objectively influences the direction of enterprise innovation activities. At the same time, through supervision and management of the output of enterprise research and development activities, the competitiveness of enterprises and technological innovation ability can be improved.

(2) Government procurement Affecting Enterprise through the External Pull of the Society

Firstly, government has a leading effect on enterprises. If government preferentially purchases products with independent intellectual property rights, it will create a good atmosphere for technological innovation in the whole society, and encourage entrepreneurs to participate in technological innovation activities. Additionally, market demand push the innovation forward. Government procurement is bound to occupy a certain market share. If the government procurement's influence is large enough, then the other main body of society will also want to know about the content and form of the purchasing products. As a result, government procurement objectively promote the products and there will be more social subjects to join the ranks of the procurement, which plays an important role in promoting the successful commercialization of technological innovation product. Lars but not least, industry competition can also promote technology innovation. Government procurement can also promote the optimization of industrial structure. Through the purchasing of industrial technological innovation products,

government procurement can get more social resources into the industry so that the technology innovation in the industry is more likely to succeed and the output is more competitive in the market.

5. MODEL CONSTRUCTION

This paper will examine the incentive effect of government procurement on the scientific and technological innovation ability of large and medium-sized enterprises in China from the macro economic level. Government procurement is a direct support for the government's investment in scientific and technological innovation, and is also one of the important means to regulate the economy. In the process of government procurement, the government's investment expectation is to improve the scientific and technological ability of the enterprise, thus promoting the development of the society and economy. So the independent variable in this paper is the total size of government procurement, which is represented by GP. While the dependent variable is the ability of technological innovation. The research and development personnel and effective patent number are the two index to represent the science and technology innovation ability of China's large and medium sized enterprises. The model is established as follows:

The equations are established respectively:

$Y_1 = A \cdot GP^{\alpha}$ (1) and $Y_2 = A \cdot GP^{\beta}$ (2)

The natural number are taken simultaneously on both sides of the equation, and get : $\ln Y_1 = \ln A + \alpha \ln GP$ and $\ln Y_2 = \ln A + \beta \ln GP$. In which GP represents the scale of government procurement (Billion Yuan), Y_1 represents the research and development personnel, and Y_2 is effective patent number. In macroeconomic research, the two index research and development personnel and effective patent number has been widely used in measuring innovation ability of science and technology.

In the equation, αand βindicates the increase of LnY_1 and LnY_2 when LnGP is added per unit. Therefore the impact of the scale of government procurement on the number of research and development personnel and the number of patent inventions can be quantified, and the greater the coefficient value, the greater the impact. In this paper, the data of China from 2006 to 2015 years are selected and analyzed.

Table 1 The government procurement scale, research and development personnel and effective patent number from 2006 to 2015 in China

Year	GP (Government Procurement Scale) Billion Yuan	Y1 Research and Development Personnel (Size of Large and Medium-sized Industrial	Y2 Effective Patent Number(Size of Large and Medium-sized Industrial
2006	3681．6	18.9	8141
2007	4000	24.82	13386
2008	5990.9	28.51	23915
2009	7413.2	32	31830
2010	8422	39.9	50166
2011	11300	42.67	67428
2012	13977.7	52.6	97878
2013	16381.1	55.9	115884
2014	17305.34	57.3	147927
2015	21070.5	59	199728

Data sources: The Statistics Annals of the Chinese Government Procurement, The Annals of Chinese Science and Technology Statistics, The National Statistics Bureau of People's Republic of China and the National Database.

According to the data in the table, we use EViews software to analyze the linear relationship between GP and Y_1. The results are as follows

Dependent Variable:Y Method: Least Squares Date: 01/06/18 Time:19:03 Sample: 2006 2005 Included observations:10				
Variable	Coefficent	Std. Error	t-Statistic	Prob.
C	15.23665	2.538754	6.001627	0.0003
X	0.002367	0.000206	11.51572	0.0000
R-squared	0.943106	Mean dependent var		41.16000
Adjusted R-squared	0.935994	S.D.dependent var		14.67123
S.E.of regression	3.711736	Akaike info criterion		5.637733
Sum squared resid	110.2158	Schwarz criterion		5.698250
Log likelihood	-26.18866	Hannan-Quinn criter		5.571346
F-statistic	132.6118	Durbin-Watson stat		1.321856
Prob(F-statistic)	0.000003			

According to the result LnY_1=LnA+ aLnGP and LnY_1=15.23665+0.002367LnGP, it can be seen that the government procurement scale has a positive relation with research and development personnel. The increase of government procurement has a positive effect on the growth of the research and development personnel of large and medium-sized enterprises. When LnGP is added per unit, the LnY1 increases 0.002367 units.

According to the data in the table, we use EViews software to analyze the linear relationship between GP and Y_2. The results are as follows

Dependent Variable:Y Method: Least Squares Date:01/05/18 Time:00:01 Sample: 2006 2005 Included observations:10				
Variable	Coefficent	Std. Error	t-Statistic	Prob.
C	-38451.90	8016.077	-4.796848	0.0014
X	10.41426	0.648872	16.04978	0.0000
R-squared	0.969879	Mean dependent var		75628.30
Adjusted R-squared	0.966114	S.D.dependent var		63665.95
S.E.of regression	11719.75	Akaike info criterion		21.75279
Sum squared resid	1.10E+09	Schwarz criterion		21.81331
Log likelihood	-106.7640	Hannan-Quinn criter		21.68641
F-statistic	275.5953	Durbin-Watson stat		0.996749
Prob(F-statistic)	0.000000			

According to the analysis LnY2=LnA +βLnGP and LnY2=-38451.90+10.41426LnGP, it is believed that there is a positive relationship between the size of government procurement and the number of effective patents. The increase of government procurement has a positive effect on the growth of the number of effective patents in large and medium-sized enterprises. When LnGP is added per unit, LnY2 will increase by 10.41426 units.

From the above data analysis, there is a obvious correlation between government procurement and technological innovation in China, especially for the number of effective patents in large and medium-sized enterprises, and its incentive effect is more significant than that of research and development personnel.

Government procurement promotes scientific and technological innovation from the aspect of the market demand, so that it can lead the development direction of scientific and technological innovation more effectively. If the government procurement policy can be used to encourage enterprises to make progress in technological innovation and analyze the multiplier effect from the the model, it will greatly promote the national economic and social development.

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Based on the Creation of a Shared Express Package

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Abstract: Every commodity can not be separated from the packaging, such as promoting the sales of the internal packaging, logistics process of transport packaging. China has a large population and huge consumption of products. Therefore, the demand for packaging is also huge. At present, as is known to all, China's environmental pollution is more serious, and water pollution is the most serious. According to relevant research, the environment brought by the use of packaging is also quite serious, second only to water pollution, air pollution and pollution of marine lakes. It is already in fourth place. It can be seen that the dyeing of the environment cannot be ignored. This article analyzes the status quo of express parcels of modern logistics companies and proposes improvements. The courier companies can use new materials and technologies to create a shared courier box and establish a complete packaging recycling system.

Keywords: Packaging, Logistics, Express delivery, Recycling and reuse, Environmental protection

1. STATUS AND ANALYSIS OF LOGISTICS EXPRESS PARCELS

(1) Status of express parcels

The role of packaging in the transport sector is mainly to protect the safety of goods, facilitate transportation and improve transport efficiency. While the demand for express delivery is increasing, the demand for logistics express delivery is also increasing. On the one hand, it is quality of service, on the other hand, it is timeliness. The express packaging industry provides packaging for the packaging of goods in three points. However, in the process of online shopping, sellers added some additional packaging to make the goods more secure or advertise for their own stores. The packaging is called over-packing. In the past two years, the total number of courier shipments in China has been around 30 billion. If use the 1 meter long adhesive tape for each express delivery, the PVC (polyvinyl chloride) transparent tape used annually by the express delivery industry of our country will be able to circumnavigate the earth near the equator. Circle, these garbage will not be degraded in 100 years in the soil.[1] According to the survey, the current express delivery industry has three main components for parcel packaging: Packaging: The most important part of the packaging, generally corrugated paper, corrugated boxes, paper bags, waterproof bags, cartons and wooden boxes, including waterproof bags Carton is the most common.[2] Inner packaging: The role of collection and basic protection of the delivered items, usually the original packaging of the goods, plastic film, filler particles and polyethylene foam film. Waybill: The role is to indicate the relevant information of the delivery item, as well as the contract of carriage and the receipt of the receipt. Although the express delivery industry seems to have only three parts of the packaging package reasonable, the express parcels encountered in real life have been tied up. There are some problems that need to be recognized and solved urgently. Through the review of relevant materials and field visits and investigations, a lot of questions about the parcels in the modern express delivery industry have been collected. Among them, the excessive packaging of express parcels, the unreasonable use of express parcels after unpacking, and environmental pollution problems are particularly prominent.

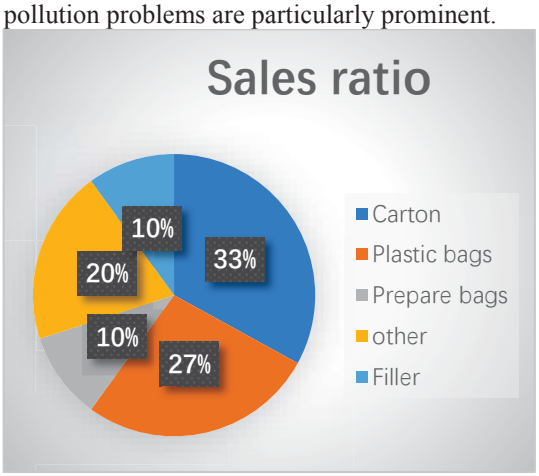

Figure 1 Courier Packaging Types and Proportions

(2) Problems

Through the analysis of the operation status of China's courier packaging in recent years, it is not difficult to find that there are many problems that urgently need to be solved in China's courier packaging, such as product failure caused by incomplete packaging; excessive packaging caused a lot of waste; packaging recycling system is not perfect, The recycling rate of packaging materials is low; Express packaging leads to leakage of personal information; Express packaging brand identity is not obvious; Courier packaging is difficult to open, easy to damage the body of goods; lack of uniform standards, excessive packaging specifications;

packaging costs are too high; some packaging leads to international disputes Wait.[3]

a. Damaged Products Due to Insufficient Packaging

The lack of courier packaging mainly means that there are some problems in the use of packaging materials or methods, and the lack of strength of the packaging does not fully protect the goods. At present, most of the express delivery companies in China express their employees with expressive packaging. In order to save packaging costs, some companies use simple packaging or improper packaging. In addition, most of China's express logistics are still inseparable from manual sorting and multiple transfer operations. According to relevant statistics, the turnover of online shopping products is usually not less than five times, resulting in the phenomenon of damage to goods in the express process. In the delivery of express mail, the random throwing of the dispatched members and the mutual extrusion of the express mails increased the risk of damage to the express mails caused by the lack of packaging.

b. Excessive waste caused by excessive packaging

In order to prevent items from being damaged during the entire express delivery process, many courier company infrequent members usually pack foam in some boxes, fill them with newspapers, wrap the products layer by layer, and wrap the tape in a circle. To deal with the rough handling that may occur in the delivery. The over-protection of the secondary packaging of items in the express delivery process not only wastes the packaging materials, but also wastes capacity to a certain extent, increases the burden of recycling, and pollutes the environment.[4] According to a survey, 11% of e-commerce companies in the survey sample indicated that packaging costs account for more than 5% of the value of the goods. For example, if a laptop computer worth 5,000 yuan is sold, the cost for secondary packaging may be 250 yuan. These unrealized costs and expenditures undoubtedly caused great waste, and at the same time greatly increased the burden on businesses and consumers.[5]

c. Incomplete packaging recycling system

Low recycling rate of packaging materials at present, China's express delivery companies and express delivery users are not enthusiastic about the recovery and utilization of express packages, and have not established a complete express package recycling network, resulting in most of the express packages cannot be truly recycled. The results obtained through analysis of the material flow analysis method show that, of the secondary packaging materials in China, only the recycling rate of paper packaging materials can reach 90%, while that of plastics is only 14%, and that of composite materials is only about 10%.[6] At present, China's courier packaging recycling system is not perfect, express packaging mainly rely on domestic garbage recycling system for recycling, that is, after the recipient receives the express mail, the packaging waste will be thrown into the garbage for recycling, this recycling model for general paper The quality of waste recycling can still be efficient, but it seems to be incapable of using specialized technologies for recycling. This is one of the main reasons for the low recycling rate of plastics and composite packaging materials.

d. Courier Packaging Opens Difficult

Easy to damage the body Because of the lack of uniform standards and operating practices, express delivery companies often only consider the protection of items when carrying out courier packaging, but lack human considerations. For example, for the packaging of apparel products, customers can easily scratch the inner package or even the product itself when unpacking the outer package, causing unnecessary trouble. To be on the safe side, some courier packaging even wraps layers of tape on the outer packaging. When the packaging is unpacked, it is necessary to use tools such as scissors and blades to open the packaging. This is very inconvenient.

e. Lack of uniform standards

Excessive packaging specifications without rules, not a radius, the current China's courier packaging is still lacking relevant standards. According to a survey of China's large-scale express e-commerce enterprises, when courier packaging, the express package of China's e-commerce companies does not operate according to a unified standard, but 48.4% of e-commerce companies determine the packaging materials according to the characteristics of the goods. In this way, 43% of e-commerce companies will seize their own, and another 6.5% of e-commerce companies choose to pack as much as possible. In addition, there is also a lack of corresponding standard packaging and filling for items with different characteristics. For some fragile items, the industry lacks a buffer material that can effectively protect the items and lacks a standard universal structural design. For valuables, there are also problems such as lax sealing of the packaging, easy deformation of the outer packaging, and no counterfeiting measures. For hazardous chemicals, especially those with toxic or inflammable and explosive properties, there is also a lack of uniform packaging container specifications and corresponding packaging materials. If a damaged leakage occurs during transportation, the problems caused are particularly serious. Due to the lack of a unified standard, the final specification of the express package in China is too complicated. Too many specifications of the packaging will not only increase the production cost of the packaging, but also greatly increase the possibility of damage to the packaging and the goods in the transportation process, and may also increase the logistics costs.

2. BASED ON THE CREATION OF A SHARED EXPRESS PACKAGE

(1) Product Description

Figure 2 Graphical model

This is a new type of express delivery box that can be recycled. The shape is shown in the figure above. Its outer shell is made of environmentally-friendly PP plastic and has an inflatable cushion made of TPU material. This new type of express box is similar in shape to a storage box. When it is not opened, it is like a rectangular plastic plate. After opening, just place the airbag in the courier box and put the items that need to be delivered into the courier box. Then use the constant pressure inflatable equipment. The airbag is inflated so that the airbag and the article fit well and the lid is closed. An express item is packaged. The airbag realizes constant-pressure inflation under the assistance of the constant-pressure charge suction device, so that the airbag can fully fit with the commodity, achieve the best buffer effect, and better protect the goods from being damaged during transportation. The key is that the recyclable inflatable coffer box can be recycled for 5-8 years, which greatly reduces the low circulation rate and serious pollution problems of traditional courier packaging such as cartons, foam fillings, and adhesive tapes.

(2) Solving Problems

a. This new type of express package is made of environmentally-friendly PP plastic and has an inflatable cushion made of TPU. Under the full cushioning and protection of the vacuum cushion, the items placed inside the box are not easily damaged. No matter whether it is dropped from a height or subjected to a huge impact force, it will not change its appearance, and it can also effectively prevent the items in the courier. Damage from collisions when unloading boxes from trucks solves the threat of items being damaged.

b. This new type of express package box is simple and lightweight, which can greatly reduce the current use of packaging materials such as plastic bags, tapes, and foam fillers in express delivery and the burden of packaging waste on the environment. It is understood that the express delivery industry is traditional The disposable corrugated boxes consumed as many as 46 Xiaoxing'anling trees. Using such boxes can achieve energy-saving, emission reduction and environmental protection.

c. The packaging box can be uniformly configured with multiple specifications, which facilitates the unified setting of shelf storage in the warehouse and facilitates the calculation of how many boxes can be transported on the transport vehicle to solve the transportation quantity and distribution problems. The packaging is exquisite with good confidentiality. Can well ensure consumer privacy. When the new type packaging box is opened, there is no need to tear open the layers of adhesive tape, which is simple and time-saving when opening, and the strong sealing ability when closing can effectively prevent the articles from dropping out of the box due to bumps or other reasons during the distribution process.

d. The outer shell of the packaging box is made of PP plastic. There are not many other things inside, mainly cushioned by the air cushion to cushion the impact, so the packaging box is very light, the outer tape is not tied with the packaging and the packaging has a bayonet The packaging is simple. It takes about 20-30 seconds to manually pack a box, and it takes about 40-60 seconds to pack a disposable cartons. Compared to a disposable corrugated box, the packaging time can be reduced to more than half, which improves logistics. s efficiency;

e. It can also greatly reduce the cost of logistics and express delivery. A box can be used for nearly a thousand times. In the age of this price increase, due to the service life, it is much lower than the cost of a disposable cartons, which is about once. The 0.01-fold cost of the corrugated cardboard box is longer than the one-time-use carton pack. It is easy to store, and it is no longer necessary to consider storage problems such as moisture-proof, waterproof and rodent-proof.

(3) Recycling process

a. Necessity of recycling

Table 1 Necessity of recycling

Objects	Recycling necessity
School	Improve the awareness of environmental protection on campus students and the value of packaging recycling; To a certain extent, it also eased pressure on the school environment and waste of resources.
Express	Saved costs and eased business pressures; Lay the foundation for post logistics; Create new business.
Company	Saved costs and eased business pressures; Lay the foundation for post logistics; Create new business.

Society	Open up the business, provide employment, reduce the emission of pollution to nature and reduce the waste of resources.

b. Express Recycling Process

Take the school as an example, the campus currently deals with courier packaging and recycling in addition to a very small amount of courier packaging that is recycled by campus agents. Most of the rest is wasted. There are several problems with this approach:

a) The cost of recycling is high, and the profit of packaging waste is low. Recycling through recycle bins will increase recycling costs.
b) Recovery is difficult, courier packaging is more dispersed and needs to be recycled in different consumers
c) Wasted waste, most courier packages are thrown away like garbage, and few are recycled.

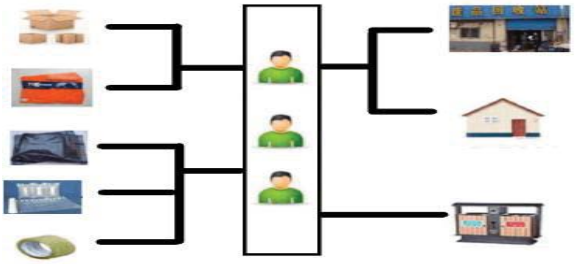

Figure 3 Existing recovery model

Taking the campus packaging collection point as the center, the front-end main infants will collect express packages for consumers, carry out simple processing of the recovered express packages, and then carry out further recycling operations for the back-end express delivery companies and packaging factories.

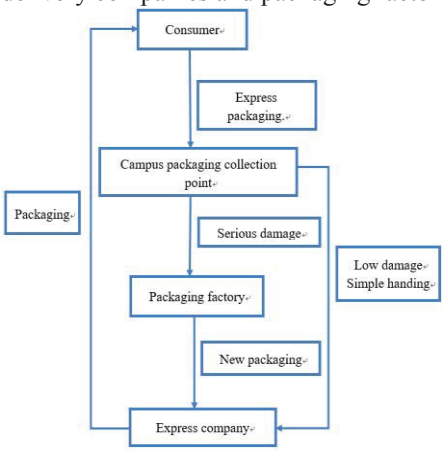

Figure 4 Optimized recovery mode

Table 2 cost analysis

Cost analysis			
Cost type	Quantity	Unit price	Total annual fee (yuan)
Staffing	3 people	600 yuan/month/person	16200
Electric tricycle	1 vehicle	1500 yuan	1500
Warehouse	1	School Free Support	0
transportation cost			969.63
Packing processing fee			2000
total			20669.63

Process node logistics operation

Front End: Consumer to Recycling Center

According to the statistics of the survey data, found shows that campus students mainly have the following attitudes and handling methods for express packaging: About 15% of the students expressed their willingness to dismantle express packages directly at the campus agent sites, and about 85% of teachers and students chose to bring Back to the dorms, about 44% of them expressed their willingness to cooperate with the recycling work and to carry out the recycling of the packaging in accordance with the prescribed recycling model. About 54% said they would not bother to use it and chose to throw it directly at the garbage in the dormitory.

In response to these different attitudes toward express packaging, so have adopted the following three different ways to recycle the express packaging:

Every week, three and five of the college's dormitory building express packaging for recycling.

Aunts in the dormitory and garbage collection and sorting personnel cooperate with the recycling.

Directly by the courier agency to recover.

Ends: For the different nature of the express package and the damage layer, it can be roughly divided into: can be directly used, and need to be deep-processed again. So the final express package mainly has the following three kinds of flows:

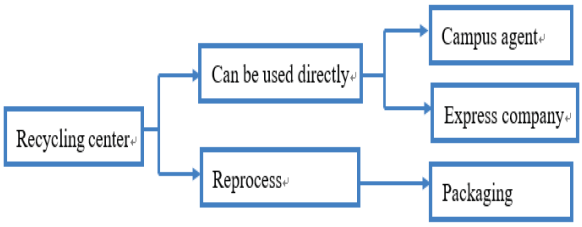

Figure 5 Recycling mode

(4) Express Recovery Cost Analysis and Recommendations

Table 3 Suggestions

Suggestions for all walks of life		
Industry category	Measure	Suggest
School	Establish a system, vigorously publicize and enhance the teachers and students' awareness of environmental protection	Call for students to send courier packages to designated locations or on the floor, etc.
Express company	Standard express single paste method	Use electronic tags
Packaging company	Improve packaging materials	Vigorously promote the use of environmentally friendly materials
Government	Issue Policy - Encourage Build Recovery Model	Give economic support and equipment support - The government funded the establishment of a secondary recovery station. The unified management of recycle bins also indirectly integrates the use of resources for courier packaging recycling and standardizes the recycling market operations.
Logistics	Regulate recycling operations and build network information platform	Create a unique logistics APP. Customers can check express logistics information on the APP, chat, exchange idle items and notify staff to collect express packages and inquire about their own points and points for prizes and other services.

3. CONCLUSION

The production of new express delivery boxes can reduce the amount of garbage caused by discarding express packages in life by 30%, and reduce the number of courier-packaging wastes. Express delivery companies also indirectly reduce packaging costs. On the other hand, express delivery companies waste their packaging every year. The loss amounted to more than one billion yuan, and the recovery system of the new express package can greatly reduce the package cost of express delivery companies. However, everything has advantages and disadvantages. The packaging box is no exception. Although it can reduce the use of tree felling, it is also a hard-to-degrade plastic product. The used scrap box is also for the environment. Cause pollution. Moreover, there is no way to pack and transport high-temperature sharp products and corrosive products. In addition, it is difficult for some small enterprises to get out of this step without the help of the government and other large companies. Therefore, it is also a problem that promotion and overall popularization are also issues.

The recycling and utilization of courier packaging is a systematic project that requires the concerted efforts of the whole society, and it needs to step into the normalized, scientific, and legalized track. At present, people from all walks of life are paying close attention to the issue of environmental governance and are all aware of the importance of strengthening waste recycling to achieve recycling of resources.

If continue to carry out pilot work, Then will continue to improve the express packaging and recycling operation process, and promote the implementation of the entire society in conjunction with specific circumstances, not only improve the utilization of express packaging, but also reduce the waste of secondary use of resources and environmental pollution, for logistics companies, the government and the entire society will be a major welfare.

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The New Model of Unit Appliance Sharing in Logistics Industry

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Abstract: This paper focuses on the research and analysis of the current situation of the circulation development of unit devices in the Internet + logistics industry, mainly including the following aspects: Firstly, the development status, existing problems and solutions of unit devices in the logistics industry are analyzed. Secondly, the advantages and market of Internet + unit devices in the current logistics industry are implemented. The information sharing platform of logistics unit device integration was established again, and the integration from the upstream to the downstream of the industry with JIT (just in time) was used to make logistics unit device sharing and socialization. Finally, taking the fresh industry as an example, this paper analyzes the economic benefits brought by the standardization and sharing of unit equipment in the logistics industry.

Key words: logistics industry unit equipment; sharing circulation platform; block lease

1. DEVELOPMENT STATUS OF LOGISTICS UNIT EQUIPMENT

In recent years, with the continuous development of logistics business and the intensive introduction of various policies, China's logistics industry has entered the fast track of development. But the overall level of development is still far behind that of developed countries. The reason is that the cost of logistics is too high, the logistics industry is standardized, and the modernization development is slow, leading to a long-term restriction on the development of China's logistics industry. The key factor restricting the development of logistics lies in the basic standardization degree of logistics industry. The standardization degree of logistics unit is difficult to standardize and becomes the sore point of the industry. National specification unit related industries: tray leasing enterprises, large chain enterprises, fast-moving consumer goods production enterprises, the tray production enterprise, logisticspark and other unit the application of container equipment. As a basic and leading industry of national economy, the largest service industry is to realize the sustainable development and recycling economy and improving the efficiency of the national economy, to protect the environment, and to optimize the industrial chain plays an important role in such aspects. Pallets, in developed countries, have already realized circular sharing, and in pallet operation circular sharing has made great achievements. China's research in this area is still in the primary stage of exploration.

Current situation of the development of logistics industry unit can flow slowly is insufficient understanding of the logistics industry standard, only considering their own efficiency, without being aware of the whole supply chain can achieve optimal, benefit maximization.

It is a simple and efficient way to transport goods. In general, it uses assembly equipment to combine a certain amount of goods into transportation units of corresponding specifications according to the logistics module. The basic types of collecting devices include pallets, collecting bags, collecting cages, collecting net, collecting shelves, containers, etc. The assembly and transportation unit should be convenient for mechanical loading, unloading and handling, and for stable stacking. It can guarantee the safety and integrity of the goods and make reasonable use of the load capacity and volume of the vehicle. It is convenient for the combined transport between various means of transport.

Containers and pallets are mainly used for storing and transporting materials. Also according to the shape of materials into a variety of special materials rack. Pallets can be divided into flat tray, column tray and box tray (also called material box or cargo box) pallets can be made of wood, metal, plastic, paper and composite materials. China's national standard stipulates that there are 2 kinds of external dimensions of pin-tray: 1000*1200 mm 1100*1100 mm.[1]Container is a kind of steel large container. The largest standard container appearance size is 2591 * 2438 * 12192 mm, loading up to 30.5 tons.[2]The standardization of pallet and container dimensions is an important measure to promote unitized transportation.

2. ANALYSIS OF PALLET SIMPLIFICATION

Now every enterprise is using unit appliance, tray when there are many problems.

(1) It needs to purchase the pallets by itself, carry out post-maintenance management and increase costs.

(2) As the goods shortage or excess volatility exist tray such as the status quo, the tray can't be efficient utilization, enterprise must, in accordance with the biggest demand configuration, tray occupy storage space problems

(3) The use of pallets improves the loading efficiency, but as most pallets are purchased by themselves, the downstream unloading efficiency is reduced due to the non-downstream operation of the supply chain
(4) Self-operated pallet needs management cost, pallet operation is out of scale, unit cost is high
(5) The pallets cannot be transferred, the enterprise stacking methods are different, the parameters are different, and the industry standardization degree is greatly reduced
For solution for the problem of flow unit, for example: the tray in the supply chain upstream and downstream flow, in transit does not need to remove material from the storage and transportation equipment change, thus reducing the loading and unloading time, accelerate the turnover of unit, each tray can turnover 24 times a year, as the unit of the unitized, 6 times to enhance the efficiency of handling, vehicle transportation efficiency three times, reduce artificial cost 15%, a 90% increase in overall efficiency, reduce the handling time, and the unit can be high stacking goods, can effective use of storage space; The unit can be recycled to save material cost. In addition, it can prevent the damage and loss of goods and reduce the rate of damage. It is beneficial to realize the mechanization and automation of transportation, reduce the labor cost, and reduce the accident in handling. But tray its weight and volume to reduce the effective part of transportation equipment weight and volume, tray recycling, management, maintenance and deployment of increasing the difficulty of management, but the unitized transport in the transport of the supply chain has greatly enhance comprehensive economic benefit, it also greatly improve the degree of standardization and specialization of logistics industry.
Logistics industry unit flow, greatly improving the efficiency of logistics operation, but also increase the difficulty of the tray recycling, tray, maintenance, loss, no problems such as the precise management, the management difficulty multiply. So we have a tray lease.

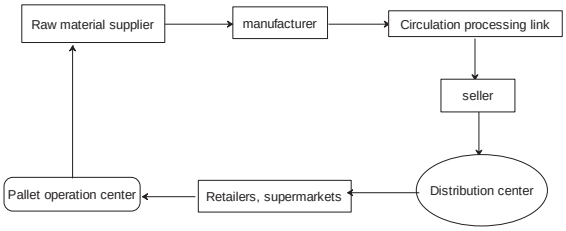

Figure 2.1 pallet rental flow diagram
Production is carried out by an enterprise in a professional way according to the demand parameters of different supply chains, so as to reduce the cost of single unit equipment and generate scale effect. At the same time recycling, maintenance and utilization, increase the reusability. And one pallet is used in more than one home, greatly improving pallet turnover rate, also making pallet cost reduced.
In this way, the logistics transportation cost is greatly reduced, and the consumption rate of trays is reduced by the participation of multiple family members. However, it is difficult to standardize and socialize the unit equipment industry because of the single pallet, specialization and priority of the cooperative enterprise or the cooperative enterprise.
In a word, the flow of logistics equipment will increase the efficiency of logistics industry transportation industry and supply chain enterprises. It will also promote the development of the industry. Quicken the socialization of unit equipment of logistics industry.
With the development of economy and technology, Internet + unit appliance has great market advantage. Now "Internet +XXX" has become the mainstream development. Because of the Internet, the transportation industry has developed by leaps and bounds. No matter when the "Internet + industry" enters that stage, it needs the flow of things. The flow of needed goods requires the logistics of unit equipment, we have a vast market. We can design different units for use according to the property, volume, storage conditions, transportation conditions and other factors of the goods. It has high commercial value and social value for the sharing and use of simple logistics packaging equipment. Tray, for example, at home, a tray average circulation 24 times a year, in the process of the bearing products circulation, storage, loading and unloading and transportation cost saving can be an average of 3000 yuan, equivalent to tray dozens of times their own costs. Therefore, it is not only beneficial to improve the efficiency of enterprise logistics and the overall efficiency of supply chain, but also to reduce the cost of the whole society. Therefore, we need to establish a logistics unit sharing platform.

3. LOGISTICS UNIT SHARNING PLATFORM

(1) Design module: for different supply chains, the standardized module design of loading unit is carried out according to the goods property. Make it more efficient in loading, unloading and handling.
(2) Lease module: lease business can be carried out on the platform, online transactions can be carried out, offline service mode can be provided, and supply chain enterprises can pay rental fees in pieces
(3)Transaction module: it can be traded on the platform, such as goods that need to be stored for a long time, or it can be purchased or there is second-hand transaction if the leasing method is not appropriate.
JIT technology and GS1 coding technology are implemented at runtime management time. JIT technology enables enterprises to reduce inventory of pallets and reduce operating costs. GSI coding technology can track pallet during pallet flow. Reduce pallet damage rate, provide pallet in a number of enterprises in the flow of the basis. The pallet leasing is flexible and can be carried out in different places. It solves the problem of increasing or decreasing the

number of pallets needed by enterprises due to the low season, and satisfies the need of pallets used by enterprises. At the same time, it can also exempt enterprises from pallet maintenance management, reduce enterprise management costs, and effectively save pallet procurement costs for enterprises.

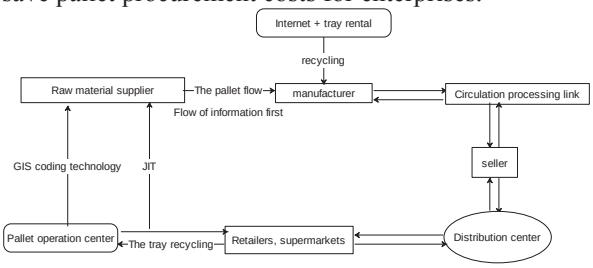

Figure 3.1 Internet + tray rental flow tracking diagram

Take the fresh industry as an example: fresh food is very fragile, and the value of fresh food is directly related to its freshness and integrity. Fresh fruits and vegetables that ordinary handling in the past, need to constantly pour goods or goods of extrusion, during the process of selling and shipping knock against loss, average damage rate is as high as 35% above, through circulation unitized vessel sharing, from the fields to fresh fruits and vegetables classification standard load container unitization, from producers, distributors, logistics companies to store, share unitized container, implement neither fall after a packing case handling. The loss of fresh fruits and vegetables can be greatly reduced to less than 5%.It reduces the loss rate, improves the freshness and appearance of fresh food, and expands the profit space. In the logistics unit equipment sharing platform for payment in block mode, the pallet flow to which link, which link of the responsible party to pay the rental fee. Make supply chain enterprises closely connected and improve transportation efficiency. In the logistics industry, loading, unloading, and handling are the most important parts that cannot create value. The less time lost in loading, unloading, and handling means the less the unit cost of goods increases, the maximum benefit.

4. AT PRESENT THE SHARED DEVELOPMENT OF CHINA'S UNITIZED LOOGISTICS PACKAING EQUIPMENT FACES THE FOLLOWING DIFFICULTIES

First, The standardization degree of unit equipment in China is only 21%, which is low and hinders the development of logistics packaging sharing model. Tray, for example, according to the end of 2015 the ministry of commerce international trade and economic cooperation research institute jointly set insurance company issued the fast-moving consumer goods industry in China supply chain logistics research report statistics, FMCG tray wholesale enterprise standardization rate is highest, at 77.84%; However, the tray standardization rate of FMCG and FMCG was only 59.03% and 50.11% respectively. However, there are still a lot of goods for bulk or zero order goods do not have uniform specifications, cannot carry out standardized pallet transportation. Tray specifications and cargo attributes jointly restrict the flow of unit equipment sharing mode.

Secondly, the unified quality of unit equipment hinders the sharing of unit logistics equipment. The quality level of logistics equipment in China is different, which leads to uneven quality, greatly reducing the number of recycling and serious damage. The lack of unified quality certification standards in the industry makes the provision and recycling pallets in the recycling sharing system inconsistent, hindering enterprises from joining the sharing system.

Third, the development of plate turnover transportation is restricted by many factors. Mainly include: the tray itself needs to take up the space, cargo by 40%, resulting in a decline in transportation vehicles cubed out and unable to offset the freight of the possible cost savings rise phenomenon, restricted the enterprise the enthusiasm of using zone plate transportation. Moreover, belt and board transportation requires the joint participation of upstream and downstream enterprises in the supply chain. The calculation and distribution of interests of relevant parties are complicated, and the supply chain partners have doubts. The development of plate-carrying transportation is restricted by the inconsistent logistics standards among individuals in the supply chain and the inability of retailers to integrate their order forms.

Fourth, Companies also tend to think about residual values,[5]But in fact the pallet is a device that improves transportation efficiency. Its scope of application is limited by cargo volume shape, use in circulation after the basic no longer has the depreciation value, only waste recycling value, the value can not bring any value or value-added role. Become a burden in the long run, management, and enterprise replication is very high, the early market development enterprise advantage is large, but with the increase of market saturation, also can appear in the form of an oversupply. As a result, few enterprises are specialized in the leasing of unitized equipment, or even unwilling to enter the market.

5. SOLUTIONS

On policy; The state should further improve industry standards, carry out mandatory reform, determine classification standards in industries, optimize industries, integrate standards and integrate resources

On the economic aspect: the state conducts the guiding role, USES the lever principle, the leverage industry, by the subsidy, the preferential policy support and so on policy sex, promotes the economic development and the enterprise enthusiasm.

In the industry: benchmarking, mainstream driving. Under the new model, we can not only maximize the benefits, but also promote the development of the industry. We can achieve win-win cooperation.

6. THE CONCLUSION

In view of the current situation of logistics

development, the rapid development of the logistics industry, most enterprises enter the logistics market, logistics enterprises integrate, self-management logistics to social logistics transformation has become an inevitable trend. With the development of the industry and the increase of the protection of intellectual property rights, the standardization of logistics unit level will be more and more high, therefore, the earlier unit sharing market, future development advantage is, the greater the its industry status will be more and more high, logistics unitized equipment share market has a certain potential and existing value.

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A Meta-synthesis Study on the Political and Regulatory Risks of Chinese Power Companies Investing in Pakistan

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Abstract: "Think Globally, Act Locally" is becoming urge for enterprises. Political regulation are essential to be considered while moving from home country to host county for long term investments like investing in energy sector. Conventional wisdom holds that multinational enterprises (MNEs) pose less investment in the countries who have greater risk-the risk of altering the policy opportunistically which have direct or indirect expropriation of companies' assets or revenues. The study involves Meta-synthesis approach of research. This approach focuses on amplifying, interpreting and integrating the phenomena rather reducing information. This research approach is different from quantitative research method. This study investigates the political and regulatory indicators which have a potential risk factor for Chinese, energy sector, companies especially but not confined to them. The research probes the political systems of Pakistan & China and its similarities and differences which have impact on decision making of energy companies. The study explores that, the decision making about investment in China is easier as compare to Pakistan due to its meta-constitutional factors. Meta-constitutional rules are embedded in system of Pakistan which are in lieu of formalized rules and is system of axioms.

Keywords: Pak-China political system; sustainable decision making factors

1. BACKGROUND

Majority of enterprises are contented in early years of their incorporation, profound in systems and mature in decision making but on other side, many enterprises struggles for decades to reach at this level. The answer is quite obvious, the modern-states with stable political systems are unhesitatingly growing exponentially and contributing to the economic system. Regulations are indemnity against manipulation and discrepancies. According to [1] ``Political Economy'' is denoted as an art rather than a science in modern world, it is theory of right government management system which sets grounds for flourishing of corporations instead independent system of governments for industries to be organized.

As stated by [2] that all political entities are called power elites because all such kind of systems are stratified and participating actors which constitutes the minority leaders that play a functional role in policy making for public. Authoritative decision making are critically administered at various level in political system. They are having greater influence on mass structuring and expressions given to system overall. Pakistan's political system and ideology is far different and unique than most of the civilizations. The base of being independence was laid on 'two nation theory' proposed by Dr. Muhammad Iqbal and Muhammad Ali Jinnah. Iqbal wanted a separate homeland where the people can be controlled by the laws of Allah (God) and this separate land should help people in production of common values operated by different agencies (provinces). In short the politics of Pakistan is much influenced and regulated according to rules of Islam because, it was came into being as land for Muslims [24]. Iqbal, the philosopher and ideologist of Pakistan, considered Quran as not only as "legal code" but also as primary source for political and legal system. As Plato does in his republic, Quran also considers necessary to unite nations, religions, ethics and politics at a central disclosure [16].

Furthermore, it is pivotal to have bird view on political regimes and their impacts on economics structure of the country. It is very unfortunate that since its being existence Pakistan remained victim of unstable political system. Fluctuation in political regimes cost Pakistan towards immaturity in rules and regulations, unclear foreign policies and lose control in its internal territories also [30] Good economic outputs are gained through political governance and good economic circumstance [15]. The main power elites remained in circle of democratic system influenced by western form of democracy, military and mix form of military and civilian governments.

The prominent political regimes of Pakistan from past; 1958–1968, 1968–1971, 1973-1977 1977–1988, 1999–

2007, 2007-2013 and 2013-217 to present who contributed in economy of Pakistan in either way, positive or negative. Chart-1 explains the GDP contribution of different governments. The below statistics are quite evident that GDP in regimes of Marshal Law's, remained always high in different time frames as compare to democratic setups.

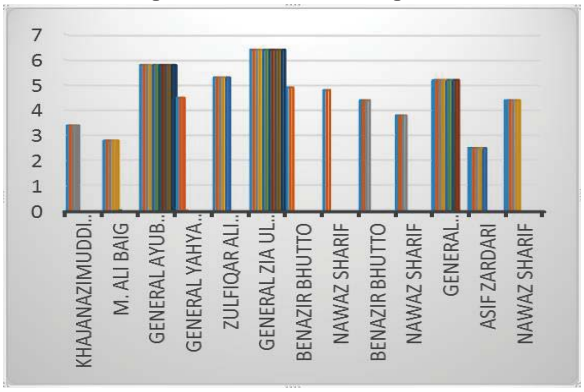

Figure1: Regimes and GDP growth in Pakistan, 1957 to 2017 Source: Federal Bureau of Statistics, Pakistan.

Past couple of decades are showing positive trend toward democracy. It is manifest that government systems are becoming more and more sustainable and are moving toward real democratic system which is need of the era. The strong democratic process has lead the country towards good political and economic relations with neighboring countries especially with China. China is also a country which believes on mutual growth and cooperation in economic gains.

China is penetrating in global market. The manifestto of 18th CPC, 2017 "We call on the people of all countries to work together to build a community with a shared future for mankind, ……. sake of human survival". This strategy has lead china to top economies of the world. Since initiating market reforms in 1978, China has shifted from a centrally-planned to a market-based economy and has experienced rapid economic and social development. GDP growth has averaged nearly 10 percent a year—the fastest sustained expansion by a major economy in history—and has lifted more than 800 million people out of poverty. Beside all above realities, China needs to be more conscious about the numerous problems, while it is investing in global market. The political and regulation, are provoked in different countries such as 'Myanmar Myitsone hydropower station' failed to operate due to political issues and the railway contract between China and Thailand are also prominent examples for being more cognizant about political issues. Such problems are inviting researchers to investigate the potential issues which companies can face during globalization especially politico-economics and regulatory issues. Researchers must investigate the measurements to safeguard Chinese enterprises from such disasters. China-Pakistan Economic Corridor, further discussed as CPEC, is the largest economic alliance done by any country in history of Pakistan and it has numerous threats and difficulties to be implemented. As investigated in studies of [28] that central government of Pakistan has baggy control over its provinces. Moreover, Pakistan is weak in economic progress and infrastructure development to alleviate poverty. Although there are previous studies [29] who investigated on different issues like environmental and social risks, terrorism and other factors but there is lack of research on Political and regulatory issues that potentially can hinder the power projects initiated under CPEC agreement between Pakistan and China. So this study is important to measure the political and regulatory risks evaluation for energy companies working in Pakistan or are planning to invest in Pakistan. This study is helpful for companies' decision makers to address the challenges investigated in this study. This paper also narrates about different determinants of politics and regulations which are effecting power sector directly or indirectly because research on this issue is in dearth especially with respect to Pakistan and China. This study underpins the key factors which are pivotal to understand before stepping in business at international level, along with a comprehensive overview of political system of Pakistan and China. This study is primarily helpful for chines Power companies who are potentially looking forward to invest in Pakistan. Next section is about literature review of the study.

2. LITERATURE

Political and regulations are essential to be considered while moving from home country to host county in long term investments like energy sector [2]. There are twofold examples of energy reforms, one-fold who managed the transformations of power supply quickly and efficiently whereas other-fold have taken long time to make basic reforms which were important to power sector [12]. Reforms are found inconsistent in many countries, especially developing, that resulted divergences in political, economic and institutional level and dropout of mega investments in many cases [3]. Political, socio-economic and regulatory dysfunction vary between region to region but administrative inefficiencies, corruption, political instability, and regulatory negligence are found most common among all under-developing and developing countries. Resultantly, it enhances investment cost especially in developing than developed countries and it also counters the factors like untrained or poorly trained workforce which plea engineers from abroad [17]. To compensate the higher risks, the financing cost goes up in developing countries and investors demand more

rewards for risks. Additionally they have to compensate the lenders as well at higher markups. These situations rise because of instable political and inconsistent regulatory policies. Moreover, it is because of red-tapism, uncertain and whirl permission processes and other colonial problems [2].

It has become a common wisdom that multinational enterprises (MNEs) pose less investment in the countries who have greater risk-the risk of altering the policy opportunistically which have direct or indirect expropriation of companies' assets or revenues. Furthermore, an international business research [6] investigated that there is negative relationship between foreign direct investment (FDI) and political instability which causes; corruption, political violence and social disorder.

However, in many, MNEs had showed trend of investing in countries which are considered risky. Almost twenty five percent of the privately owned companies of power sector investment is made in the countries which are in top quartile of policy risk [10]. Empirical research has created a link that the conflict across the border flows the investment into a single host county, at country level, because of the guarantee from the host country [4]. It is also theorized by research that company's political capabilities, identifying socio-political influences and recognizing stake-holders relationship has also strong impact on its success in host country [29]. Policy outcomes are won through nation policy making processes which enhances opportunities. Policy risk for firms is also created through this source as domestic politics is organized [10] and political opportunity can be grabbed when domestic resistance is muted. Though, companies rely on their political maneuvers in order to shield sunk investment alongside to potentially avoid the adverse consequences of political and regulatory factor and to safeguard from policies of rivals. Even more, to convert these consequences in favor of the company.

Embedded-ness of community impacts the formalization of rules, their nature and application mechanisms or governing structure for the overall well-being especially for economic benefits [11]. There are three formal layers of rules in institutional environment; first, met-constitutional rule which is upper level. Second, constitutional rule that is made through a hierarchy prevailing in systemic. Third, this rule is emanated through constitutional rule such as political, economic and legal institutions of the country. Successive rules of the country are made according to the requirements of the markets, organizations and individuals. According to [23] it is in the favor of power sector that institutional stakeholder, comprising societal rules, official rules, and regulatory institutions, should cohesively reform the policies.

This section of the study has explored the political and regulatory factors which causes efficiency or inefficiency of the energy-organizations and their propensity of hedging the risk. The study witnesses that FDI especially energy sector investment across the border is trickier and is embedded in underpinning philosophy of understanding geo-political situation of the country. It is proved that mastery in political policies-not only of Macro system but also about its own system can hedge the investment risk. The next section of the study elaborates about political and regulatory comparison of Pakistan and China.

3. POLITICAL AND REGULATORY COMPARISON

(1) China

National People's Congress (NPC), State Council (SC) and Communist Party of China (CPC) are the highest level policy making actors in China. Top nation's legislative body with highest authority is known as NPC. State council or sometime referred as central government is highest and leading administrative unit of government in PRC. This body is authorized to implement policies and laws made by NPC. CPC has mediating role in law making and influences the process by appointing members of NPC and top personals in ministries and commissions [24]. There are three other factors in political systems of China which co-exist. State government bureaucracy is the chief and muscular among them which is close to party throughout China. Its operation are mainly distinct from party but interlocking way of implement and administer the state business. People's Liberation Army is another key institution in China which is working separately and independently from political system. National People's congress is constitutionally the highest element of the state power but institutionally the weakest in political system [21]. Other political actors working in China are; provincial and local officers. New forms of communication and information availability also have pressured the PRC government to make changes in its political system, and have provided the Party with new means of maintaining political control. The political story in China today is the extent to which these multiple actors and changing circumstances have helped blur the communist regime's lines of authority. "The thought is the "theoretical crystallization" of the past five years of practice, according to a statement released after the meeting" [7]. The political system in China is strictly centralized, and has no federal state order. Even though it is highly acknowledged that the decision making is delegated in state economy [5]. This system has raised up the economic incentives for state and made local government more disciplined [19]. It is considered one of the reason that China has extraordinary high-growth in the region consecutively for over than thirty years. Moreover, it has significantly

addressed its environmental and health issues with up bring the livelihood standard of people in China [27].

There are number of major institutions which are working under state council that are responsible for making policies related to environment, energy and climate laws such as; the National Development and Reform Commission (NDRC), the Ministry of Environmental Protection (MEP), the State Electricity Regulatory Commission (SERC), the National Energy Commission (NEC), the National Leading Group on Climate Change (NLGCC) and the State Council Energy Conservation and Emissions Reduction Leading Group. MEP was formed in 2008 to replace the former State Environmental Protection Administration (SEPA), and it aims to prevent and control environmental pollution, protect nature and ecology, supervise nuclear safety, safeguard public health and environmental safety, and promote harmony between humans and nature. SERC is a statutory organization.

(2) An overview of Pakistan political and regulatory system

It is undeniable fact that military had dominant role in civilian government of Pakistan but now army is establishing and strengthening the civilian's government [20]. Moreover, the study reveals that external relations are determined with mutual consent of both civilian and army's representatives particularly the relationship with China under agreement of CPEC is mutually guaranteed to ensure its success to be happen. The government in Pakistan is characterized as parliamentary democratic republic. The characteristics are resembled with many nations round the globe such as, US, UK, Germany, Ireland and Switzerland. The constitution of Pakistan establishes the government, as the US government, is consist of three branches; Legislative, Executive, and Judicial.

Legislative Branch

First tier of government structure is legislative branch of government system which is also known as parliament/Majlis-i-Shoora. It is very pivotal part of whole government system as it is responsible for lawmaking which has deeper impact on whole affairs of state. Parliament is two-house named as the National Assembly also known as lower house of cabinet that has 342 members, including sixty seats reserved for women and ten seats nominated for minorities (non-muslins). The upper-house of the parliament is known as The Senate which has 104 members with seventeen reserved seats for women and four seats for minorities.

Executive branch

Executive branch is consist of the two top members of the state who ensure the proper execution of law made in parliament with mutual consensus of all members of parliament. Prime Minister is the state head whereas President is the ceremonial head of state with many other responsibilities. It is mandatory for prime minister to be Member of Parliament to ensure lawmaking process as unbiased and purely for the welfare of the people of state. The prime minister is elected by members of National Assembly for the term of five years. Furthermore, prime minister leads all ministries and advisories operating under the cabinet

Judicial System

This is the important part of government system which ensure that there are no misrules in the state. Supreme Court is the ultimate court the country under which provincial courts, session courts, magistrate courts, and other special courts and tribunals works. If someone convicts such crimes he is liable to present himself/herself in-front of courts for trial. The Magistrates courts are responsible to handle all non-capital cases and Session courts handle all offences including capital cases and hear grievances from magistrate courts. Tribunal courts are to handle special cases such as, banking offenses, drugs, corruption and various criminal matters.

Further it is important to know the territorial distribution of the region which has a lot of impact on Foreign Direct Investment in terms of every region has different social norms and priorities for their development. Pakistan is consist of five province, one autonomous territory and two federal territories. Thirty four divisions are the further regions for each province that are more categories into Districts and Tehsils 149 and 588 respectively [17]. The largest province is Punjab with approximately 50% of population of whole country. In terms of area, Baluchistan is the largest province of Pakistan which has fabulous potential of solar and wind energy. China-Pakistan economic corridor (CPEC) is mainly incorporated in Baluchistan. This province is blessed with Gwadar port, one of the deepest port in world.

Provincial system

It is vital to have a holistic view of provincial government system because after 18th amendment, it has made provincial government more autonomous. This power has lead provincial governments to make decision by their own while on other hand this amendment has weakened the authority of federation in provinces. It is important for all organizations that are interested to invest in any local government setup of Pakistan to understand its power streams. Each province has a Governor, Chief Minister, councils of ministers and provincial assembly members. Provincial member are directly elected by local people of the province through election process. The governor is a ceremonial head of the province directly appointed by the president of the state. Chief Minister, as national assembly members select PM, is elected by the provincial assembly members for the tenure of five years. Chief

Minister is the executive head of the province who select the council of ministries and other upper tiers of the institutions.Pakistan's government structure is pretty complex but has similarities with many developed democracies of the world. The three-branch system is similar to the white house but presidential system is quite different from US. Similarly provincial system is also unique which provides autonomy to the structure.

(3) Political and regulatory comparison of Pak-China

This part of the study is to compare the government system of China and Pakistan not to discuss the efficiencies or deficiencies of either system. The government systems of both countries lies on opposite side. Pakistan's government system is 'democratic republic' system which is based on electoral process that ensure the participation of each nationalist to choose executive body of the country in terms of Prime Minister, similar to US, UK and many other countries. China is based on 'communist' system of government which is usually referred as 'workers state' operated by a single party representation. National People's Congress (NPC) is the highest legislative authority in the country, as the parliament system in China. State Council is the administrative unit of government is China while law making process is ensured by Communist Party of China (CPC). The following table narrates a brief comparison of both governments.

Determinants	Countries	
	Pakistan	China
Government structure	Democratic Republic	Communist (Worker state)
Legislative Authority	Parliament/ Majlis-i-Shoora	National People's Congress (NPC)
Executive/administrative body	Prime Minister	State Council
Influential authorities	Judiciary	Communist Party of China (CPC)
Similarity of government structure	U.S, UK, Germany, Switzerland, India…..	Russia, Democratic People's Republic of Korea (North Korea), Socialist Republic of Vietnam, Lao People's Democratic Republic (Laos), Republic of Cuba
Appointment of head energy regulator	Ministry of Water and Power & WAPDA	State council & NDRC

Table-1 Comparison of government structure between Pakistan & China

4. REGULATORY INSTITUTIONS IN PAKISTAN

The energy regulation system in Pakistan is complex and whirl. However, it is important to understand the regulation system of Pakistan for safe investment in the region. National Electric Power Regulatory Authority (NEPRA) was formulated and as an autonomous body under act 1997 which has no influence from government. However, it has close interaction with Federal and provincial territories it also has link with ministry of Water and power which controls Water and Power Development Authority (WAPDA). Structure of NEPRA is consist of one chairman and four member who represents each province. The main function of this authority is to ensure transparent and judicious economic operation in the energy sector. The role of NEPRA is multifaceted though, it performs basic function of; setting terrify rates and terms & conditions, issuance of licenses, ensuring quality standards and investment standards, privatization and industry structure and consumer rights & complaint redresser.

Oil & Gas Regulatory Authority (OGRA) is another pivotal regulatory authority for energy sector. This institution is responsible to establish mechanisms for investment and to create favorable situation in petroleum and gas either for energy sector and general. Power sector is consist of generation, transmission and distribution. The power sector is mix of hydro and thermal, the Water and Power Development Authority (WAPDA) and the privatized Karachi Electric Supply Corporation (KESC). In addition, there are two nuclear power plants, KANUPP and CHANUPP, and a number of IPPs and small power producers (SPPs) established since 1994. Since October 2007, the state-owned WAPDA has become two distinct entities i.e. the WAPDA and the Pakistan Electric Power Company (PEPCO). The WAPDA is responsible for water and hydropower development, whereas the PEPCO is responsible for the management of the WAPDA's 14 public limited companies in thermal power generation, transmission, distribution and billing. The PEPCO supplies electricity through its nine Distribution Companies (DISCOs); the Lahore Electric Supply Company (LESCO), the Gujranwala Electric Power Company (GEPCO), the Faisalabad Electric Supply Company (FESCO), the Islamabad Electric Supply Company (IESCO), the Multan Electric Power Company (MEPCO), the Peshawar Electric Power Company (PESCO), the Hyderabad Electric Supply Company (HESCO), the Quetta Electric Supply Company (QESCO), and the Tribal Electric Supply

Company (TESCO), to all sectors in the country [44] .

5. KEY CHALLENGE TO FDI IN PAKISTAN

Key economic prosperity indicators such as; employment, income, trade surplus, balance between import & export are not favorable in Pakistan with passage of time. In-fact, this is erected in sluggishness to GDP and instable political environment since independence of Pakistan. In the era of globalized economy it is becoming substantial to create favorable environment for international companies to work especially in Pakistan [11]. To grow ominously, it is fundamental to identify and to rectify the key challenges faced by industries in Pakistan particularly to power-energy sector. It is pivotal for government to address the key challenges that are encountering the private sectors to flourish and restricting the foreign direct investment. This research study has highlighted them in following;

The major constraints to businesses to get established are; electricity crises that contributes to constraints is 71.3%, another reason which creates problem for businesses is political instability with 7.9 percent [13] deliberates political legitimacy as responsible factor for electricity crises in the country [14] argued that political instability in Pakistan is major prevention factor for foreign direct invest especially in context of power-energy demands high legitimation and government support. In this context political factors are very important to be addressed aligned with social and religious pressure groups. Social norms in the region are very strong which are deeply rooted in Islamic-religion believes. The societal customs and religious believes are important to individual lives and have impact on government's stability. But it is important to understand that these pressure groups are active and imposes their power when there is something against those customs and religious believes nor on the economic and bilateral relationships with any country which is not contradict to those believe systems. Hence, it is observed and experienced that energy sector investment is considered more attractive and popular investment in the region to overcome the shortfalls of electricity. Moreover other problems are related to bureaucracy especially concerned regulatory institutions such as inadequate support in terms of system formalization, registration, R&D etc. According to [3] regulatory institutions were established to develop regulations to private and foreign companies to ensure the national interest at first but these institutions are somewhat being miss-lead towards red—tapism and corruption. Moreover, the regulatory institutions do not have proper mechanisms for accountability if any business institution get indulge in any sort of manipulation like bribe and violations of laws. According to [33] energy sector is the engine of economy but, regretfully is facing many obstacles especially in regulation. Her study elicits that faintness in institutional and organizational matters supplemented with unproductive, non-optimal tariffs, high losses in lines and exploitation at operational and production level [1]. The weak administrative governance in NEPRA is pined in the shape of lack of independency which cause overall institutional inability that leads NEPRA towards ineffective in desired functions. Another, major problem in regulatory institution is in in-expertise and non-professionalism at operational level which annoys both at producer and consumer level. Regulators' transparency process is mandatory to ensure the effectiveness and efficiency in the system in order to gain the incentive system for production. Mysteriously, the regulatory system is unable to create a holistic structure linked with other concerned authorities. Additionally, business owners, most of the time, face difficulty in registering their firms in order to get legal entity entitlement.

6. WHY PAK-CHINA COOPERATION IS NEEDED?

A pragmatism by a Britain Lord Palmerston's states that, 'There are no permanent friends and enemies in international relations, national interest is the permanent thing'. National interest is based and choice on domestic and global situation. Foreign policies are made and decided according to the current regional circumstances. Pakistan and China has time tested and historic friendship since long. This friendship is a symbol for neighbor countries to learn a lesson of cooperation and development. These relations are political, defense, social and economic but not confined to them. The essence of bilateral relation is not bounded to the government position. The beauty of ties among two countries is based on the slogan of equality and mutual gains in all spheres of life. Independence, sovereignty and territorial dignity are kept as first priority from both sides [20]. The ties are deeper than oceans and higher than Himalayas. So, it is vital to understand a brief history of this relationship which can help the potential researchers and investors to make decisions.

Pakistan was among the early countries and first from Islamic countries who recognized People's Republic of China (PRC) and broke relations with Republic of China (Taiwan) in 1950. The formal diplomatic relation between these two countries was established on May 21, 1951. The first testimony of friendship started in 1950s and 60s when PRC was in difficulty due to western blockades and Pakistan opened its air corridors to connect it with outside world. In matter of Tibet with India back in 1950s Pakistan openly supported the cause of China. The first trade between two countries started, though late, in 1963 and same year both countries tied the border agreement also. The war

between Pakistan and India in 1965, in which Pakistan remained un-beaten, reminders the golden words of President Mao Zedong for Pakistan that "If there is a nuclear war, it is Beijing that will be a target, not Rawalpindi". History has saved this moment of relationship. Pakistan supported China firmly for the permanent seat in UN council. Pakistan and China went through a comprehensive nuclear agreement in 1986 although they started working on it before this, as reported in US media. Economic cooperation is considered the best cooperation in any relationship. China is among the top five import source for Pakistan. The bilateral trade has crossed $ 15.5 billion according to 2015 statistics. 'One Belt One Road (OBOR)' economic and regional cooperation manifesto of CPC is grabbing the success all the way. China-Pakistan economic corridor (CPEC) is the symbol of the success and witness of regional cooperation between these two friendly countries. This agreement is crossing the investment of amount $60 billion in different shapes especially in energy, Gawadar Port and infrastructure. At the end of 2017 both countries agreed upon to trade in RNB (Chinese Yuan) which is another good gesture for economic cooperation. By the June, 2018 China is launching two satellites to monitor CPEC routes and to strengthen Pakistan's security system. Moreover, China is providing latest navigations system to Pakistan to monitor its missiles. Beyond this Pakistan has made its first jet F-17 fighter with help of China. The list of cooperation and trade is longer and mightier which needs a separate discussion and narration. In nut shell this cooperation is much needed between these two neighboring countries for regional development and growth due to strategic location of both countries. The bilateral prosperity will ensure the regional growth and peace.

Indicators	Countries comparison		
	Pakistan	China	USA
Political Factors			
Power-energy legitimation	Average to Good	Very Good	Very good
Govt. support	High in recent era	Very High	Very High
Social norms	Rigid, Aggressive to moderate	Moderate	Moderate
Environmental policies	Gearing Up	Very strict	Very strict
Sustainability of political power	Unsustainable	Strongly sustained	Sustained in democratic way
Political relations	Average	Very good	Good
Systematic	More un-formalized	formal	Formal
Regulatory Factors			
Support	Medium to High	High	High
Accountability	Hit and trail	High	High
Integration of system	Poor	High	High
Registration	Complex, Red-tapism, weird	Complex but formal	Complex but formal

Table-2 Political and regulatory indicators related to energy sector

7. CONCLUSION AND RECOMMENDATIONS

Being global-is always a tricky decision on one side to make, as well as an unavoidable on other side. Working globally-acting locally is a demand of the era. Investing beyond the boundaries is becoming more complex and risky due to uncertain command and control of governments especially in developing countries. So, it invite the researchers to access the political risks and regulatory issues to predetermine and hedge the risk. The findings show that political instability and regulatory discrepancies are one of the major source in weakening the economy of Pakistan as, found in literature [11] also. This study found that social norms are very important to study before entering in global market especially related to power. In Pakistan social norms and believes are important but are somehow distinct from economical decision making. Furthermore, it is also investigated that Pakistan environmental regulatory are getting active now, as found in studies of [20] as well.

Meta-constitutional rules are embedded in system of Pakistan which are lieu of formalized rules. It is system of axioms as recommended in studies of [8] also. So, it is recommended to companies to make policies which are not contradict to meta-constitution like social norms and believes, as evoked in this study. Although this system gives more easiness to 'exit option'. It is for safety of companies to take mutual consensus of civil-military authorities otherwise it may lead to collision as happened in case of Enron (Dabhol-India) power plant [28] or embedded guarantee of constitutional rule from parliament to provincial assembly. The study also

investigated that state has baggy control on its provinces hence, it is recommended to firms to take consensuses of provincial governments for sustainable operations. As provoked in this research, it is important to study a systematic flow of chain of command in order to avoid red-tapism. Environmental cost is becoming more crucial to all regions so, it is imperative for companies to take precautionary measurements before establishing business as it may cause a set-back, as observed in a few cases of power plants. Establishing solid links with government and society, investing in society, a proportion of income as part of CSR, is another way to get deeply rooted in the system.

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The Recent Development of Exoskeleton Robots in Japan and Other Countries

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Abstract: Though exoskeleton robots were first invented for military purposes, a lot of countries such as Japan pioneered the development of wearable exoskeleton robots for civilian purpose. With the rapid development of science and technology, exoskeleton robots are constantly upgrading and playing a huge role in various fields, making their development prospects, especially, for high quality medical care, more broad.
Keywords: exoskeleton robots; medical care; rehabilitation; assistive robot; servo control; Cybernics.

1. BACKGROUND

The development of exoskeleton robot is a super task for human being to create an automatic robotics device that can provide help in time and never interfere with the action of man, replace his/her hands and feet, and be fully integrated with the human body. In war, soldiers need to carry as many weapons and equipment as possible to carry out military activities as little as possible. To achieve this goal, developed countries such as the United States have pioneered the development of wearable exoskeleton robots, greatly improving the operational level of the armed forces. With the rapid development of science and technology, exoskeleton robots are constantly upgrading and playing a huge role in various fields, making their development prospects very broad. For example, in the civil field, the exoskeleton robot can help the elderly to act normally; in the medical field, the exoskeleton robot also greatly reduces the pressure of the medical staff while assisting the disabled people's normal life; in the military field, the exoskeleton robot can improve the efficiency of the battlefield rescue and help more.

In recent year the living standard of human being is gradually increasing, and the demand for high quality medical care increases too. This makes the medical robot have great potential in China and the global market. According to the national survey data on disabled persons, the number of disabled people in China is over 20 million. However, the statistical bulletin on the development of China's disabled persons in 2016 showed that by 2016, there were 7858 disabled rehabilitation institutions in the country and only 1 million or so persons with disabilities received basic rehabilitation services.

On the other hand, with the acceleration of aging society, the group of cerebrovascular disease patients is also expanding. The report on nutrition and chronic diseases of Chinese residents (2015) shows that patients with stroke (stroke) increase at an annual rate of 9%. According to the World Bank's data, if there are no more effective measures, there will be over 31 million stroke patients in China by 2030. However, traditional medical means are hard to deal with. The number of Chinese rehabilitation physiotherapists is seriously inadequate. According to the number of stroke patients in China, about 400,000 rehabilitation physiotherapists are needed, but only about 20,000 of professional practitioners are available.

Therefore, the application of exoskeleton robot to assist medical rehabilitation will benefit large numbers of disabled people. At present, researches on gait planning and motion control of exoskeleton system for healthy people are numerous. Because healthy people have good stability and balance ability, it provides a practical guarantee for them to wear lower extremities exoskeleton and walk steadily. However, for the disabled with the lack of stable balance, though the traditional exoskeleton can help them effectively reduce the joint load and provide the ability to walk, it does not ensure that it can achieve adaptive and stable walking in different conditions, which is also an obstacle to the rehabilitation of the exoskeleton rehabilitation robot. Therefore, the study of the key technology for the stable walking of the lower limb exoskeleton rehabilitation robot has very distinct pertinence. It can provide powerful technical support for the disabled people to share the exoskeleton technology, and further promote the development of the related industries in our province, which has a strong scientific significance and social public welfare value.

2. The RESEARCH PROGRESS OF EXOSKELETON ROBOTS

In 1960, GE Corp. developed the equipment Hardiman I, which could only replace one hand of man. Massachusetts Institute of Technology (MIT) has also started research on exoskeleton robot since 1978. At

present, in the framework of the Enhanced Human Exoskeleton program, the Pentagon developed full military exoskeleton robots with legs and hands, which can help lifting weight, aiding walking, and carrying more ammunition and more heavy weaponry.

For instance, SARCOS company has developed a wearable, energy automated robot (WEAR) prototype in 2005. The Berkeley Lower Extremity Exoskeleton (BLEX) project [1-2] in the US Army of Berkeley's robotics and human engineering laboratory had also matured. The device consists of a backpack rack, metal legs and corresponding power equipment with the hydraulic transmission system in the knapsack and the box type micro speed sensing instrument as the energy source of the hydraulic pump, in order to enhance the human body function completely.

In the present society, more and more people have lost their ability to walk independently because of accidents, congenital heredity, disease and other reasons. Many people have to spend their lives on wheelchairs, and unable to recover their normal walking ability [3] for a long time because they are unable to get good rehabilitation training [4]. Since Hospitals do not have the facilities to help patients do fundamental physical exercise to get rehabilitation, auxiliary walking exoskeleton robot came into practice. The joint position of the exoskeleton robot is equipped with a special servo control system, which provides power for the motion of the joints. The joint angle value and the acceleration value of the exoskeleton robot will change constantly when the exoskeleton robot works. These states of skeletal robots continually switch based on outside conditons.

At present, the research on exoskeleton robots of lower limb assistance has become a hot direction in the international "man-machine integration" project [5-16]. It has attracted a large number of scientific research teams and institutions to carry out the research of exoskeleton robots. In recent years, a lot of achievements have been achieved [10-12]. In the near future, walking in the lower extremities will lead exoskeleton robots into the lives of thousands of ordinary families.

Playing a leading role in robotics, Japanese scientists and engineers developed their own exoskeleton robots. The Cybernics Laboratory at University of Tsukuba (Cyberdyne Company) in Japan developed the world's first commercial Hybrid Assistive Leg (HAL) robot with the mixed leg in 2004. The device could help the disabled to walk at a speed of 4 km/h and climb the stairs effortlessly. The motion of the HAL machine leg is controlled by the automatic controller by the user without any console or external control equipment. HAL consists of a backpack, a set of inductive control devices equipped with computers and batteries, and 4 telex devices (corresponding to both sides of the hip and knee joints). The exoskeleton power auxiliary system, which helps people walk, is equipped with more sensors, such as the angle discriminators, the electromyography sensors, the ground sensors, etc. All power drives, measurement systems, computers, wireless network and power supply equipment are packed in the backpack, and the battery is hung in the waist. According to the principle of physiological feedback and feed-forward, the power assistant controller can adjust the posture of the human body and make it feel comfortable. In 2012, HAL was used to help the Fukushima cleanup, using technology to monitor users' health signals, to provide a "barrier" by affecting the functions of an exoskeleton robot, and to protect the wearer from radiation and other health risks. In 2015, the sales of Cyberdyne increased by 30% due to the advent of the upgraded version of the robot. At the end of 2016, Japan's public health insurance began to incorporate Cyberdyne exoskeletons for medical treatment, which is an important step in the growing popularity of exoskeleton.

In order to develop more advanced exoskeleton robot, Japanese scientists have applied all kinds of science and technology, such as cybernetics, mechanical electronics, biology, medicine, informatics, electronics, physics, mathematics and so on. In addition to the HAL hybrid auxiliary leg, a whole body exoskeleton robot Power Assist Suit (PAS) developed by the Kanagawa Polytechnic Institute can increase the strength of the person by 0.5-1 times, by using a muscle pressure sensor to analyze the wearer's movement, and increase the strength of the human being through a complex pneumatic transmission. In fact, the device was originally developed for nurses to help them care for patients who are heavy or unable to walk.

In 2015, Hiroshima University, in collaboration with the pharmaceutical manufacturer Daya Industrial Corporation (DIC), developed the Unplugged Powered Suit (UPS) for "simplified exoskeleton", which is different from other exoskeletons using motor. UPS uses the user's weight to drive the suit to save energy. When a user walks, his/her body weight injects a certain amount of air into a tube, and then the air is sent to the gel to form artificial muscles.

Also at the end of 2015, MITSUBISHI Motor Co. developed an exoskeleton robot for nuclear disaster with the Japanese atomic energy company, a power auxiliary Kit (PAS), and used the standard configuration of the exoskeleton industry, "hip-knee-ankle" design.

In addition, Panasonic launched a "AWN-03", an exoskeleton robot for workers and old people, which counteracts the weight of 15 kilograms (33 pounds) and reduces the pressure of the loader's waist. This is not the only exoskeleton robot that Panasonic developed. Its robotics department, ActiveLink, also developed an

exoskeleton robot called PLN-01, which can help people walk and move more easily.

Now, the United States and European countries have also done numerous leading research on rehabilitation robots. For example, The University of Balgrist in Switzerland and the Swiss Federal Institute of Technology jointly developed Lokomat, a robot system for the rehabilitation of lower limbs and mainly used as an automated equipment for gait training and rehabilitation of hemiplegic patients. Lokomat is characterized by the design of exoskeleton as a hip and knee joint with a total of two degrees of freedom. The DC servo motors independently drive the ball rods to achieve the movement of each joint and drive the patient's rehabilitation training. The training of the foot ankle joints of the trainees mainly relies on the spring tension device to achieve the flexing training movement of the swing phase. The required joint angles, leg pressure, and the output torque of the hip and knee motors are all detected by the corresponding sensors. According to the measured value of the sensor installed, tracking the walking trajectory and referring to the normal gait trajectory as an evaluation of rehabilitation effect. In the passive training mode, the lower limbs of the trainer are tied to the rehabilitation training system based on the requirement of the robot training. It is necessary to actively participate in the rehabilitation training and exercise the strength of the lower limbs of the patient, while the force on the exoskeleton mechanical leg makes the joint torque change. In summary, the advantages of Lokomat are: 1) the use of virtual reality technology can improve the initiative of the training participants; 2) the parameters can be adjusted according to the height of different patients, in order to expand the scope of rehabilitation training; 3) the whole process of patient training is monitored in real time.

The Institute of mechanical engineering and medical school of Delaware University in the United States had studied the balance structure based gait correction robot for exoskeleton of lower extremities. The mechanism is characterized by a gravity balance mechanism, which aims to help patients reduce the impact of gravity on rehabilitation gait during rehabilitation training, thus achieving the purpose of auxiliary walking rehabilitation training. The whole mechanical system is made up of telescopic springs and structural parts. Because it belongs to the passive mechanical exoskeleton, it does not include any power mechanism. When considering the adaptability problem in design, the leg size can be adjusted to comfortable position when the patient is wearing.

Free University at Berlin of Germany has developed the Mechanical Gait Training (MGT). It can simulate the movement track of the ankle joint when the human body is walking. At the same time, each part can coordinate and cooperate to drive the different gait track of the patient, realize the rehabilitation training for the lower limbs of the patient, and also realize a variety of rehabilitation training modes. A high precision and high resolution force sensor and a track sensor were installed on the pedal, and the patient's accurate gait information can be obtained. According to this, the doctor can determine the effect of the patient's rehabilitation training and arrange the training plan for the patient.

The lower extremities exoskeleton robot ReWalk developed by Argo Medical Technologies, Israel, had entered the product sales phase. Paralytic patients can stand up and walk freely with the help of this robot.

ReWalk body consists of three parts: an electric leg bracket, a body sensor, and a backpack. There is an auxiliary but indispensable device outside the body's exoskeleton, a pair of crutches, which assist the patient to maintain balance. The controller and the battery are placed in the backpack. Because the target user of Rewalk is disabled, the preset gait is adopted. After wearing an exoskeleton robot, the patient can use a remote belt to select a certain body position, such as standing, sitting, walking, climbing and so on, then tilting forward to activate the body's sensor, making the mechanical leg in motion, and then driving the wearer to carry out the related movement.

3. CONCLUSION

The application of exoskeleton robot to assist medical rehabilitation could benefit large numbers of disabled people. Therefore, the study of the key technology for the stable walking of the lower limb exoskeleton rehabilitation robot has very distinct pertinence. It can provide powerful technical support for the disabled people to share the exoskeleton technology, and further promote the development of the related industries in our country, which has a strong scientific significance and social public welfare value.

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Design, Production and Analysis of Stadium Structural Model

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Abstract: The development history of model reflects the progress of human social science and technology. The means for processing, the environment in which they live, and the design concept are changing constantly, but the only thing keeps unchanged is the goal of human development. Human develop toward transforming the depth and breadth of objective things, which requires a more realistic, comprehensive and systematic simulation as well as reflection of the real world. Model making will evolve in all directions, including the performance, tools, materials and manufacturing processes.
Keywords: House; Structure; Model; Design

1. BACKGROUND

Model is a fashionable and enduring handicraft product that is exquisite in workmanship, colorful, light and durable, cheap while in good quality. Except for self entertaining, it is also very suitable for being given as a gift, so model is very popular among consumers. In the past, only a small crowd of people were interested in model, which did not receive much attention, but now it becomes more prevalent thanks to network development. Many model enthusiasts in different regions of the world, such as Germany and Taiwan, have set up online communities and web pages about model creation so as to share their experience in making models. Meanwhile, the regular exhibitions they hold in different places make models more popular

As a very environmentally friendly casual game, it is suitable for people in all ages. For example, model can be taught as a manual class in primary and secondary school to improve students' hands-on ability. The increasingly diversified themes of model that involve in military facilities, scientific instruments, architecture, animals, toys, and film and television contents not only can stimulate children's interest, but also will expand their knowledge. For the elderly, model can be a puzzle game to alleviate loneliness; for young people, it is a pressure relief game that can be done independently or by teamwork.

2. ADVANTAGES

(1) Low Threshold

It is possible to start making only with a pair of scissors, a pen knife, a ruler and a bottle of glue.

(2) High Cost Performance

There is no lack of super large works several meters in length, which are very magnificent.

(3) Low Cost

Model lovers only need to find the model they like, adjust the model size according to their own preferences, print it out with an inkjet printer and then paste it, which gives high freedom.

(4) Interesting production process

Model is completely printed on the plane of sheet, so the production is a process from plane to three-dimensional with high difficulty. In particular, the precision mold produced in Eastern Europe often contains thousands of parts, so the production cycle is long.

3. PROJECT DESIGN

(1) Taking photos

Taking photos of the building to make, observing the details, thinking about how to splicing, discussing with the team members, consulting the instructor where there is controversy.

(2) Design of 3D Model

Creating a 3dsmax model of the building, establishing scale and marking the details

(3) Drawing Design

Making the drawing of each building through CAD.

(4) Drawing Modification

After sample making of the building, trying to put it together, modifying the unreasonable places, and then re-sampling the unreasonable area again.

4. PROJECT REALIZATION

(1) Building sample making

Purchasing the PVC board needed for sample making of the building, and then printing the parts of building through the printing machine and printer.

(2) Building splicing

Asking the director of each building to splice the parts printed according to the drawing, improving unreasonable places, re-sampling and splicing again.

5. MAKING OF STADIUM MODULE

(1) Establishment of Stadium 3D Model

completing the building modeling of stadium through

the tools such as cube double-track sweep, Boolean operation association, array, combination, trim, movement, rotation, and three-axis zoom. The real photo of stadium is shown in Figure 1.

Fig.1 Real Photo of Stadium

The 3dsmax model of stadium is composed of a plurality of irregular hexahedrons, rectangular parallelepipeds and trapezoids. The completed 3dsmax model of the stadium is shown in Fig.2.

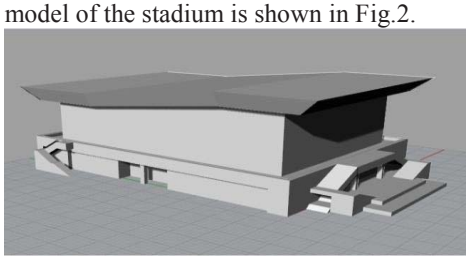

Fig.2 Stadium 3dsmax Model

The front view, top view, right view, and full view of completed stadium are shown in Fig. 3, Fig. 4, Fig. 5, and Fig.6.

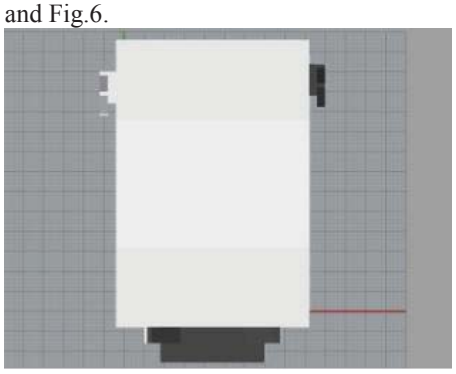

Fig.3 Top View

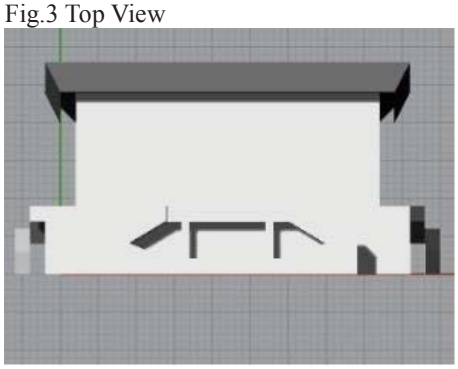

Fig.4 Front View

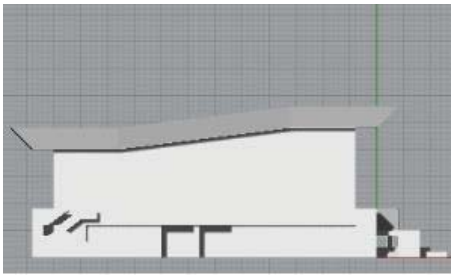

Fig.5 Left View

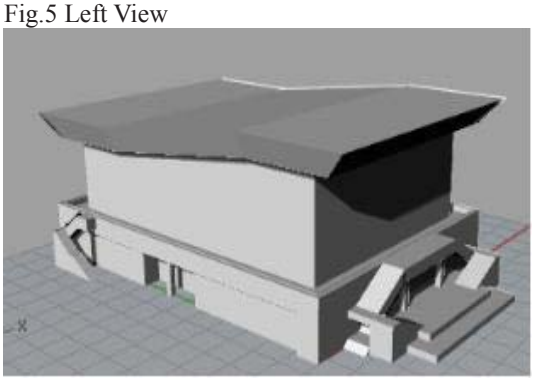

Fig.6 Full View

(2) Adding Indications

The front view, top view, right view and full view after indicating the scales of each part of the stadium are shown in Fig. 7, Fig.8, Fig.9 and Fig.10

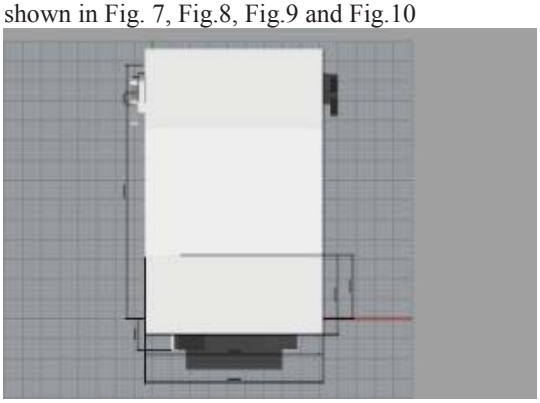

Fig.7 Top View

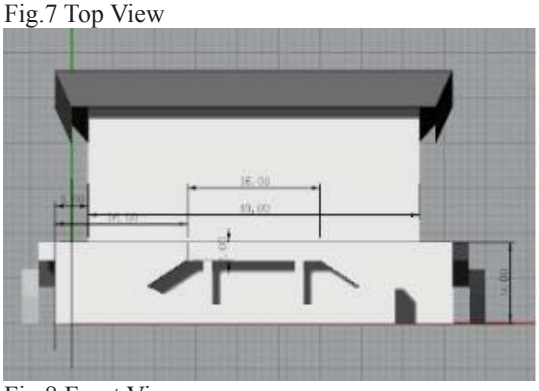

Fig.8 Front View

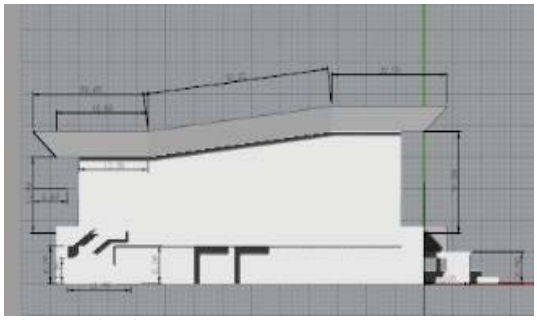

Fig.9 Left View

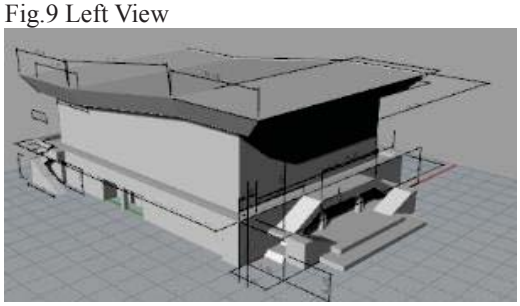

Fig.10 Full View

(3) Establishment of Stadium Drawing

After opening the CAD interface, click [File] → [New] command so that the dialog box of "Create New Document" appears, selecting the size of A4 unit and click the [OK] button to create a new document. Adjusting the object size and position through rectangular and hand-painting tools in 3dsmax model so as to complete the design of the stadium drawing. The stadium drawing is composed of a plurality of rectangular parallelepipeds, trapezoids, irregular pentagons, and irregular hexagons. The completed stadium drawing is shown in Fig. 11.

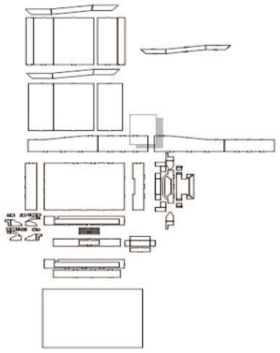

Fig.11 Drawing of Stadium

The drawing after adding holes and connections to the joints of stadium is composed of multiple rectangle, trapezoids, irregular pentagons and irregular hexagons, along with the overall framework adding multiple holes and a plurality of connection fixing points. The completed drawing of adding holes and connections to the joints of stadium is shown in Fig. 12.

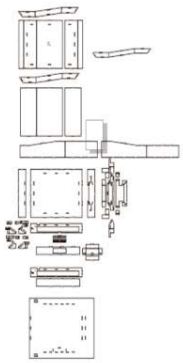

Fig. 12 Drawing of adding holes to stadium

The components in details of stadium are shown in Fig. 13.

Fig 13. Components in stadium details

When building the stadium, considering the complex roof structure in curved structure, and the construction material PVC board is relatively hard, so the roof of stadium is designed into folding surface, as shown in Fig. 14.

Fig. 14 Surfacing Design

6. MATERIAL SELECTION

(1) Waterproofing, flame retardant, acid and alkali resistant, anti-mite, light weight, heat preserved, sound insulated, and damping characteristics;

(2) Can be processed just the same as wood with superior processing performance;

(3) Ideal substitutions of wood, aluminum and composite board;

(4) PVC board is often used to make cabinet and furniture with smooth surface and high hardness, which is not easy to be scratched

(5) Self extinguishing with flammability; assured for use;
(6) Not apt to lose luster or aging based on the water-proof formula;
(7) Light texture; convenient for storage, transportation and construction;
(8) Suitable for thermal forming, heating bending and folding process;
(9) Available to be welded according to general procedure and being spliced with other PVC materials;
(10) Easy for printing with smooth surface.

PVC foam board, also known as PVC board, contains a chemical composition of polyvinyl chloride, so it is also called a foamed polyvinyl chloride board. It is widely applied to passenger cars, train car roofs, cabinet core layers, interior decoration panels, building exterior wall panels, interior decorative panels, offices, dwellings, public space building compartments, commercial decorative frames, clean room panels, ceiling panels, screen printing, computer lettering, advertising signs, display panels, sign board, album board and other industries such as chemical anti-corrosion engineering, thermoforming parts, cold storage panels, special cold preservation engineering, environmental protection board molds, sports equipment, aquaculture materials, seashore waterproof equipment, water-resistant materials, art materials and various light partitions that replace glass ceilings.

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Recent Progress of Artificial Intelligence in Automatic Programming

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Abstract: Since 2014, researchers engaged in artificial intelligence have started to deal with the field of automatic programming, which is another important application of artificial intelligence. The system that the researchers first proposed wouldn't write code, it didn't produce human-readable code. until 2016, when there were some frameworks that could generate simple code. This kind of framework is mainly divided into two categories, one is use the neural network and reproduce the behavior of the program. One is to produce snippets of code that can be read by humans through learning. In this paper, we mainly introduce the development of artificial intelligence technology in the field of automatic programming, then we introduce the application of automatic programming.

Key words: artificial intelligence; automatic programming

1. INTRODUCTION

The core problem of automatic programming is to solve program synthesis. Researchers have been engaged in this field for a long time. In this paper, we mainly introduce the development of artificial intelligence technology in the field of automatic programming, then we introduce the application of automatic programming.

(1) The development of program synthesis

The task of program synthesis is to find the required programs from the program space that satisfy some form of constraint (user's intent).Different from the traditional compilers through semantic translation, the senior code translated into low-level code. Artificial intelligence of automatic programming usually go to search in line with the constraints of task in the program space, one of the most common constraints is input and output pairs.

Program synthesis has been considered as the core problem in the field of computer programming for a long time0.Nowadays, the technology of programming language, artificial intelligence has made great progress in this field. As early as 1932, in study of structural mathematics, the idea of constructing an algorithm by combining solutions to small problems was proposed0.After that, there was a lot of outstanding work on program synthesis000.The main idea behind these methods is to construct the proof of the specification provided by the user, and then use the proof to extract the corresponding logic program. Another popular method after that is the conversion based on synthesis, in which a complete high-level specification is repeatedly converted until the required low-level programs are implemented0.

The deductive synthesis method assumes a complete and formal specification of user intent, but in many cases it is proving as complex as the programming itself. This leads to the creation of new standards-based inductive synthesis methods, such as input and output examples, demonstrations, and so on. Shaw0 proposed a Learning framework from several input and output examples called LIPS (Learning Inductive Program short).Summers0 and Biermann0 developed techniques to learn a lot of the LIPS program from multiple input and output examples. Pygmalion0 proposed the first system to successfully implement programming as a constraint, and it infer a recursive program from the concrete execution of a program. Evolution in the use of genetic algorithm to automatically compliance program0, there are also many groundbreaking work, these methods are inspired from Darwin's theory of evolution, and will be a random program population evolution for a new generation unceasingly, until to produce the required procedures.

The recent program synthesis approach allows users to provide a framework (syntax) for a possible program space in addition to the specification0.This brings two benefits, firstly the syntax provides the structure for the hypothesis space to achieve a more efficient search process. Second, learning programs are easier to interpret because they are derived from grammar. The Sketch system0 first implements this idea, allowing the programmer to write part of the program draft (with a bug program) and then automate it according to some specifications. FlashFill00 is probably one of the most successful programming system, it is applied in the Microsoft Excel, FlashFill0 use based on regular expression string conversion domain specific language to define the hypothesis space program, and use the synthetic technology based on space algebra from the input and output pairs of few effective synthetic string

conversion program.

Many modern programming applications are built on a few meta-synthetic frameworks. This framework allows the user to define a space program alone (syntax or application framework), and describe some insights about the synthesis algorithm (for example, by encoding the synthesis problem to SAT/SMT operator inverse semantic constraints or program), then the framework automatically converts these definitions to the efficient synthesis of a given application domain. The most popular composite framework includes the aforementioned Sketch system, the Flashfill programming framework in the example, and the Rosette virtual machine0 used to solve the auxiliary programming.

(2) The Challenges of Program Synthesis

Program synthesis is known to be a very challenging problem, and there are two main reasons for this, program space is hard to navigate and the diversity of user intent.

a. Program space

In the most general formula of the program space (formula: a complete programming language + arbitrary constraints), program composition is unknown. Therefore, almost all successful program synthesis methods perform some kind of search method in the program space, and the search itself is actually a complex combination problem.

Early procedural synthesis methods focus on deduction and transformation methods00.This method is based on the theorem of an exponential growth tree, proving deductive reasoning or modification of retained code rewriting rules. Both methods to ensure the generated program to satisfy the constraints provided by structure but theorem proving or code rewrite cycle non-deterministic nature does not guarantee the efficiency of the synthesis process is terminated, even lead to search the successful application of similar technologies adopted ingenious domain specific heuristic methods to reduce the derivation tree00.

Over the past 20 years, the rise of comprehensive program research has led to many breakthroughs in technology and algorithms. First, the evolution of Moore's law and constraint solving allows for greater programming space within a reasonable period of time. Second , the new method of enumeration program space, such as random technology00 and deduce the top-down search technology, makes it hard for synthesis technique was applied to the program through theorem and rewrite the rules of formal occasions. However, while modern synthetic programming techniques produce considerable actual code snippets, they still rarely apply to industrial-scale projects. For example, at the time of writing this article, the most advanced super optimization technology, by Phothilimthana0, found that the program space of 1079 could be generated. Instead, the program space required for the industry is much larger than 1079, such as the MD5 hash function, which requires a program space of 105943.In the future, the progress of the new algorithm and the clever use of specific knowledge in the domain provide a broad research field for the planning of large-scale program space.

b. User intent

Even with efficient search technology, the program synthesis can't achieve the goal of automatic programming immediately. Another challenge in program synthesis is the precise interpretation of the user's intent, the specification of the target code. There are many ways to indicate user intentions, such as formal logical specifications, informal natural language descriptions, and input/output equivalence. For example, the given an input/output (" Zhang San "- >" San, z. "), FlashFill can generate millions of blocks of code to match the input and output pairs, most of which have a code block for fitting of input and output pairs, and cannot really reflect the user intent. However, if there is no additional interaction, the FlashFill system does not distinguish between these over-fitting code blocks.

2. THE TECHNOLOGY OF ARTIFICIAL INTELLIGENCE IN AUTOMATIC PROGRAMMING

(1) Deep learning technology

The problems of program synthesis and program induction have caused great interest in people engaged in deep learning in recent years. The method of using deep learning to solve program induction is mainly divided into two major categories. The first category is program induction, and the second category is program synthesis. The neural network framework of program induction can replicate the network of program behaviors. The neural network framework of program synthesis can return an interpretable program that matches the required normative behavior.

a. Program induction technique

Using program induction techniques, the developed neural network framework can learn the behavior of programs that are consistent with given input and output examples. Most of these neural network architecture calculation modules are inspired by the CPU00 or GPU0, and the data structure uses the stack0. As NTM (Neural Turning Machine) proposed by Alex Graves, NTM expands the capabilities of a neural network framework by coupling external storage resources and neural networks. The neural network framework interacts with external storage through additional processes. The system thus

combined is similar to the Turing machine or von Neumann architecture, but its subtle end-to-end structure makes it possible to effectively train the samples by the gradient descent method. Preliminary results indicate that the Neural Turing machine can infer simple algorithms such as copying, sorting, and associative memory from input and output examples.

Since NTM is not parallel, and it is difficult to train due to its own depth, Lukasz Kaiser proposed a new neural network framework to solve this problem, namely the neural GPU. It is based on a periodic unit of convolution control and, like the NTM, is basically the same in terms of computational modules. Unlike the NTM, the neural GPU is highly parallel, which makes it easier to train and run efficiently. The neural GPU can be trained on short instances of algorithm tasks and successfully extended to long instances. The researchers performed validation on a number of tasks, including long addition and long multiplication in binary representations. Even if the neural GPU is trained as a 20-bit number, no errors will be found during testing.

At present, the most typical neural network framework for program induction is Scott Reed et al.'s neural program interpreter NPI (Neural Programmer Interpreter). NPI is a circular combined neural network framework. NPI has three components for learning: 1, Task-independent looping kernel. 2, a permanent key-value memory. 3, A specific encoder allows a single NPI to operate in different environments and provide different scenarios for support. NPI promotes learning and writing higher-level programs by learning to write low-level programs, thereby reducing sample complexity and generalization ability. After the program memory allows the task to be established on the basis of the existing program, so that it has a memory. NPI can also use the environment (for example, a pad with a read-write pointer) to cache the intermediate results of calculations, reducing the long-term memory burden of hiding the cells.

The core structure of NPI is Long Short Term Memory (LSTM), which was proposed by Sepp Hochreiter and Jurgen Schmidhuber in 1997[30]. After Alex Graves's improvement, it has become the mainstream technology for program induction. LSTM can successfully copy program behavior. LSTM can successfully reflect that the program behavior depends on its cell state can be maintained and updated in real time. The cell state is closely related to the internal structure of LSTM. Inside the LSTM, there are three gates that work together to save and update the cell state. The gate are forget gate, input gate, and output gate.

Oblivion gates determine the current cell state and need to delete some unnecessary information. The input of the Oblivion Gate is the output of the previous cell and the current external input. The output of the Oblivion Gate is a number between (0,1). In extreme cases, "0" represents the state of completely forgetting the last cell, "1" The representative fully retains the state of the previous cell.

$$\mathrm{f}_t = \sigma(W_f \cdot [h_{t-1}, x_t] + b_f) \quad (1)$$

$$i_t = \sigma(W_i [h_{t-1}, x_t] + b_i) \quad (2)$$

The input gate determines which parts of the new information need to be retained, including two parts, which first information needs to be updated, and the second provides candidate information c_t that needs to be updated information

$$\mathrm{C}_t = \tanh(W_c \bullet [h_{t-1}, x_t] + b_c) \quad (3)$$

The output gate determines what kind of information o_t is output for the next cell

$$o_t = \sigma(W_o [h_{t-1}, x_t] + b_o) \quad (4)$$

Recently, researchers have proposed neural network frameworks that can learn interpretable procedures. For example, the neural FlashFill0 system proposed by Emilio Parisotto, in order to overcome the difficulties of massive calculations, difficulty in training, poor scalability, and difficulty in verification, FlashFill uses a new technology, namely neural symbol program synthesis. The technology is based on two new neural modules. The first module is called a cross-correlation I/O network and the second module is called a recurrent neural network (R3NN).

The cross-correlated I/O network produces a set that can continuously represent pairs of input and output. The cross-correlation encoder first passes the input and output strings through the LSTM bidirectionally, and then calculates the correlation between the two output tensors derived from the LSTM. The key reason for doing this is to understand what part of the input string comes from the output string.

In DSL, R3NN can learn the tree generation model. The model has four parameters: 1. Each symbol in the grammar is represented by a vector. 2. Each rule in the grammar is represented by a vector. 3. Use the deep neural network as input for the RHS symbol set and generate the corresponding LHS symbol set as a representation. 4. Use the deep neural network as input for the LHS symbol set and generate the corresponding RHS symbol set as a representation. The R3NN first assigns a vector representation to each leaf node of the partial tree, then performs a recursive transfer in the tree, assigning the global representation to the root. Then perform a reverse recursive transfer from the root, assigning a global representation to each node in the tree. The idea is to assign a representation

to each node in the tree so that the node knows every other node in the tree.

After the experiment, the FlashFill system can successfully synthesize two pieces of code after training with the synthesis program of 13 program code fragments. At present, the best training strategy is to choose the best distribution in each subscale, and the correct rate can be set to 60%. When the number of samples is sufficient, the accuracy rate can be increased to 97%.

Karol Kurach0 proposed a neural random access machine. It can manipulate and cancel pointers to random access memory for external variables. Back propagation training is used from input and output examples. We evaluate new models on some simple algorithm tasks that require pointer manipulation. Our results show that the model can learn algorithm tasks and can operate on simple data structures such as linked lists and binary trees. For simpler tasks, the learning solution is summarized as an arbitrary-length sequence. In addition, during the reasoning process, under certain assumptions, memory access can be performed for a constant amount of time.

The core idea of these neural network frameworks is to develop an operable network that can be expressed continuously, and then use neural controllers to train them or use enhanced learning methods to learn program behaviors. Although the process has been summarized in several good neural structures, there are some drawbacks. One of the disadvantages is that it does not produce human-readable code, and it requires a lot of computing resources and requires thousands of input and output pairs for each program synthesis problem.

b. Program synthesis technology

DeepCoder0 is a masterpiece of a neural network framework that produces pieces of readable program code that can return a human-readable program that matches the required specification.

The generated program code can be divided into four parts. The first part is to select the appropriate DSL (Domain Specific Language, which is a programming language suitable for specialized areas, but more stringent than the common programming language). DSLs are analogous to SQL statements. Advanced functions are used sequentially to manipulate data. A program in the selected DSL is a sequence of function calls in which the result of each call will initialize a new variable, either a single integer or an array of integers.

The second part generates the data set. To generate a valid input for a program, we force the integers of the output value boundaries to be within a predetermined range, and then propagate these constraints backward through the program to obtain the valid value of each input. range. If one of the scopes is empty, we will give up this program. Otherwise, an input-output pair may be generated by picking an input from a pre-calculated effective range and executing a program to obtain an output value.

The third part uses neural network modeling to map input and output pairs to attributes. This part can be divided into two steps: 1. Encoder: Maps a set of input and output pairs generated by the program to a vector. 2. Map the generated vector to the program's properties. The encoder is a simple forward feedback structure. It first encodes the type of the input and output, and then maps each integer in the input and output to a vector of length 20. Then the type of the input, the type of the input, and the output The outputs are all connected to a single vector and passed through a three-layer, hidden layer of 256 neurons per layer. Finally, the output is mapped to the corresponding program properties by simple arithmetic averaging.

Through the properties of the program generated by the neural network, the program code that matches the input and output pairs is searched for. The prediction program from the input and output examples can be viewed as a multi-label classification problem where each instance (input-output pair) is associated with a set of related tags (functions that appear in the generated sample code).

The Hamming loss function can calculate the number of mispredicted tags by a classifier h:

$$o_t = \sigma(W_o[h_{t-1}, x_t] + b_o) \quad (5)$$

The Rank loss function can distinguish between related and non-related tags by the scoring function f:

$$L_r(y, f(x)) = \sum_{(i,y):y_i=1, y_j=0}^{C} 1_{\{f_i < f_j\}} \quad (6)$$

The Zero-One loss function can determine if the h classifier is all predicting correctly:

$$L_s(y, h(x)) = 1_{\{y \neq h(x)\}} \quad (7)$$

According to the loss function, the probability of the function appearing in the program space is deduced, and the automatic encoding of simple tasks is realized.

At present, there are also some related studies on comprehensive procedures that use quantitative goals. The idea of procedural smoothing is to simplify the synthesis problem into a series of numerical optimization problems. In some continuous spaces, the program is approximate. With the development of the sequence, the approximate goal is getting closer and closer to the original quantitative goal. The idea of combining program smoothing and neural program synthesis techniques is very beneficial for synthetic tasks with quantitative goals.

Finally, there have recently been some probabilistic

programming languages such as Terpre0, a programming language specifically tailored for program synthesis problems. The model expresses the specification (ie, the declaration of random variables) and describes how the program maps the input to the output. The interpreter consists of. Terpre has two special advantages. First, it supports fast search in the program space. Second, the model can separate the specification constraints from the reasoning algorithm. In the face of different problems, it can choose different inference algorithms. For simple problems, the model can also automatically select inference algorithms including machine learning, program synthesis techniques, and so on. Similar to Terpre and Forth et al., these techniques are based on programmers writing some code, and then use gradient descent to improve the code to match the requirements.

(2) Machine Learning Technology

At present, the technology of machine learning is mainly used to guide the search process in the program space, aiming to improve the efficiency and accuracy of search programs0. For example, Percy et al. proposed to introduce a non-parametric hierarchical Bayesian function before sharing statistical strength among multiple tasks. The key is parameterized multi-task sharing. For this reason, Percy introduced a program based on combinational logic. The expression method also provides an MCMC algorithm that can perform safe program conversion on the representation to reveal the shared program substructure.

Menon et al. proposed a machine learning framework that uses input and output programming. The program space is set to the CFG (Context Free Grammar). Given a set of input/output pairs, the system learns the grammar rules with different weights (Called as a clue to get the Probabilistic Context Free Grammar (PCFG) corresponding to it, and then use the PCFG to guide the enumeration search to find the desired program. The weight of different grammar rules depends on the input and output pairs as well as the selection of the corpus used by the training input and output. The framework can be instantiated in a text processing language and add text functionality to FlashFill. Experts in the field have also manually defined some important features in order to allow the learning algorithm to better select the more qualified code from the input and output pairs. These features include dedup cue, which can check whether any string in the output string is copied, sort_cue can check whether the output string is sorted, and so on. The learning process uses a clue for the desired project. A set of input/output pairs (x,y) depends to a large extent on certain features of the structure, namely (x,x). The result of this approach is an improvement in the performance of the enumeration base by an order of magnitude. The disadvantage of this framework is that manually setting useful clues (characteristics) is a time-consuming and difficult task that requires a lot of domain knowledge. In addition, due to the weighted results learned in the PCFG, the framework cannot use the context information of the partial trees generated during the search, making it impossible to direct the exploration more effectively.

3. AUTOMATIC CODING OF APPLICATION

(1) data reduction

The digital revolution has led directly to the massive digitization of human data, Over the past few years, as cloud computing and the Internet of things have grown, so has the explosive growth of machine-generated data. Now data is a new form of oil, is the new currency of the digital world, data can be guide businessmen to make the right business decisions, can give the directional crowd on the targeted advertising, etc., which embody the value of the data. In the face of such a huge amount of data, it is very urgent to use the machine to sort out the data.

Data collation is the process of clearing, transforming and preparing the initial data. It processes the original semi-structured data into more structured data for human analysis and utilization. It is estimated that the current data engineers and scientists spend most time on the data collected, in order to convert data into a form of can be applied to machine learning, and fast and efficient target results. For small data processing of disposable, users want to interaction with the system as soon as possible, and synthetic procedure may be hidden, and for processing big data, the user can still hope check to verify that the program is correct.

a. data transformation

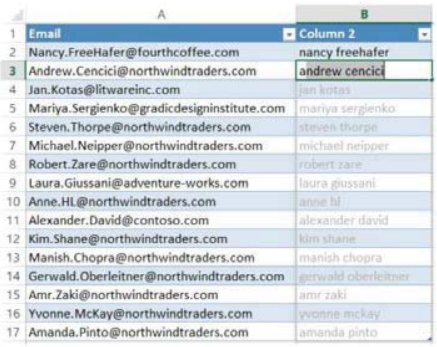
One of the most useful applications of program synthesis is data conversion of strings or other data types in context. Data conversion is a tedious task that requires a lot of people to perform, and there is no specialized programming technology to automate data conversion.

Like Microsoft Excel spreadsheet system provides to the user use the built-in string and digital library to write macros, Microsoft Excel with about 1 billion users worldwide, but unfortunately, 99% of the users are not proficient in programming, they find it so hard to write the macro or script. After many rounds of communication between users and experts, it is found that PBE is the ideal technology to solve this problem.

Change the string format

As shown in figure 3.1, you want to convert the E-mail address form like "Firstname.Lastname@domain" to "Firstname Lastname" format, This change in string format often leads to error deletion, incomplete

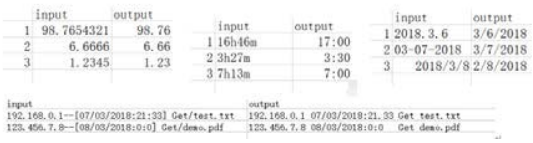
removal, and low labor efficiency. In this case, FlashFill PBE technology to shine, it can learn a set of input and output sample, thus to generate a forecast for the next string conversion code, when the next similar tasks, it can be replicated on a task.



	A	B
1	Email	Column 2
2	Nancy.FreeHafer@fourthcoffee.com	nancy freehafer
3	Andrew.Cencici@northwindtraders.com	andrew cencici
4	Jan.Kotas@litwareinc.com	jan kotas
5	Mariya.Sergienko@gradicdesigninstitute.com	mariya sergienko
6	Steven.Thorpe@northwindtraders.com	steven thorpe
7	Michael.Neipper@northwindtraders.com	michael neipper
8	Robert.Zare@northwindtraders.com	robert zare
9	Laura.Giussani@adventure-works.com	laura giussani
10	Anne.HL@northwindtraders.com	anne hl
11	Alexander.David@contoso.com	alexander david
12	Kim.Shane@northwindtraders.com	kim shane
13	Manish.Chopra@northwindtraders.com	manish chopra
14	Gerwald.Oberleitner@northwindtraders.com	gerwald oberleitner
15	Amr.Zaki@northwindtraders.com	amr zaki
16	Yvonne.McKay@northwindtraders.com	yvonne mckay
17	Amanda.Pinto@northwindtraders.com	amanda pinto

Fig.1 Digital date conversion

PBE is also suitable for conversion of Numbers and the conversion of dates0, for example (a) to be accurate to two decimal places after a decimal point.(b) transfer the time to the nearby half.(c) adjust the date to a uniform format.



	input	output
1	98.7654321	98.76
2	6.6666	6.66
3	1.2345	1.23

	input	output
1	16h46m	17:00
2	3h27m	3:30
3	7h13m	7:00

	input	output
1	2018.3.6	3/6/2018
2	03-07-2018	3/7/2018
3	2018/3/8	2/8/2018

input	output
192.168.0.1--[07/03/2018:21:33] Get/test.txt	192.168.0.1 07/03/2018:21.33 Get test.txt
123.456.7.8--[08/03/2018:0:0] Get/demo.pdf	123.456.7.8 08/03/2018:0:0 Get demo.pdf

Fig.2 String segmentation

A string partition is a long string that splits each substring. As shown in the input columns and the desired output columns, because there are multiple separator, rather than a separator string are all actual separator, so perform desired segmentation is challenging. Also in this case, the input/output pair can be used as a means of expressing intent.

b. data extraction

Data for various types of documents such as text files, log files, spreadsheets, web pages, JSON files, XML files, PDF files and is locked into the corresponding document format. These document formats combine with the underlying data to make storing data much more flexible. Because of this, will make the query, transformation, changes to other storage mode becomes extremely difficult, the data extracted from various kinds of document, added to the structured form, using the appropriate data processing tools, can reduce the complexity of the this kind of problem.

FlashRelate PBE technology can extract relational data from tables in semi-structured spreadsheets. The two-dimensional grid structure of a spreadsheet can store data of higher dimensions by using a spatial layout that includes a header, a space, and a relative position. Although the data can be simple and intuitive visual representation, very suitable for human to understand, but it also means more data processing tools, we will become a semi-structured this spreadsheet, because their data is regular format, but still can't access data processing tools, FlashRelate allows the user to provide the sample in the output table, then FlashRelate will produce a matching code, made from the input of semi-structured data extract more similar to a spreadsheet. FlashExtract's PBE technology can extract structured data from semi-structured text or log files. FlashExtract technology has been released in Microsoft products, one of which is the Powershell in Windows10.Another is Microsoft Operations Management Suite, which provides SAAS services for professionals to collect machine data in the cloud.

(2) code suggestion

In the field of software engineering, it is the most direct application of program synthesis to find the following code prompt or to perfect a segment of code. Now most of the code editor or IDE contains a automatically function, the function can be based on the previous code, the next need to enter the code to forecast (such as Microsoft Visual Studio intelligence of components, and keep the agreement content components in Eclipse).For programmers, the automatic generation of code becomes very effective when an unfamiliar API occurs in the program, otherwise the programmer needs to write multiple lines of code to do the same thing. Some predictive components are modeled using n-gram or CNN.

Training for computing resources increase leads to a more widely adopted neural network to predict the probability of sentences, RNN didn't catch a word and a special fixed number of laws between the words before, but to capture the distance between the relationship between words. The original Elman model is shown in the figure. put forward that RNN can be used to predict the model of the I +1 word from the ith word.

In the graph, v^i and y^i are vectors in the D domain, and the D domain is the same as a dictionary, and each of the following possible words x, can be found in the D domain. The RNN uses two functions, f and g, and iterates over the probability of the word in a sentence.

In training, functions f and g can learn from the data how to minimize the error rate of y^i.

$$\Pr(w_{i+1} \mid w_1 \cdot \ldots \cdot w_i) \approx y^i_{w_{i+1}} \qquad (8)$$

(3) Google's bug prediction tool -- bugspots.

In Google company to produce large amounts of code every day, every month and fifty percent of the code from the Google code repository will be updated, in order to keep the code base of robustness, the code requires not only by the current test, and the new test

should also be used for any new functions. And some of the code runs very well, and in certain cases, the code returns the error. Google in order to prevent the bugs of the similar handle hard into the code base, the use of machine learning and probability statistics related knowledge, by creating a connection to the source code control system of the program to realize Rahman algorithm, to display all of the changes to the bug, check each bug number, and through the bug tracking database validation, it is indeed a bug, and then filter out all the other content, the final will be in the top 10% of the output file reference for programmers. Google has now provided an open source version of the bug prediction tool, bugspots, which has been downloaded tens of thousands of times.

By scanning the specified code base with instructions, bugspots produce a similar message, as shown in figure 3, to predict the code that might be buggy.

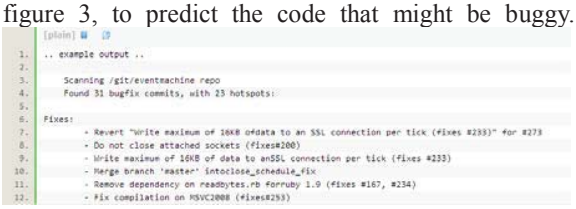


Fig.3 message of bugspots

4. CONCLUSION

Through the use of technology, such as artificial intelligence through task requirements or constraints (such as input/output pairs), so as to realize automatic coding, can efficiently improve the efficiency of compiled code, is an important application of artificial intelligence. Machine learning and deep learning technology application in the field of automatic coding begins around 2014, and most of the researchers put forward learning framework does not truly implement code automatically generated, although a small number of framework can realize simple task code automatically, but the research is still at the initial stage, there are still many questions to be solved.

First of all, because of the artificial intelligence applied in automatic coding time is shorter, with poor ability to deal with problems, and engineering in the actual need to be there is a great distance of the generated code, most of the technology and practical application in development.

Code produced by artificial intelligence, more than a single candidate items, but also it is difficult to verify the correctness of the code, how to pick out the most from numerous candidates that can meet the demand of constraints or code, researchers remain to be improved search, sort and verify the technology.

Current code with poor universality, once the task change, it is hard to generate the code migration to the new task, the neural network need to be trained, so how to improve the reusability of neural network, also need to be resolved.

The task (user's intention) can be reasonably expressed, so that the machine can understand the user's intention as much as possible, and cannot be restricted by the input and output pairs.

Above all, artificial intelligence technique is applied to automatic coding is difficult, but we still firmly believe that with the promotion of technology, the future every step of stabilization, the particular areas of implementation and automatic coding, even completely liberated programmer, is very promising.

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Impact of the Marathon on Health of Education in China

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Abstract: Based on the development of marathon at home and abroad, this paper establishes the influence mechanism indicator system of marathon on health education, and USES AHP to calculate the weight of each influence indicator. In the end, the biggest impact of marathon on education is that it sets an example of great patience and perseverance. In addition, more attention should be paid to the promotion of marathon sports spirit in the operation mode of marathon, providing theoretical support for the development of health education in China.
Keywords: Marathon; Healthy sports; Analytic hierarchy process

1. INTRODUCTION

With the rise of marathon (running) in China, its influence on Chinese health education has attracted more and more attention from many scholars. At present, many domestic scholars have studied the rise process and operation mode of marathon in China. Shi hongyang et al. analyzed the development status and development countermeasures of marathon in China through investigation and research [1]. Few scholars have conducted quantitative research on the impact of marathon on China's health education. Starting from the development status of marathon in China, this paper established an impact indicator system and used ahp to quantify the impact of marathon on health education.

Marathon has certain advantages in many sports [2]. First, it has low restriction conditions on sports equipment, easy to find sports venues and can adapt to geographical conditions in cities, rural areas and other areas. The second is that it can be suitable for the majority of people from the age of ten to sixty or seventy years of age in the way of sports, with a lower entry threshold. The operation mode of the marathon is generally initiated by a certain organization and carried out in a certain area, which is organized and regional. With the rise of marathon in the world, the operation mode of marathon at home and abroad has been formed and the system has been relatively perfect.

(1) Overseas marathon development and operation

In more developed countries abroad, there is a tradition of holding marathon competitions in some cities every year [3]. The organizing form of marathon is mainly urban, the organizing form of the marathon is mostly voluntary participation by the whole people, and the organizing group is mostly voluntary sports organizations organized by the society. The government management mechanism has no direct management power to organize sports events for social sports groups. On the one hand, the social market economy has been effectively developed; on the other hand, the social public benefit has been effectively promoted. The Boston athletic association, a social sports organization, for example, organized the Boston marathon in the United States. The fukuoka international marathon in Japan was also organized by the social sports organization fukuoka amateur athletic association.

(2) Development and operation of domestic marathon

In the early days of the founding of the People's Republic of China, the government led the organization and operation of marathon events in China. In the context of the national conditions at that time, the government can only organize the time arrangement, personnel organization, reception, and funding sources of the sports events. With the progress of reform and opening up, the management mechanism and market economy system of domestic sports events are constantly improved. The state departments carry out government-led sports events are not conducive to the development of socialist market economy, and fewer and fewer sports events. At present, most marathons in China are usually social activities combining government and business, public welfare and profit. Nowadays, the operation mode of sports events has adapted to the political system and social system of our country, and promoted the economic development and marketization of our country. The Shanghai international marathon, for example, was organized by the Shanghai international marathon organizing committee of the Shanghai sports bureau, an interim body under the Chinese government's sports ministry.

(3) The status quo of China's marathon

The expansion and development of marathon scale and mode reflect the development of China's economy and

society [4]. In the course of economic and social development, people's material standard of living has been continuously improved, and the pursuit of spiritual life has become more urgent. The rise of marathon (running) in China has adapted to the development level of Chinese society and met the spiritual needs of the people. The great changes in the lifestyle, the continuous improvement of the average production efficiency of the society, the constant improvement of people's requirements for physical health and physical and mental health, the increasing proportion of mental work in social work, and the increasing demand for people's sports and fitness skills. Therefore, there will be a big difference in the way and time of fitness between different income groups. The following is the fitness rate at different income levels, as shown in Table 1:

Table 1 Ratio of income to weekly and fitness times:

Income	Number	2 to 3 times per week and the number of people above	Percentage (%)
Less than 1500 yuan	92	38	41.3
1500-3000 yuan	123	108	87.80
3001-5000 yuan	95	87	91.85
5001-10 thousand yuan	36	31	86.11
More than 10 thousand yuan	7	6	85.71

It can be seen from table 1 that the income level of the people is closely related to the average weekly fitness times, among which the monthly income of the people between 3001-5000 yuan has the highest fitness time's ratio and the lower the income of the people with lower fitness time's ratio. Marathon can effectively relieve people's work, study and life pressure, and provide people with a channel to vent their pressure, release themselves and exercise their body.

2. STUDY ON THE INFLUENCE OF THE RISE OF MARATHON ON EDUCATION HEALTH

Due to the low threshold of entry, amateur runners, even college students and white-collar workers in urban areas have the opportunity to compete with professional athletes at the same level [5]. After the 20th century, marathon competitions began to rise in China and developed rapidly in China. The number of cities hosting marathons and the number of marathon runners increased rapidly. The influence of marathon on health education is also becoming more and more significant. In this paper, the influence index system of marathon on health education is established from two aspects, to further study the influence mechanism of marathon on health education, as shown in figure 1.

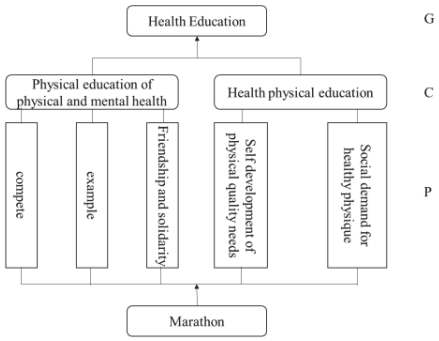

Fig.1 The impact index system of marathon on health education

Considering education in sports spirit, the rise of marathon has stimulated people's desire for sports, created an atmosphere of education in sports, spread sports culture, and provided spiritual support for education in sports health. First, as a kind of sports competition, marathon is full of the competitive spirit of sports competition. Marathon competition not only has the competition of physical quality and endurance, but also has the advantage competition of running skills and accumulated over a long period of exercise, effectively spreading the competitive spirit for education. Secondly, the winners in the marathon generally have the sports foundation of perseverance and long-term exercise, and most of the losers are persevering in challenging the limits. Therefore, the participants in the marathon provide the power of example for sports health education and encourage sports participants to develop the sports spirit. Finally, although marathon is a personal sport, the spirit of friendship and solidarity is especially prominent in the process of competition, and the spirit of solidarity and friendship is carried forward in education.

From the perspective of education, the rise of marathon has raised people's expectation of healthy physical quality, lowered the threshold of physical exercise and increased the way of education [6]. On the one hand, with the increasing social pressure and the further acceleration of urbanization, people's places for entertainment and leisure and time for relaxation and fitness are constantly compressed, which leads to people's increasingly urgent pursuit of healthy life and health. On the other hand, the study and work intensity are continuously increasing, and there is a prevailing tendency for all social classes to stay up late and work overtime. Marathon not only can effectively exercise physical endurance and physical function, but also

suitable for various site requirements including urban or suburban roads.

The influence of the rise of marathon (running) on education health generally comes from education of sports spirit and education of health constitution, which has a profound influence on the development of education of people's sports health. The education influence indicator system of marathon on sports health is shown in figure 1. In the process of developing marathon, in order to focus on the aspects of developing marathon on health education, the influence indicator system of marathon on health education is graded and evaluated.

3. EDUCATION IMPACT RATING OF THE RISE OF MARATHON ON HEALTH

The establishment of the indicator system of education influence of marathon (running) exercise on health reflects the comprehensive influence of marathon exercise on health education from spirit to constitution. However, because these effects are all caused by human perception, vague and uncertain degree, various factors influencing education cannot be well grasped in the promotion and operation of marathon, so it is necessary to grade and evaluate the indicator system of marathon influencing education process of sport [7]. In this paper, ahp is used to quantify the weight of each index, to determine the degree of influence of marathon on education.

Through analytic hierarchy process (ahp), multiple indicators influencing health education of marathon were analyzed, the weight of each indicator in the process of influencing health education was calculated, and the following figure was drawn:

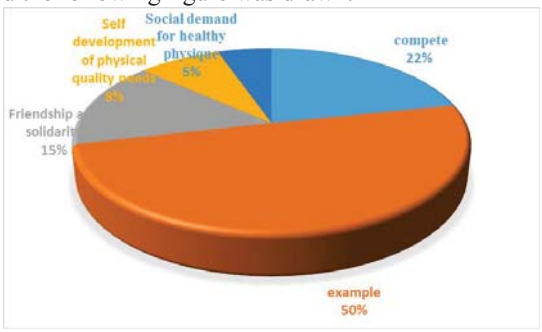

Fig.2 The weight distribution of each index

From figure 2, it can be seen that the influence of the rise of marathon on education in China is mainly reflected in the strength of its role model. Marathon has set up an example of super endurance and perseverance for people, thus promoting the progress of education in sports health. As the demand for health and fitness can be realized by other means of fitness, the degree of influence is minimal.

4. CONCLUSION

By establishing the influence indicator system of education on health caused by marathon, it can be seen that the influence of marathon on health education is mainly the influence of education in sports spirit and education in healthy constitution. By using ahp to assess the various indicators, it can be seen that in the process of influencing health education, marathon sports should pay more attention to the promotion of marathon sports spirit in the future operation and development of marathon in China through the power of setting an example.

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Study on the Development Opportunities and Countermeasures of Sports Industry under "the Belt and Road" Strategy

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Abstract: Industrial development should be in line with national policies, and the development strategy of "The Belt and Road" proposed by the state has a very important influence on the development of sports industry. This paper analyzes the opportunities brought by The Belt and Road strategy to the development of sports industry, and provides reasonable Suggestions for the development of domestic sports industry to formulate effective countermeasures.

Keywords: Belt and Road; Sports industry; Opportunities; Countermeasures

1. INTRODUCTION

The proposal of "The Belt and Road" and its further promotion have brought new opportunities to the development of China's sports industry. Sports industry is becoming a new growth point of national economy, at the same time, the sports industry plays an important role in international communication, it across different regions, nations and cultures, let more countries people is same [1]. This is also a major advantage of the development of sports industry under the strategy of "The Belt and Road".

2. DEVELOPMENT OPPORTUNITIES OF THE SPORTS INDUSTRY UNDER THE "THE BELT AND ROAD" STRATEGY

(1) There is a huge demand for investment in sports infrastructure

The technical accumulation of domestic sports infrastructure construction enterprises is more mature, and they have relatively good brands and images in the countries along the routes and have certain advantages. The increasing demand of sports foundation implementation will undoubtedly bring opportunities for domestic sports enterprises to realize the rapid expansion of overseas projects and improve their profits.

(2) Sports consumer goods manufacturing industry provides industrial transfer opportunities.

After many years of development, the domestic sports consumer goods industry has improved greatly in technology, brand and management. However, it must be admitted that the human resource cost of the sports goods manufacturing industry is increasing, which has brought a great burden to many sports goods manufacturing industry. In many countries along the Belt and Road line, the labor market price is lower than that at home, which provides more options for domestic enterprises to implement the "going global" strategy. For the domestic sports industry to find foreign countries and regions with low labor price level for industrial transfer, providing choices that are more favorable.

(3) Embedded development of the sports tourism industry

The development of the sports tourism industry will usher in a broader opportunity during the further promotion of the "The Belt and Road" strategy. Including further enrich the tourism resources, tourism market development, sports cultural transmission, etc., these opportunities for the countries along the "area" of the sports industry development with our country sports industry development, provides a good basis of cooperation. Through the development of sports tourism, it plays a very important role in promoting the development of sports performance art sports events and large-scale sports events. At the same time, the deepening of the above sports series activities has also cultivated a more mature market for the development of sports consumption industry.

(4) Provide more opportunities for the development of the sports events industry

With sports competitive level and increasing of social citizens' love for sports, to hold high-level sports competition is more and more become an important embodiment of the development level of regional sports. Countries along the way "and" area, especially the connection parts of European countries, the sports demand, for domestic enterprises through joint, embedded event sponsorship, sports marketing, etc., to provide more opportunities [2].

(5) "Internet + sports" promotes the development of

other sports industries

Domestic Internet enterprises have great advantages in technology and strength. There are various innovative ways of "Internet + sports". Through scientific and reasonable implantation of "Internet + sports" model, many other types of sports industry can be created.

3. CASE ANALYSIS OF THE DEVELOPMENT OF SPORTS INDUSTRY UNDER THE STRATEGY OF "THE BELT AND ROAD"

3.1 Promote the sports industry to go abroad with the help of sports events

Case background: On October 1, 2017, ZHI MEI sports successfully held the Belt and Road marathon in Malaysia. This competition is the first large-scale sports event held by a domestic sports enterprise in Malaysia. About 20,000 people were involved. In the course of the competition, ZHI MEI sports successfully demonstrated its ability to hold sports events and promote sports events to other countries. The event has also made great achievements in attracting audiences and stimulating local public participation [3].

Case analysis: Domestic sports enterprises in the process of market development, through holding large sports events, first activate the sports participation in groups, then success into enterprise sports service idea, sports products and related services, such as project management is one of the more successful model. This model has good reference and reference significance for other sports enterprises in China.

3.2 holding exhibitions to stimulate the consumption of sports products

Case background: On April 18, 2017,jin jiang will hold an international exhibition with the theme of "promoting the integration of sports industry and cities and striving to hold the world China games". Italy, Russia, India, Vietnam and so on more than 70 international and regional merchants gathered in here, once again bear witness to the first super billions of scale, has 21 national brand, 21 of jin jiang sporting goods industry listed companies will be advantage in winning. First set the exhibition "area" brand pavilion, Vietnam, India, Bangladesh, uzbekistan and other countries along the "area" enterprises, promote JINJIANG sports enterprises in the context of "area", strengthen exchanges and cooperation with southeast Asia market.

Case analysis:With the advent of the era of great consumption in China's sports industry, sports product industry segments have been highlighted. jin jiang through holding the top sports goods exhibition, capture the forefront in the design of sport concept, seize the international market of sports goods consumption trend, to promote the development of jin jiang sporting goods industry, has a very important role in promoting.

4. COUNTERMEASURES AND SUGGESTIONS FOR THE DEVELOPMENT OF SPORTS INDUSTRY UNDER THE "THE BELT AND ROAD" STRATEGY

(1) the policy actively supports and encourages the development of the sports industry along the Belt and Road line

Under the strategy of "The Belt and Road", China's sports industry is facing great development opportunities. The country should further introduce relevant support and dig into the development potential of the sports industry. The state actively encourages and guides private capital to enter the fields of stadium construction and operation, sports fitness and leisure and sports competitive performance. Supporting private capital in the production and marketing of sports goods; we will increase support for the investment of private capital in the sports industry, promote diversification of the main body of investment in China's sports industry, and gradually realize the healthy, stable and sustainable development of China's sports industry.

(2) Provide financial support and establish a sports industry development guide investment fund

Under the "The Belt and Road" strategy, the development of domestic sports industry needs more financial support. Government in terms of financial support, development of sports industry can be set up to guide investment fund, the sports industry companies, financial institutions and other social capital to raise money, to support the sports enterprises in the "area" all the way along the sports infrastructure projects, sports game operations, personnel training, etc. Where conditions permit, the sports industry can also be accelerated by means of project funding, loan discount and incentives.

(3) Build special brand competitions to gather the popularity of the development of the sports industry

The development of sports industry requires not only the foundation of the whole people, but also the industrial foundation. Domestic sports brand competitions still need to be strengthened. In order to build brand competitions, we will use the sports competition performance to create a new name card for the development of the sports industry along "The Belt and Road". Countries along the way "in the" area and domestic in the areas along the ice and snow, cars, motorcycles, marathon, cycling, water sports, outdoor challenge, air movement, directional cross-country, e-sports sports activities such as rock climbing, and strengthen the innovative, inclusive, build activities every year, every month there are bright spots, anywhere there are wonderful sports atmosphere. We will carry out tai chi, wushu, dragon dance, lion dance, dragon boat dance, archery, wrestling, equestrian and other ethnic sports activities. We will promote special sports events such as snow and ice culture, snow and ice sports, snow and ice entertainment.

(4)Strengthening the construction of sports tourism facilities

Know "area" all the way along the sports facilities for unified planning and construction of form a complete set of conforming hiking trails, recreational green way, cycling, ski, water sports boat wharf, e-sports venues, cars drive sports camp, aviation flight camp, outdoor sports park and other sports facilities. Strengthen sports equipment research and development innovation, encourage "neighbourhood" all the way along the route area professional exhibitions held various sports equipment, sports domestic enterprises should actively attending, launched its own advantage sports consumer goods, such as sports equipment and utensils.

(5) Attach importance to cultural and cultural exchanges and vigorously develop sports culture

Sport itself is closely connected with culture and is a very important part of culture. The proposal and further promotion of The Belt and Road initiative have brought new opportunities to the development of China's sports culture. Hearts are interlinked to the construction of "area" is the social foundation, "The Belt and Road" be gathered popularity, must pay attention to cultural exchanges, and promote the understanding and cooperation between people from different countries, formed to build an "area" of the consensus. In addition, sports is an important breakthrough to promote cultural exchanges. As a worldwide popular cultural activity, sports has a neutral color beyond language, race and civilization, creating conditions for countries to communicate and understand each other.

(6) Strengthen the training of sports personnel

We will actively promote the development of traditional sports schools and schools with sports characteristics, encourage famous school teams and coaches to enter schools and carry out the work of "one school, one quality". To strengthen the human resources demand forecast, the sports industry to encourage more investment and cooperation between colleges and cultivating sports management idea, creative design, scientific research, mediation and other professionals, to provide talent support for the sports industry development. Encourage sports enterprises at home and abroad are introduced high-end planning, operation and management, and other sports talents, encourage sports professional clubs to introduce domestic and foreign outstanding coaches and athletes, enjoy the treatment by the regulation.

(7) Improve the operation quality and efficiency of sports infrastructure

Sports venues, sports equipment and other infrastructure, is the sports industry hardware foundation. Therefore, under the strategy of "area", countries should pay much attention to the development and utilization of sports infrastructure, through training, competition, tourism, fitness, rich means such as performances, exhibitions, give full play to the role of the sports venues, improve the quality and efficiency of operations. At the same time, we will promote the opening of stadiums and gymnasiums to the public free of charge and low fees in their spare time. Through cooperation in running schools, faces the society recruit badminton, table tennis, tennis, boxing, taekwondo, go, track and field, wushu amateur athletes, to strengthen the high level sports reserve talent reserves, raise the utilization ratio of venues, increasing the income of the school. In sports trauma rehabilitation hospital, community center and other infrastructure, also need to further increase the intensity of resources integration, to ensure sufficient sports health care resources, for the "area" all the way along the countries and regions to enrich sports fitness, treatment and rehabilitation care of medical resources.

5. CONCLUSION

Analyze the "area", this paper indicates the opportunities brought about by the strategic development of the sports industry development, and connecting with the actual case, for our country sports industry how to seize the "area" strategic opportunity, realize the innovation and development, provides the experience for reference and thinking of the scientific enlightenment. On this basis, in this paper, the strategy of "area", the development of sports industry, put forward the policy, financial support, cultivate sports talents and attaches great importance to the cultural exchanges and developing countermeasures in aspects of sports culture, with strong practical guiding significance.

6. REFERENCES

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