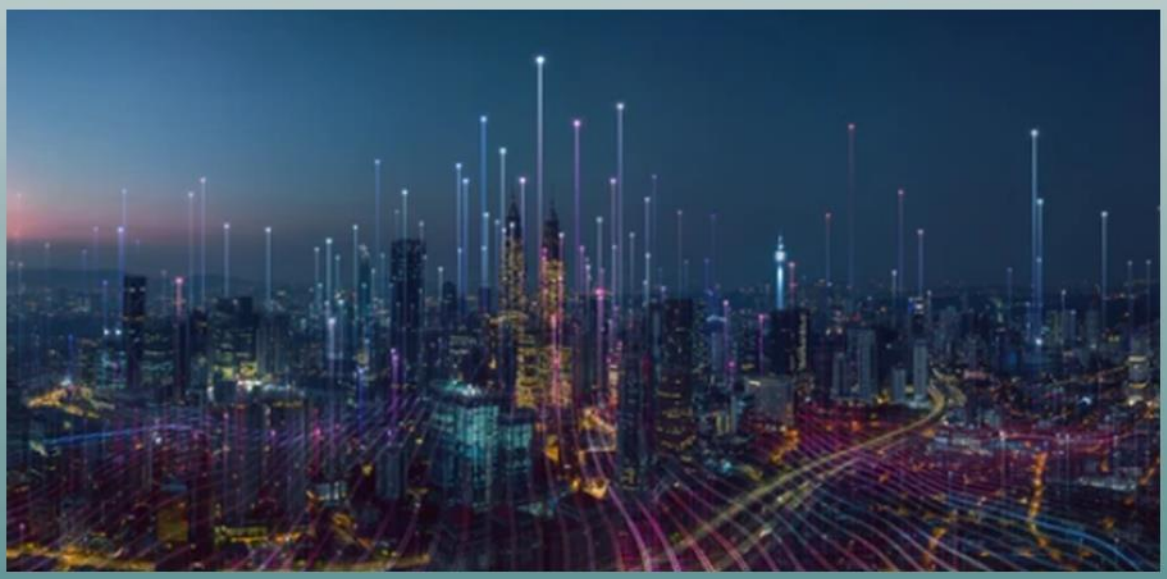
Volume 6, Issue 2, 2024

Print ISSN: 2663-1938
Online ISSN: 2663-1946

JOURNAL OF COMPUTER SCIENCE AND ELECTRICAL ENGINEERING



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Journal of Computer Science and Electrical Engineering

Volume 6, Issue 2, 2024

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Journal of Computer Science and Electrical Engineering
Print ISSN: 2663-1938 Online ISSN: 2663-1946
Email: info@upubscience.com
Website: http://www.upubscience.com/

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Journal of Computer Science and Electrical Engineering
ISSN: 2663-1946
DOI: 10.61784/jcseev6n213

RIGOROUS INVESTIGATION OF A CONTROLLABLE TORQUE LOADING SIMULATION TECHNIQUE FOR ASSESSING THE BRAKING PERFORMANCE OF VEHICLES INVOLVED IN ACCIDENTS

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Abstract: In order to more accurately test the braking performance of vehicles that have lost their driving ability, this paper conducts a simulation study on the torque loading method in the braking force detection of accident vehicles. First, the feasibility and characteristics of the single-wheel braking force detection method were analyzed through experiments; then, a torque loading model based on the electromagnetic slip clutch was established, and the loading torque, excitation current and rotor were deduced based on the mechanical characteristics of the asynchronous motor The relationship between the rotational speed and the PID control algorithm were combined to propose a controllable torque loading method; finally, the simulation of torque loading control was carried out in MATLAB/Simulink, and reasonable loading time intervals and other parameters were obtained. Through the torque The loading error analysis verifies the feasibility of the method proposed in this article and lays the foundation for the braking performance detection of accident vehicles.
Keywords: Accident vehicle; Braking force detection; Controllable torque

1 INTRODUCTION

The rapid growth of car ownership and the frequent occurrence of traffic accidents have led to an increase in car-related quality disputes and accident disputes. In these traffic accident disputes, the identification and testing of car braking performance is a key. However, due to the collision damage of the vehicle, it does not meet the conditions for road test or Taiwan test inspection. Appraisal agencies can only use appearance observation methods, and their conclusions lack scientificity and objectivity. Therefore, related research on the braking performance testing of accident vehicles is of great significance.

In terms of accident identification, there is a relatively mature forensic identification industry abroad [1], which can well reproduce the accident process and conduct collision analysis and auto parts safety research. In the process of identification and analysis, the slip velocity calculator and collision data recorder (EDR) are mainly used for highway collision data analysis [2], photogrammetry technology is used for on-site map drawing analysis, and software is used for collision simulation [3-6]. Mature forensic analysis of accidents focuses on reproducing the accident process, but lacks devices for detecting the accident vehicles. On the other hand, from the perspective of national standards, such as the U.S. Federal Motor Vehicle Safety Regulations, Japan's "Motor Vehicle Safety Standards" and the Russian Federation's national standard "Methods for Testing Requirements for Technical Conditions of Safe Driving of Vehicles", etc., do not involve the detection of accident victims. Braking performance testing of damaged vehicles. The current standard GB 7258-2012 "Technical Conditions for Motor Vehicle Operation Safety" [7] that is being implemented in our country requires that the ability to drive after an accident must be tested by road test or bench test. For accident vehicles that cannot drive normally, experienced vehicles must Professional technicians conduct disassembly and inspection, that is, static inspection is used to determine its status at the time of the accident, and at the same time, refer to the national standard GB/T 18344-2016 "Technical Specifications for Automobile Maintenance, Inspection, and Diagnosis" [8] to determine whether the technical condition of the vehicle meets the technical requirements. Requirements[9-10]. On the basis of national standards, literature [11] and literature [12] introduce in detail the methods of road test, bench test and static disassembly and inspection. At the same time, the latter also introduces a simple single-wheel braking force detection method; literature [13] used the method of dynamic simulation model to conduct research on accident vehicles equipped with ABS; in 2011, the document [14] made some innovations in the application of braking performance tester in the braking performance detection of accident vehicles.

In the above-mentioned literature, there are relatively few studies on the detection of braking performance of accident vehicles that have lost their driving ability. Accordingly, based on the single-wheel braking force detection method, this paper studies the torque loading method during the braking force detection process. Combined with the principle and mechanical characteristics of the electromagnetic slip clutch [15-16], the relationship between the torque loading parameters is analyzed, and the PID control algorithm [17-18] is combined to make the loading torque controllable. Finally, through the dynamic simulation of the loading process and The experiment verified the feasibility of the method used in this article.

2 TEST BASED ON SINGLE WHEEL BRAKING FORCE TEST METHOD

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Accident vehicles often lose their driving ability after collision and do not have the technical conditions for road tests or bench tests, making it difficult to conduct routine testing. Therefore, the research method in this article is based on the single-wheel braking force test method and adopts an alternative method of measuring the brake braking force. , to approximately measure the ground braking force.

When testing, first loosen the wheel bolts, jack up the axle where the wheel to be tested is located, remove the wheel, and apply torque to the brake disc by pressing the brake pedal. When the applied torque is greater than the maximum static friction torque of the brake, the brake disc will rotate. On the axle with a larger axle load in the car, the maximum static friction torque is approximately equal to the torque generated by the ground braking force on the wheel. Finally divided by the wheel radius, the approximate ground braking force can be obtained. This method can approximate the ground braking force, but from the measurement process and principle analysis, it can be seen that the single wheel braking force detection method also has many shortcomings, such as the torque loading process is uncontrollable, it is a static detection, etc. Therefore, in this article, the torque loading process is innovated to make the torque loading controllable and realize dynamic detection.

According to GB 7258-2012, automobile braking performance testing generally uses a reaction-type (or inertia-type) roller brake test bench for no-load testing. When there is any objection to the testing results, a full-load testing or road test testing will be performed. In order to analyze the reliability and characteristics of the single wheel braking force additional measurement method, the roller braking test bench was selected as a comparative test. Two sets of tests were conducted on cars of the same model. The test results of the roller test bench are shown in Table 1.

Table 1 Braking force test results of roller test bench

project	Left wheel braking force/N	Right wheel braking force/N	Brake pedal force at maximum braking force/N	Pipe pressure at maximum braking force/MPa
front axle	3 196	3 468. 5	488	8.2
rear axle	757	1 081	473	8

The single-wheel braking force detection method must be based on the test results of the roller test bench to find out the brake pedal force and pipeline oil pressure when the vehicle braking force reaches the maximum value, and use this value to simulate the brake pedal force in the test. test. The test results are the first set of test values in Table 2.

Table 2 Single wheel braking force detection test results N

project	First group		Second Group		
	Left wheel braking force	Right wheel braking force	Left wheel braking force	Right wheel braking force	
front axle	3 178. 4	3 292. 6	3 237. 4	3 393. 6	(3)
rear axle	3 076. 4	3 049	3 170. 6	3 222. 2	

GB 7258-2012 has clear requirements for brake pedal force, that is, the brake pedal force of four-wheel vehicles of 3.5t level and below cannot be greater than 500N. Accordingly, the upper limit of brake pedal force is set to 500N. Therefore, the second set of tests was conducted under the condition of 500N brake pedal force, and the measured pipeline pressure was 8.5MPa. The test results of the two groups are shown in Table 2.

Comparing Table 1 and Table 2, it can be seen that in the detection of front axle braking force, the detection results of the single wheel braking force detection method are relatively close to the results of the roller test bench, and the measurement results are credible. Since the single-wheel braking force detection method has nothing to do with axle load, the detection results are similar for the front and rear axles.

3 CONTROLLABLE TORQUE BRAKING FORCE LOADING METHOD

In view of the limitations of the current traditional single-wheel braking force detection method, a new method is designed in this article to achieve automation and dynamic measurement. After the testing equipment and the vehicle being inspected are installed and debugged, the testing system continuously provides torque to the brake disc of the vehicle being inspected for continuous loading. In this method, the braking force of the brake is approximately equal to the friction torque generated on the ground when the car is braking. When the brake disc rotates, the system can still load the brake disc, so that other indicators that can evaluate the braking performance, such as thermal decay resistance and ABS performance, can be obtained through dynamic measurement. Its applicability is more than traditional methods. has seen an increase.

3.1 Torque Loading Model Based on Electromagnetic Slip Clutch

Journal of Computer Science and Electrical Engineering
ISSN: 2663-1946
DOI: 10.61784/jcseev6n213
The key to the detection method in this article is to output a series of controllable torque values. Since the asynchronous motor cannot output a given value of torque, components for freely adjusting the torque must be added to the motor. In this article, an electromagnetic slip clutch is selected to complete the task of adjusting torque.

3.1.1 Model establishment

A torque loading model based on the electromagnetic slip clutch is established in Solidworks. The model is mainly composed of an asynchronous motor, an electromagnetic slip clutch, a torque sensor, a speed sensor, a reducer, a force-applying chuck, a support device and various connection accessories. . The system is connected to the vehicle brake disc and the asynchronous motor is started. The power is transmitted from the asynchronous motor to the vehicle brake disc through the electromagnetic slip clutch, torque sensor, reducer and force-applying chuck. Continuously load torque until the brake disc starts to rotate, and the speed sensor outputs a signal to end the loading. At this time, the torque value output by the system is the maximum static friction torque between the brake disc and the brake shoe, which is the braking torque on the ground. Then divided by the wheel radius, the ground braking force of the vehicle to be inspected is obtained.

It can be seen from the figure that the system needs to continuously load variable torque during the working process, so the relationship between the output torque and the input value must be found. In this article, based on the working principles and characteristics of each component, the influencing factors of the output torque are obtained through theoretical analysis.

3.1.2 Theoretical derivation

It can be known from the principle of the electromagnetic slip clutch that if the torque output by the electromagnetic slip clutch is required to be T, then: nd is the speed of the active part of the clutch; n1 is the speed of the driven part of the clutch, measured by the speed sensor; K is the clutch structure parameter.

The mechanical characteristics of asynchronous motors determine that when the load of the motor changes, its speed will inevitably change. The excitation current of the electromagnetic slip clutch changes the output torque, that is, the load of the motor is not constant, and the speed of the active rotor of the clutch is not constant. Therefore, the relationship between output torque and excitation current cannot be directly established through equation (1). To further solve the relationship between the two, the mechanical characteristics of the asynchronous motor must be considered to find the relationship between output torque and speed.

K1 is a constant related to the motor structural parameters and power supply frequency; U is the power supply phase voltage; S is the slip; R2 is the resistance of each phase winding of the rotor; X20 is the resistance of each phase winding of the rotor when the motor is stationary (nd = 0) Resistance.

Figure 1 shows the mechanical characteristics diagram of an asynchronous motor. It can be seen from Figure 1 that there is a maximum torque Tm in the asynchronous motor, which is the critical operating point of the motor. If the motor load exceeds this value, the motor will not work.

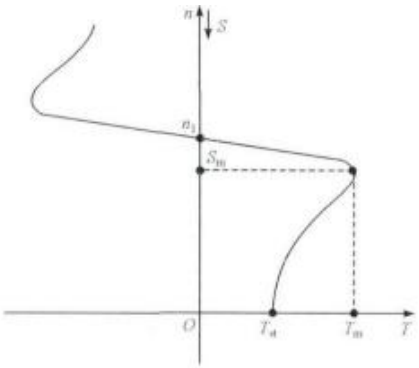

Figure 1 Mechanical characteristics of asynchronous motor

To find the maximum value of torque, equation (2) can be derived. When dT/dS = 0, the slip obtained is the critical slip Sm:

$$Sm = \frac{R_2}{X_{20}} \quad (1)$$

Asynchronous motors often encounter short-term impact loads during operation. If the impact load torque is less than the maximum torque, the motor can still run, and short-term overloading of the motor will not cause severe heating [28]. The ratio λm of the maximum torque of the inherent mechanical characteristics to the rated torque is usually called the overload capacity coefficient of the motor.

$$\lambda m = \frac{T_m}{T_N} \quad (2)$$

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3.2 Braking Force Loading Control Based on PID Control Algorithm

It can be seen from the previous theoretical derivation process that the output torque of the electromagnetic slip clutch is affected by the rotor speed difference and the clutch magnetic induction intensity. The magnetic induction intensity of the electromagnetic slip clutch is directly proportional to the excitation current. The speed of the asynchronous motor rotor also changes with the input current. Therefore, if you want to output a specified torque, you must use a controller to adjust the excitation current in real time. The adjustment is based on the output torque, rotor speed and excitation obtained above. relationship between currents.

4 SIMULATION OF TORQUE LOADING CONTROL PROCESS

As can be seen from the above, in order to output a certain torque, a controller must be used to control the excitation current in real time. The control is based on the relationship between the three variables. That is, the relationship between the output torque of the electromagnetic slip clutch, the rotor speed and the excitation current, and the relationship between the output torque and speed derived from the mechanical characteristic curve of the motor selected in this article, plus the obtained output torque relationship with the excitation current.
During the simulation process, whether it is static loading simulation or dynamic continuous loading simulation, before the loading is terminated, the output rotor of the clutch is stationary, that is, n1 = 0, which is used as the initial state of the simulation.

4.1 Static Loading Test

During simulation, the structural parameter K of the electromagnetic slip clutch is 2500, the initial motor speed is 1440r/min, and the given output torque is 50N·m. First, a small initial current is passed through the excitation winding of the clutch, and the initial torque output is generated and then fed back. The PID control part controls the output current according to the formula, and takes the larger value than the initial current. The motor speed takes an initial value of 1440r/min, and after a period of time, the torque is output according to equation (1).
During simulation, the three parameters of PID control must be continuously selected and debugged in Simulink .

4.2 Dynamic Loading Test

After completing the simulation of the specified output torque, the actual detection process, that is, the dynamic continuous loading process, must be simulated. The simulation conditions and parameters are the same as the static simulation. The end torque is set, that is, the output rotation of the slip clutch when the maximum static friction torque is reached. moment.
In this article, the Jetta sedan is selected as the simulation object, and the relevant structural parameters are shown in Table 3.

Table 3 Braking related parameters of Jetta sedan

parameter	Maintenance quality Amount/kg	Full mass Amount/kg	Maximum mass of front axle/kg	Maximum mass of rear axle/kg	Tires are the most large size
numerical value	1 120	1 450	700	440	175/70R14

The braking force is calculated based on the braking force being 80% of the axle weight. Here we take the single wheel braking force of the front axle. After calculation, the braking force is 2 744N. The turning radius of the 175/70 R14 radial tire is 279mm, so the braking torque of the front axle single wheel is 2744 × 0. 279 = 765. 576N·m. Then, the end torque set in this simulation should be 766N·m.
During the continuous loading process, there are two important parameters: loading torque increment and loading interval time. These two parameters play a decisive role in the accuracy and stability of the system.
The loading torque increment determines the accuracy of the system. In order to improve the accuracy, the loading torque increment must be reduced. Although the smaller the loading torque increment, the higher the accuracy, but if the loading torque increment is too small, it will result in too many loading times required to output a certain torque value. Therefore, taking the accuracy of the roller test bench as the standard, when the vehicle model is Jetta, the system loading torque increment is 0. 28N·m. It can be seen that under the loading torque increment of 0. 28N·m, the output of 766N·m requires 2,735 loading times.
The loading interval determines the stability of the system. The shorter the loading interval, the faster the time to reach the maximum static friction torque. But the loading interval time is not as short as possible, because the PID control torque output has a response time. In this article, the controller controls and adjusts the excitation current according to the difference output signal, thereby adjusting the clutch output torque. This series of processes requires a certain response time. If the loading interval is too short, the PID control output has not yet reached the load. Continue loading if the torque value is reached. In this case, even if the torque loaded by the loading system has reached the maximum static friction torque of the brake disc, the PID control torque will not output a corresponding value, which will

Journal of Computer Science and Electrical Engineering
ISSN: 2663-1946
DOI: 10.61784/jcseev6n213
eventually lead to the system being unable to detect the braking torque of the brake disc. Therefore it is very important to calculate a reasonable time interval. Regarding the value of the time interval, first determine a specific time interval, that is, the time when the output value first appears during the PID control process. Under the previously set PID parameters, the value is 0. 031 7s. When the end torque is 766N·m, the loading torque increment is 0.28N·m, and the loading interval time is 0.025, 0.03, 0.045 and 0.06s respectively, the simulation line is For a straight line that passes through the origin of the coordinate axis and whose slope is the ratio of the loading termination value to the loading time, the acceptable ratio of the stability standard deviation to the total range is less than 5%. The results are shown in Table 4.

Table 4 Time deviation results of different loading intervals

Loading interval/s	Variance/ (N·m) 2	Standard deviation/(N·m)
0.025	3 002. 50	54. 795
0.030	1 114. 58	33. 385
0.045	319. 44	17.873
0.060	6.58	2. 565

The maximum allowable deviation is calculated from the final torque of 766N·m to 38.3N·m. It can be seen from the above results that under the loading accuracy of 0.28N·m and the interval time of 0.03s, the loading situation is different from the ideal The deviation of the conditions is within the allowable range, and the deviation of the 0. 025s time interval is greater than 5%, indicating that the minimum interval allowed by this system is around 0. 03s. The testing accuracy and system stability of the loading method at this time interval will achieve satisfactory results.
It can be seen from the torque loading test in this section that according to the method in this article, choosing a reasonable loading amplitude and loading time interval can make the output torque controllable and the deviation within the acceptable range.

5 CONCLUSION

In this paper, in response to the demand for braking performance detection of vehicles that have lost their driving ability, the torque loading problem is studied based on the single-wheel braking force detection method, and a torque loading model based on electromagnetic slip clutch is proposed, combined with the PID control algorithm. Controllable torque loading method. In order to verify the feasibility in principle of the single-wheel braking force detection method, before designing the test plan, a comparative test of benchtop testing and single-wheel braking force detection was first conducted, and the characteristics and precautions of the detection method were analyzed. In order to achieve controllable loading torque, a torque loading model based on electromagnetic slip clutch was established. Based on the principle of electromagnetic slip clutch and the mechanical characteristics of asynchronous motor, the relationship between its output torque, excitation current and rotor speed was found. The relationship between the two, combined with PID control theory, achieves the purpose of torque controllable. Finally, the control model was established by analyzing the system, and torque loading simulation was carried out in MATLAB/Simulink. The dynamic response time and other parameters of the controlled object were determined and optimized, and a loading method that met the requirements was obtained. The analysis of the torque error showed that this method can achieve deviations in the deviation. Within the acceptable range, the controllable torque loading model proposed in this article has certain feasibility.
The torque loading model based on the electromagnetic slip clutch established in this article can not only measure the braking force of the accident vehicle, but also obtain other indicators for evaluating the vehicle's braking performance. Since the model proposed in this article can achieve controllable loading torque, it can continuously apply torque to the wheels to make the wheels reach a certain rotational speed, simulating the vehicle speed when the car's ABS system takes effect, and then the vehicle's ABS can be measured by braking the vehicle. performance. When the brake disc rotates and the torque is continued to be applied, the thermal degradation resistance of the automobile brake disc can be measured. Due to limited space, the controllable torque loading model proposed in this article is only used as a basic research for the detection of braking performance of accident vehicles. As for the acquisition of other indicators of braking performance, it will be included in the next research plan.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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Journal of Computer Science and Electrical Engineering
ISSN: 2663-1946
DOI: 10.61784/jcseev6n214

CONSTRUCTION STRATEGY OF DIESEL GENERATOR SYSTEM FOR LARGE-SCALE CLOUD COMPUTING CENTER

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Abstract: With the rapid development of cloud computing business, cloud computing centers have gradually shifted from small and medium-sized to large-scale centralized deployment. This article uses the diesel generator system engineering practice of a cloud computing center in Guangdong as a reference to discuss the diesel generator set in large -scale cloud computing center projects.
Keywords: Medium voltage distribution cabinet; Diesel generator; Cloud computing

1 PROJECT NEEDS ANALYSIS

A cloud computing center project in Guangdong covers an area of 11,000 square meters and deploys 1,216 cabinets, 512 with average power of 5.5kW and 704 with 6kW. The total power of the 1,216 cabinets is 7,040kW. According to PUE=1.35, the total power is 9,504 kW. The construction standard is as follows: National standard "GB50174-2017 Data Center Design Specification" Level A standard. According to Class A standard requirements, a diesel generator set must be configured as a backup power supply, and the diesel generator set must be in an N+X (X=1~N) redundant configuration [1].

2 DIESEL GENERATOR SYSTEM DESIGN

Class A engine room requires the oil machine to operate continuously and without time limit, that is, COP power. The calculated load of the oil engine in this plan is 9504 kW, and the Italian Mercedes-Benz 10kV medium-voltage diesel generator set GSW2520P is selected. The engine specification of the oil engine is Perkins 4016-61TRG3, and the generator specification is Leroy Somer's LSA53.1 UL85, the automatic control panel uses PRAMAC AC03 parallel controller. The main power (PRP) of the generator set is 1804 kW/2255kVA, the standby power (LTP) is 2004kW/2505kVA, and the continuous power (COP) is 1603 kW/2004kVA. A total of 7 oil generators, 6 main and 1 backup, are used in parallel [2-3]. The total COP power is 9618 kW, which meets the load demand.

Under normal circumstances, two lines of 10kV mains power operate at the same time, each carrying half of the load; when one line of mains power fails or fails, the bus tie is automatically switched on, and the other line of mains power takes up all the load; when both lines of mains power are equally When power is lost, the oil generator automatically starts within 15 seconds and completes parallel operation within 60 seconds. It is controlled by the automatic control system, opens the 10kV mains power circuit breaker, closes the oil machine power circuit breaker, and supplies power to the load; when the mains power returns to normal Afterwards, the system continues to be powered by the diesel generator system and needs to be manually switched back to the mains power supply; the diesel generator system will not run in parallel with the mains power supply under any circumstances[4].

After the oil engine detects the start signal, the six units start the parallel output at the same time. After running for 5 minutes, the engine is reduced according to the actual load rate of the back end. This can ensure that the oil engine has sufficient resistance to load impact in the early stage of startup. If one of the 6 oil generators fails to start normally during the startup process, it will automatically switch to the backup engine to start[5] .

This oil machine system includes a total of 7 oil machine inlet cabinets, 1 PT cabinet, 2 parallel output cabinets, 1 parallel control cabinet, 1 dummy load wiring cabinet, 1 dummy load test control cabinet, 1 One set of grounding resistance cabinet, one set of DC operating power supply cabinet, and one dummy load.

The maximum rated current of a single unit is 137.74A, the circuit breaker current is 630A, and the complete set of medium-voltage distribution cabinets for the oil machine control system uses Schneider's original PIX-12 medium-voltage distribution cabinet [6].

The circuit breaker in the oil machine inlet cabinet is Schneider HVX-12-25-06 vacuum circuit breaker, equipped with two CTs, ground knife, zero sequence CT, lightning arrester, microcomputer protection P127, and multi-function meter PM2125C. The PT cabinet adopts PTT-12, PT & arrester sharing solution, with PT, arrester and harmonic elimination resistor. The parallel control cabinet adopts the IG-NT-MINT system. In addition to collecting the AC-03 controller signals on the control unit, all control signals related to the grounding resistance cabinet, parallel output cabinet, parallel input cabinet and other equipment are all collected from this cabinet.

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The circuit breaker in the dummy load wiring cabinet is HVX-12-25-06, with two CTs, lower PT, arrester, fuse, zero sequence transformer, microcomputer protection P343, and multi-function meter PM2125C.
The false load test control cabinet mainly contains a control host and a display screen, and is operated and controlled through the load cabinet control system software.
The grounding resistance cabinet is a 10kV generator neutral point grounding resistance cabinet from Baoding Tianwei. Seven oil generators share one grounding resistance cabinet. When the oil machine is started, the grounding resistance cabinet mainly includes supporting equipment such as resistors, vacuum contactors, and current transformers. Among them, the resistor THT-FZG-10/58 has a rated resistance value of 58Ω, a short-term current flow capacity of 100A, a rated current flow time of 10s, an allowable deviation of the resistance value at 25℃ ≤ ±3%, and a resistivity of 1.09μΩm. The vacuum contactor is single-pole JZC1-12/400, with a rated voltage of 12kV and a rated current of 400A.
The operating voltage of the DC operating power supply is 110V and the capacity is 80AH.
The dummy load is Hebei Kaixiang AC10.5kV-2000kW high-voltage intelligent AC load cabinet. The rated voltage of the load cabinet is AC10.5kV, the rated power is 2000kW, the working power supply is AC380V/50HZ, and the cooling method is forced air cooling. It should be noted here that in the design of the external mains power distribution system, it is necessary to provide power for the forced air cooling fan of the dummy load. This is a point that is particularly easy to miss.
According to the specification requirements, the oil engine system must be configured with 12 hours of fuel. The full-load fuel consumption of the oil engine is 482L/h. Calculated based on 12 hours, the total full-load fuel consumption of the six oil engines is 34704L, which is about 34.7m3. Due to fire protection regulations, a single indoor daily fuel tank cannot exceed 1 m3. Seven units are equipped with a total of 7 daily fuel tanks of 1 m3. The bottoms of the daily fuel tanks are interconnected by balanced oil pipes, and a 30 m3 horizontal diesel storage tank is installed outdoors. installed on the ground. The outdoor oil tank is surrounded by fences for protection and isolation, and is equipped with surveillance cameras and searchlights.
Gear oil pumps are used to deliver oil, and the oil pumps are configured in a 1+1 redundant manner. After the diesel is transported by tanker, it is stored in an outdoor diesel storage tank and pressurized by the filter and oil pump. The daily tank is controlled by an automatic level transfer control system. At low fluid level, the solenoid valve opens and starts the oil transfer pump. At high level the solenoid valve closes. When a fire breaks out between the daily fuel tanks, turn on the emergency oil drain pump and drain the diesel in the daily fuel tanks into the underground oil tank.
The cable input from a single unit to the medium voltage cabinet is ZR-YJV22-8.7/15kV-3*120 cable, and the cable output from the medium voltage cabinet to the 10KV medium voltage busbar is ZR-YJV22-8.7/15kV-3*400 cable.
The operating data of the entire oil engine system is connected to the dynamic environment monitoring system of the cloud computing center through the RS485 intelligent interface. Through the dynamic environment monitoring system, the operating status of the oil engine can be viewed remotely.

3 DESIGN OF OIL ENGINE ROOM

In accordance with environmental protection requirements, noise reduction measures are installed at the air inlet and outlet, and the noise is controlled within 65dB.
Microporous sound-absorbing panels are installed on the walls and sheds around the entire oil machine room and are lined with 50mm thick sound-absorbing cotton.
The weight of a single oil engine is 18.5 tons. A concrete load-bearing foundation was built on the floor of the oil engine room. The load-bearing foundation and all floors are treated with green epoxy polyurethane anti-static floor paint, which can not only prevent static electricity, but also prevent the impact of dust on the ground. The unit is running.
As an independent fire protection zone, the oil engine room uses smoke and temperature sensors for fire detection, and is equipped with a heptafluoropropane gas fire extinguishing system. At the same time, the oil machine is equipped with a handheld carbon dioxide fire extinguisher and a gas mask.

4 CONCLUSION

After the installation and commissioning of the diesel generator system was completed, it underwent strict third-party full-load testing and simulated switching operations in various scenarios. All indicators met relevant specifications and design requirements, and can operate safely and stably. This article combines theory with practice and combines some problems that occurred during the deployment of multiple diesel generator sets. It is hoped that it can provide a reference for the majority of cloud computing center construction practitioners to avoid similar problems from recurring.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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Journal of Computer Science and Electrical Engineering
ISSN: 2663-1946
DOI: 10.61784/jcseev6n215

APPLICATION OF RELAY PROTECTION AUTOMATION TECHNOLOGY IN POWER SYSTEM

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Abstract: The demand for electric power resources in various fields of society continues to increase, making this resource an indispensable part of people's daily lives and production processes. This not only promotes the development of electric power enterprises, but also brings greater challenges to them. The reason is that high demand will inevitably affect the stability and safe operation of the system. Therefore, it currently needs to be dealt with through relay protection. This article introduces relay automation technology and its application in many aspects such as busbar and grounding protection applications are discussed in detail.
Keywords: Power system; Relay protection; Automation technology; Application

1 RELAY PROTECTION DEVICE

The power system must be continuously adjusted according to the power demand, otherwise it will cause safety accidents due to faults and cause immeasurable losses to the enterprise. The solution to this problem must be achieved through relay protection devices, which can promptly respond to system failures[1-2].

1.1 Operating Characteristics

The relay protection device can transmit signals in time when the power system fails and control other equipment, limiting the impact of the fault to a certain range, and can also remove the fault. In addition, relay devices can also have problems during operation, mainly in two forms[3]: (1) Refusal to act, that is, failure to send a signal in time and cut off the fault when a problem occurs in the system; (2) Misoperation fault mainly refers to the phenomenon of signal or action error of the protection device. This mainly refers to traditional protection devices. The currently developed relay devices have automation characteristics and can realize comprehensive monitoring of the power system, obtain the most time-sensitive information, and master the parameters of various types of equipment during operation, and Ability to remotely monitor and control equipment[4-6].

1.2 Basic Requirements

In order to ensure that the power system is always in a stable operation state, the relay device must meet the following requirements:

1.2.1 Selectivity

That is, when the system is abnormal, the fault location must be accurately determined and selectively removed to avoid affecting other parts.

1.2.2 Sensitivity

That is to say, it is clear about the scope of protection it covers, and only reflects the areas it is responsible for, ensuring that it can act in a timely manner.

1.2.3 Quickness

That is, the fault must be responded to and removed immediately to prevent the fault from being left unhandled and evolving into a larger problem that affects other parts of the system.

1.2.4 Reliability

This is the most basic requirement. Otherwise, it will be difficult for the protection device to respond to system faults, which will cause the scope of the fault to continue to expand and eventually lead to problems in the entire system. In this case, it will inevitably cause immeasurable damage loss.

2 RELAY PROTECTION STRATEGY

The application of relay protection technology began in the 1960s, and then the protection functions became more and more perfect driven by science and technology. The emergence of automation technology began in the 1990s and mainly includes three contents:

2.1 Microcomputer

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It has extremely strong computing and logic processing capabilities, and can monitor the operating status of the equipment at all times and accurately detect various parameters.

2.2 Client

Installed in substations, it can protect the interface of the wave recorder and obtain the most timely information; detect the operating status of the power system, generate fault reports, and receive accident reports; can monitor the working status of technicians and upload various abnormalities in a timely manner information.

2.3 Network and Scheduling Support

Relay protection requires network connection and scheduling support so that resources can be shared and the system will not be affected by faults.

3 TECHNICAL APPLICATIONS

3.1 Line Ground Protection

The system circuit is extremely complex and the grounding methods vary greatly. It can be mainly divided into two different types: large current and small current. For the former grounding method, the way to deal with the fault is to cut off the power supply, while for the latter, it is judged based on the alarm signal sent by the relay device, and the system is processed as soon as possible within the limited time that the system can operate. When the current grounding system is single-phase grounded, the line can be regarded as phase A grounding. The grounding point flows through phase B and phase C capacitance and zero sequence current. After analysis by relevant personnel, phase A is in a voltage-free state, and the fault current voltage drop is UR0. , according to the B-phase voltage, it can be concluded that UB =V3EAe - i1502 - URO, UC = √-3EAe -j1502 -URO. The small resistance voltage in this state is extremely small and can be ignored directly. The line voltage value of the three-phase voltage is symmetrical, larger than the phase voltage value, about V-3 times of the latter. In the specific calculation process, the symmetrical component method can be selected, and it can be inferred that the current direction of each phase is the same. Therefore, phase A is grounded during a fault, causing both line and ground fault types to trip simultaneously.

Appropriate protection measures should be selected based on the type of ground fault, which mainly include the following points:

(1) Zero-sequence power. When a ground fault occurs, the power direction will change. The current will be relatively stable and the fluctuation will not be too violent. This can not only predict the fault, but also protect the system.

(2) Zero-sequence current will increase sharply in a short period of time when the system line fails. At this time, the relay protection can cut off the power supply in time.

(3) Zero sequence voltage, which is mainly generated during the occurrence of system ground faults and needs to be processed according to the alarm signal of the relay device.

Maintenance personnel must observe the voltmeter in detail and make judgments based on the displayed values to understand the fault characteristics. Normally, voltage values below normal indicate a ground fault and should be addressed as soon as possible.

3.2 Transformer Relay Protection

Transformer protection mainly includes the following points:

3.2.1 Short circuit protection

It can be divided into two different forms: impedance and overcurrent. The former is mainly the impedance component. The component will decide whether to cut off the power supply based on the length of running time, so as to achieve the purpose of protecting the voltage regulator. The latter mainly refers to installing a relay device in the current component. The current component will decide whether to cut off the power supply based on the running time.

3.2.2 Gas Protection

If the temperature of the transformer oil tank deviates greatly from the normal state, it will cause the insulating material and oil and gas to decompose. At this time, toxic and more harmful gases will be produced. Therefore, it is necessary to activate the protection device through gas protection, cut off the power supply in time, and Send out an alarm signal, prompting maintenance personnel to find faults and deal with them as soon as possible.

3.2.3 Ground Protection

Targeted processing needs to be carried out according to whether the transformer is grounded. Zero sequence voltage should be selected when it is not grounded, and zero sequence current should be selected when it is grounded.

3.3 Generator Relay Protection

Generators are closely related to the operating quality of the power system, so it is very necessary to carry out relay protection for generators. Specifically, the relay protection of this equipment mainly includes two key points:

3.3.1 Key protection

When the generator is short-circuited, the temperature of the faulty part will be higher than the normal value, causing the insulation layer to be damaged. Therefore, it is necessary to install a relay device between the turns to ensure that the stator turns can always be in a stable operating state and reduce the probability of failure. In addition, if the single-phase ground current deviates, it is necessary to combine the center point and phase through a relay device to achieve the purpose of longitudinal differential protection.

3.3.2 Backup protection

The main form of protection is overvoltage, which prevents equipment breakdown, especially when the load is low. This protection method can prevent short-circuit faults from damaging the engine, and can automatically cut off the power supply under low load conditions and provide feedback to maintenance personnel in the form of alarms, allowing personnel to handle faults in a timely manner.

3.4 Busbar Relay Protection

There are two different types of busbar protection.

(1) Phase contrast protection, this method can make the bus more reliable.

(2) Differential protection is operated by setting a transformer on the busbar component. After connecting the terminals and windings, a relay device can be installed. The installation location is the differential part of the busbar.

For the two different grounding methods of large current and small current, the three-phase and two-phase methods are adopted respectively during the connection process.

The operator of a substation resumed operation of the 220kV transformer after the test. During the specific operation, he first closed the isolation switch, but when he closed the main switch, it tripped directly, causing the 220kV protection that was in operation to have no voltage. , after inspection, it was found that only the 220kV auxiliary bus had voltage, while the bus switch and the secondary circuit were disconnected and out of contact. However, the results measured by the relevant personnel with a multimeter showed that there was voltage on the positive bus A phase, and it was connected to the auxiliary bus A. The phases are completely consistent, so it can be inferred that the positive bus A-phase voltage is connected by the switching contact. After confirmation, it is determined that the cut-off contact is connected, thereby realizing the connection of the positive bus voltage, causing the auxiliary bus to be reversely charged to the positive bus side. This is The direct cause was that the main switch tripped, and then returned to normal operation after replacing the switching plug-in.

4 CONCLUSION

All in all, the current demand for electric energy from all walks of life is relatively high, resulting in the continued expansion of the scale of electric power companies, and the number of electric power companies in the market is also continuing to increase. Under this situation, the management difficulty of enterprises is also relatively higher, so it is necessary to reasonably Apply relay automation technology and master the principles and application standards of this technology, so that various faults can be dealt with in a short time.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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Journal of Computer Science and Electrical Engineering
ISSN: 2663-1946
DOI: 10.61784/jcseev6n275

DELIBERATION ON THE INTEGRATION OF ELECTRICAL ENGINEERING AND AUTOMATION TECHNOLOGY IN MODERN SMART BUILDINGS

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Abstract: Electrical engineering and automation technology play an important role in key components of smart buildings, improving electrical operating systems and increasing resource usage. Pass through the application of automation systems in intelligent buildings and fault monitoring and diagnosis systems, the concept and application of electrical automation in intelligent buildings are expounded, and theoretical reference is provided for relevant personnel to ensure the stable operation of intelligent building systems.
Keywords: Intelligent building; Electrical engineering; Automation technology

1 BACKGROUND OF THE EMERGENCE OF SMART BUILDINGS

In recent years, with the rapid development of our country's economy, people's living standards have improved. If the building's original electrical system continues to be used, it will eventually be closed as the market becomes more competitive. Under this situation, the functional technology of electrical equipment systems is continuously improved and improved, and electrical automation technology is widely used. In various economic development fields, electrical automation technology also provides strong support for smart buildings. Electrical automation technology has also become a new development in the construction industry, and current smart buildings dominate the construction market.

2 THE MEANING OF SMART BUILDING

Compared with ordinary buildings, smart buildings integrate a large number of high-tech products and advanced technologies. It can be said that the emergence and development of intelligent buildings are an important manifestation of the progress of modern society. It can not only meet the needs of residents at different levels for modern building infrastructure, but also ensure the safety of residents' lives and property. Therefore, the role of intelligent systems in development has also been greatly improved. The rapid development of smart buildings in China has also met the demand for smart building products in various fields of society. In this application, the control efficiency of intelligent building systems can be further improved, and the quality of buildings can be improved by increasing the automation level of various systems. Ensuring that the intelligent control level of the entire system during the operation phase can meet the needs of residents is the main reason why electrical engineering and its automation technology are regarded as the core technology of smart buildings.

3 CHARACTERISTICS AND APPLICATION ADVANTAGES OF AUTOMATION TECHNOLOGY

3.1 Features

The main features of electrical engineering and its automation are as follows. (1) Match the operation of electrical equipment through the design of control methods. The system improves the rationality of equipment management and operation, and enhances the reliability and stability of the power distribution network. (2) Through the support of automation technology, the effective utilization of power equipment is achieved. In the process of applying automation technology, the original power distribution network was reasonably rectified, and some new energy-saving and efficient equipment were selected to reduce power transmission.

3.2 Advantages

The wiring in the building is complex and the electrical system is highly interconnected, and the safety hazards caused by this cannot be ignored. Due to the limitations of human supervision and management, it is difficult to ensure the effectiveness of fault diagnosis. Electrical and automation technology can not only provide timely system information feedback, but also provide relevant information to maintenance personnel.

3.3 Device Control

Personnel can issue commands through the control system to connect to the equipment. The device can recognize instructions and perform operations, effectively improving work efficiency and avoiding human errors. At the same time, when designing smart buildings, we should supplement the automation infrastructure construction, strengthen the

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effective connection between the system and the control room, ensure the effective use of data resources, and then make the use of equipment more efficient and more efficient through local control and remote control. Fast.

3.4 Optimized Design

Mainly used in the design phase of buildings. Due to the complexity of gas pipelines, if the plan is not reasonable enough, it will directly affect the efficiency of use, there may be potential safety hazards, and even require secondary construction, which will increase the construction cost. Therefore, computer technology can be used to model and ensure optimized solutions.

4 APPLICATION METHODS OF AUTOMATION TECHNOLOGY

4.1 Power Distribution System

There are various electrical equipment and complex pipes in smart buildings, and management systems can be used to shut down or redirect power distribution. Corresponding automation equipment includes long-distance sensors, electronic detection devices, etc. The reversing valve can be used to change the switch for energy scheduling, effectively improving the efficiency of energy system management. At the same time, when choosing optical cables, the use of optical fiber communication lines is more common, because traditional power cables have weak stability and low efficiency. Therefore, the smart devices used in smart buildings monitor the effect of cable operations through remote terminals. If it is Illegal theft can be detected and remedied promptly. Adopting regulatory measures can reduce the economic losses of the power sector and maintain the harmonious use of electricity in society. In the power supply system, the scientific use of automation technology can also determine the user's electricity consumption. Reasonable allocation of energy can maximize the utilization of resources and avoid consumption, which can improve the configuration level and meet the individual needs of customers.

4.2 Communication System

Communication between building information requires the support of a communication system. The function of electrical automation is to ensure the efficiency and quality of communication, so that information can be interacted in the form of text, sound, images, etc. The traditional form of communication is mainly telephone communication, but the Internet provides opportunities for the development of information transmission. Smart buildings can establish networks between domains to exchange data with the help of computer systems. All office and electronic devices within the network can connect and communicate to improve data transmission efficiency and enable the communication system to better meet user needs. Electronic graphics systems can also retrieve valuable data, send and receive text messages, conduct video conferencing, use fax communications, etc., which can save a lot of interaction time and also improve the effectiveness of information exchange between users. For example, video conferencing uses communication technology to achieve inter-regional communication between departments, saving land resources and ensuring the effective transmission of video and audio signals, giving participants an immersive experience and breaking the limitations of face-to-face. Another example is desktop conferencing, which uses computers to interact. Participants in both locations can complete information on the same board. Information can also be printed on the meeting board for reference. All kinds of information can be transmitted to anywhere in the world in a short time, greatly meeting people's needs.

4.3 Lightning Protection System

Lightning is an important factor affecting the safety of high-rise buildings. Traditional high-rise buildings use lightning rods to protect against lightning strikes. Smart buildings improve lightning and lightning protection with the help of electrical automation technology. If the grounding system is fully equipped, the computer selects a lightning protection area, and then cooperates with grounding technology, shunt technology, equipotential bonding technology and internal protection technology. Improve lightning protection and other technologies to ensure effective protection of building electricity and communication equipment.

4.4 Control System

The automatic control system in an intelligent building is part of the user's daily life and work, so the effective application of automation technology can ensure the user's quality of life and make the services provided by the building more efficient. For example, smart lighting devices can detect by sound or light. The system can change the working or resting state, which can not only ensure the user's usage requirements, but also save energy.

For intelligent building control systems, they mainly include drainage systems, lighting systems and ventilation systems, which are closely related to users' lives. If a danger occurs, the sensor can send out an alarm in time to determine the location of the accident, making it easier for relevant personnel to make timely repairs. For example, in the application of fire protection systems, after a fire occurs, the sensor will respond immediately and transmit the fire location to the control system. Relevant personnel can arrive at the scene as soon as possible to control the fire and prevent it from spreading and endangering user safety.

4.5 Office Automation System

The application of electrical automation in office systems can save a lot of manpower, financial resources and resources, and can make full use of various information resources. Specifically, common office automation technologies include office service systems, identity systems, other systems, information systems and property management systems. Office services are document management, account processing, billing management and personnel management at work. The information system can be used to initiate identification, query, search, integration, storage and other instructions to the people in the building.

4.5.1 Interactivity

Traditional data processing is one-way, in the form of input or output, but public automation realizes two-way interaction, which can be carried out through human-computer dialogue, making manual programming and control more scientific and reasonable.

4.5.2 Synergy

Since office activities are often reflected in the collective behavior of the group, there are connections and synergies between links, which effectively ensures the quality and efficiency of work. Office automation systems can promote effective connections between employee positions and ensure that tasks are completed in a short time.

4.6 Fault Monitoring and Diagnosis System

Building electrical equipment may be affected by the internal environment or the external environment. If the fault is not repaired in time, it will shorten the service life of the equipment, increase maintenance costs, affect the normal use of users, and even cause safety hazards. Therefore, attention should be paid to fault monitoring and maintenance of electrical equipment to minimize economic losses. Electrical automation technology can play a role in fault monitoring, and can also diagnose abnormalities caused by equipment, quickly and accurately determine the location of faults, and facilitate maintenance personnel to formulate maintenance plans to ensure normal operation of the system. In actual work, in the event of a short circuit or abnormal equipment operation, the automation equipment will be connected to the alarm system to immediately activate the alarm, and the staff can immediately grasp the fault situation. If the transformer fails, maintenance personnel can use the diagnostic system to detect the decomposed gas, determine the scope of the fault on this basis, and finally narrow the scope and locate the fault point. Enable electrical equipment to be used in the shortest possible time, thereby avoiding affecting the normal work and life of users.

4.7 Application in Power Supply System

Automated smart building power supply systems can improve distribution efficiency and resource utilization efficiency. Therefore, in the design of building power supply system, the most important system is the power distribution system.

First of all, for power distribution stations, on the basis of ensuring safety, the operating efficiency of power distribution stations should be improved. (1) Electromagnetic equipment should be replaced by microcomputer equipment; (2) Traditional cables should be replaced by optical fiber communication cables; (3) Distribution stations can be monitored in real time through computers to achieve automated management of distribution stations.

Secondly, relevant personnel should establish a complete power supply automation system based on the characteristics of smart buildings to improve the scientific nature of smart building power supply.

Eventually, the conductor will heat up and destroy the insulation if the safe current carrying capacity exceeds the standard. Not only can this cause fires, but it can also cause leaks and serious threats. Therefore, in the process of applying electrical automation technology in smart buildings, attention must be paid to user safety and safe current carrying capacity control.

4.7.1 DC and AC protective grounding building design

In smart buildings, this method of mixing shielded grounding with other grounding systems can improve the stability of the power supply. Using copper-core insulated wire with a large lead cross-section results in a more stable power supply.

4.7.2 Application of safety protection grounding in buildings

During building construction, the safe grounding of conductive components and equipment can effectively prevent potential harm to users caused by equipment insulation failure. In construction projects, whether it is strong or weak electricity, it must be safely grounded. The grounding protection of equipment can better protect the safety of users and improve the operating safety of equipment. In this combination, the automated system has good joint action. It can ensure that smart buildings meet people's needs and make people more comfortable and convenient.

5 ISSUES THAT SHOULD BE PAID ATTENTION TO WHEN APPLYING AUTOMATION TECHNOLOGY

There are still many significant problems in electrical engineering and its automation technology in smart building applications. The safety protection grounding system is due to the large number of electrical equipment involved in smart buildings, which are mainly made of metal. If the insulation on the lines is damaged, residents will suffer electric shock. Therefore, in electrical engineering and its automation technology applications, grounding devices are installed on metal electrical equipment. Currently, various types of communication equipment and computers are widely used in residential life. Although the use of this equipment can effectively improve the quality of life of residents, this equipment has higher requirements for voltage stability during the operation phase. It is necessary to provide stable

power supply in electrical engineering and its automation technology applications to ensure that various communication equipment and computer applications can meet the needs of residents and play an important role in improving residents' life safety.

6 FUTURE DEVELOPMENT DIRECTIONS

Electrical engineering and its automation technology will be affected by the scale of project investment and the quality of intelligent system integrators. Related supporting services are also difficult to meet the requirements of smart building development. The rapid development of high technology and the continuous transformation of high-tech research results have laid an important foundation for the future development direction of intelligent buildings. In particular, the concept of 5G networks points out a new direction for the rapid development of smart buildings in the future. In the future development of China's intelligent buildings, they will inevitably develop to a higher level. It can not only steadily improve the level of automation and intelligence, but also improve the energy saving efficiency and operating efficiency of intelligent systems. Smart building integrators don’t just create more advanced smart systems for residents. At the same time, attention must also be paid to the energy-saving benefits of smart buildings during the operation phase. At present, the various advantages and performance of smart buildings have received widespread attention in various fields of society. It is believed that with the support of future high-tech achievements and advanced information technology, smart buildings will become the mainstream trend of future construction engineering products and further improve the overall performance of operating objects.

7 CONCLUSION

All in all, smart buildings cover Internet technology, automation control technology, modern communication technology, construction technology and computer information technology, etc., and can meet people's needs in work and life. They use electrical engineering automation technology to improve the connection of building systems and reduce the risk of accidents. The frequency is an inevitable trend in the development of modern society and can effectively promote the innovative transformation of the construction industry.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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Journal of Computer Science and Electrical Engineering
ISSN: 2663-1946
DOI: 10.61784/jcseev6n2100

RESEARCH ON THE PREDICTION OF EMERGENCY TRANSPORTATION OF E-COMMERCE LOGISTCIS PARCELS BASED ON ARIMA TIME SERIES

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Abstract: The time series prediction model can be used to predict the future change trend of the series to provide support for decision-making. For the prediction study of multivariate time series, in order to solve the prediction model of the cargo volume of the line and predict the daily cargo volume of each line during January 2023, if the new logistics site and transportation route are added, how to add more forecast is reasonable, and further explore the robustness of the established network. Using ARIMA (time series prediction model) and MATLAB programming, and combined with the topsis algorithm of entropy weight method, the prediction model of e-commerce emergency parcel transportation based on ARIMA time series is constructed to solve the problem of emergency logistics package.
Keywords: ARIMA, Logistics Transportation, Logistics Forecast, Time Series

1 INTRODUCTION

The emergency transportation of e-commerce logistics is a field that has been increasingly valued along with the development of e-commerce, network and economy in recent years. Electricity logistics network between logistics sites and logistics routes, the holidays and "double a", "618", the influence of promotional activities, electricity user order quantity will occur significant fluctuations, and earthquake emergencies or natural disasters lead to temporary or permanent suspension, the processing of the package will be urgently diverted to other logistics sites, these factors will affect the line transport number of parcels, and the number of various logistics site processing package. If you can predict the number of parcels of each logistics site and line, the manager will be able to arrange transportation, sorting and other plans in advance, so as to reduce operating costs and improve operational efficiency. In particular, when some sites are temporarily or permanently suspended, designing the logistics network adjustment scheme based on the forecast results, the processing capacity of each logistics site and the transportation capacity of the route will greatly reduce the impact of the shutdown of the logistics site on the logistics network and ensure the normal operation of the logistics network. This paper discusses how to update and obtain new data information in real time for e-commerce network logistics parcels in the face of emergency, predict the route and place of emergency transportation, and better solve the problem of emergency transportation.

2 CORRELATION STUDIES

In the e-commerce logistics prediction research, Shi Haiyang[1]In view of the logistics distribution decision problem of B2C e-commerce wave orders with dynamic release and strong heterogeneity, a forward dynamic planning method based on timing prediction is proposed to find the optimal strategy. Wang Yun et al[2]To study the sharing strategy of demand forecast information under the third-party logistics distribution, the problem of demand forecast information sharing of platform providers under the three market power structures of suppliers, platforms and logistics providers is proposed. Yin Xueming et al[3]Use the machine learning method to optimize the network of the export e-commerce logistics. Wang Jianguo[4]Logistics the logistics studied based on the time series. Draw lessons from the research results at home and abroad, this paper puts forward based on ARIMA time series of electricity logistics package emergency dispatching prediction model, through the thorough analysis of historical logistics data, predict the future period of time logistics package flow trend and demand, provide electricity enterprises and logistics enterprises with scientific decision -making basis, better grasp the dynamic change of logistics demand.

Time series prediction is a means analysis method to predict real-time data in the future period of time based on the previous data trend and cyclical development. It is widely used in predicting e-commerce logistics, meteorology, social and economic development, transportation and other aspects. When using this kind of method, Li Zhaoxi, Liu Hongyan, etc[5]In multivariate time series prediction methods incorporating global and sequence features, time series prediction models are able to estimate the future trends of sequence. Liu He et al[6]A yield prediction method based on multivariate time series model, namely multivariate long and short-term memory neural network (LSTM) is proposed. Jiang Qi et al[7]Construct the US dollar exchange rate forecast based on the ARIMA model. Therefore, this paper draws on the application of time series model in other fields, and establishes the prediction model of e-commerce logistics parcel emergency transportation based on ARIMA time series, so as to provide scientific and accurate prediction for logistics demand.

3 MODEL ESTABLISHMENT

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3.1 Data Selection and Preprocessing

The cargo volume data transferred between different logistics sites during 2021-01-01 to 2022-12-12-31. The logistics network has 81 logistics sites and 1049 lines. The lines are oriented, such as line DC1 DC2 and line DC2 DC1 are considered to be two or two lines. It is assumed that the processing capacity of each logistics site and the maximum transportation capacity of each route are its historical maximum. Through the real-time data analysis in 2023, how to establish new routes and solve the important assessment of e-commerce logistics network for different logistics sites and routes. If the new logistics sites and transportation routes are added, the prediction of how to add is the network robust.

Before the prediction and solution of the model, the data is analyzed first. It is necessary to predict the number of parcels in each logistics site and line, so that managers can arrange transportation, sorting and other plans in advance, so as to reduce operating costs and improve operational efficiency. In particular, when some sites are temporarily or permanently suspended, designing the logistics network adjustment scheme based on the forecast results, the processing capacity of each logistics site and the transportation capacity of the route will greatly reduce the impact of the shutdown of the logistics site on the logistics network and ensure the normal operation of the logistics network.

3.2 Method Description

Time series prediction is a means analysis method to predict the real-time data in a period of future based on the previous data trend and periodic development. It is widely used in forecasting e-commerce logistics, meteorology, social and economic development, transportation and other aspects. The ARIMA model, the full name differential auto regressive moving average model, is one of the important methods used for time series prediction. It combines the characteristics of auto regressive (AR) and moving average (MA), and transforms the non-stationary time series into the stationary time series through the differential operation. The ARIMA model essentially consists of three parts: AR (p-order auto regressive model) + I (i-order difference) + MA (q-order moving average model). In the use of the time series ARIMA model for prediction, the entropy weight method topsis algorithm and the MATLAB transformation can be used to solve and build the data decision tree to establish the ARIMA model. As shown in the equation (1) and equation (2).

AR part: $y\_t = \phi\_1 y\_\{t-1\} + \phi\_2 y\_\{t-2\} + ... + \phi\_p y\_\{t-p\} + \varepsilon\_t$ （1）

MA part: $\varepsilon\_t = \theta\_1 \varepsilon\_\{t-1\} + \theta\_2 \varepsilon\_\{t-2\} + ... + \theta\_q \varepsilon\_\{t-q\} + \omega\_t$ （2）

ϕ and θ is the parameter of the model, ε is the error term, ω is the white noise. The formula of the model can be expressed as follows equation (3) :

$$\left[\backslash phi(B)(1-B)\hat{}\ dY\_t = \backslash theta(B) \backslash epsilon\_t \right] \quad (3)$$

Where: (\ phi (B)) and (\ theta (B)) are polynomials for the lag operator B, representing the autoregressive and moving average parts, respectively.(P) is the number of autoregressive terms, which determines the order of (\ phi (B)).(D) is the difference order number used to convert non-stationary time series into stationary time series.(Q) is the number of moving average terms that determines the order of (\ theta (B)).(Y_t) is the value of the time series at time point (t).(\ epsilon_t) is the white noise sequence, namely the error term.

① The autoregressive part (AR): (\ phi (B)) describes the data relationship between the current time series and the past values. By fitting the autoregressive terms, the model is able to capture the autocorrelation of the time series.

② Differential part (I): ((1-B) ^ d) is a differential operation used to eliminate trends and seasonality in the time series. The choice of the difference order (d) plays a crucial role in ensuring the smoothness of the time series.

③ The moving average part (MA): (\ theta (B) \ epsilon_t) describes the relationship between the current error term of the time series and its past error term. The moving mean term is able to capture the random fluctuations in the time series.

3.3 Site Importance Considerations

Based on the importance of different logistics sites to the route. The Topsis algorithm of entropy weight method is used to select the forward treatment of the line importance index.

Very large index (benefit index), as equation (4):

$$X_{ij} = \frac{X_j - X\min}{X\max - X\min} \quad (4)$$

Minimization index (cost-type index), as equation (5)::

$$X_{ij} = \frac{X\max - X_j}{X\max - X\min} \quad (5)$$

The importance of evaluating the different sites considers the following factors:

①Total amount of goods delivered by the site e1: The more goods delivered by the site, the higher the ability to deliver the goods, and the higher the importance;
② Total amount of goods accepted by the site e2: The more the total amount of goods received by the site, the site has a strong ability to store goods and the higher its importance;
③ Times of goods sent by the site e3: the more times of goods sent by the site, the frequency of goods sent by the site is high and its importance is high;
④ Number of goods received by the site e4: the more times of goods received by the site, the frequency of goods received by the site is high and its importance is high.
⑤ Average e5 of the site: the higher, the higher the importance.
The calculated results of the Topsis evaluation algorithm are shown in Table 1.

Table 1 Results of the Topsis evaluation algorithm

Index Value	Positive ideal solution distance （D+）	Negative ideal solution distance （D-）	Comprehensive score index	Serial number
DC1	0.99997881	0.00005372	0.00005732	78
DC10	0.4090077	0.78455619	0.65732233	1
DC11	0.99372429	0.01556041	0.01541727	62
DC12	0.93759114	0.10666566	0.10214504	41
DC13	0.99632336	0.01291416	0.01279596	63
DC14	0.41989102	0.76842821	0.64665133	2
DC15	0.92763763	0.23743553	0.20379449	22
DC16	0.99310733	0.01855573	0.0183418	60
DC17	0.87502927	0.31842096	0.26680707	10
DC18	0.9828484	0.05318883	0.05133873	48
DC19	0.88030704	0.31033595	0.26064568	11
DC2	0.999466	0.00191081	0.00190818	71
DC20	0.90628994	0.26124162	0.22375551	16
DC21	0.89833688	0.23882336	0.21001733	19
DC22	0.88738109	0.29777126	0.25125146	13

4 ARIMA MODEL PREDICTION AND ERROR ANALYSIS

4.1 Prediction Results

The analysis method of the mathematical chart two-dimensional model was used, using the MATLAB model to predict the time series table, and the various values were analyzed in the time series table. Write down the analysis and comparison chart of the front information data in the analysis table, predict whether it is more than stable (the fluctuation ratio of before and after the data is limited), bias the time series (autocorrelation analysis), and estimate the p and q values according to the censoring situation. Analysis was combined with the information criterion AIC and BIC values (the lower the better), and the comprehensive analysis was combined with the time series analysis map to obtain the order results of backward prediction.
Time series analysis (ARIMA) is based on the historical period data: the goodness of fit of the model R^2 is 0.621, and the model performs well. The forecast results for the next 10 phases are respectively table 2.

Table 2 Predicted the results

Order (time)	Forecast results
1	25909.51
2	25944.53
3	25979.56
4	26014.58
5	26049.60
6	26084.62
7	26119.64
8	26154.67
9	26189.69
10	26224.71

The prediction results of line DC14-DC10, DC20-DC35, DC25-62 are shown in Figure 1, 2 and 3.

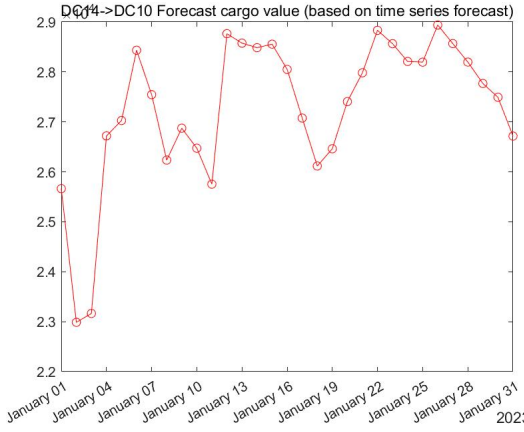

Figure 1 Prediction results of DC14-DC10

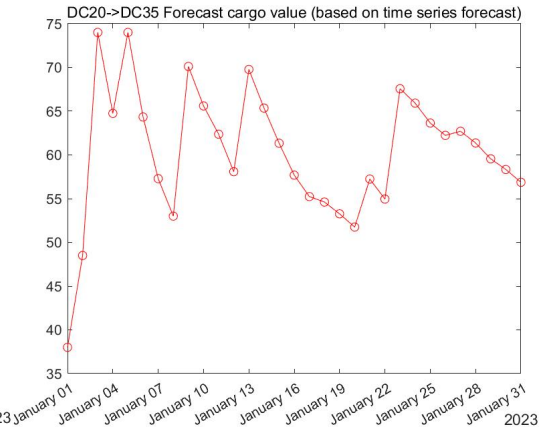

Figure 2 Prediction results of DC20-DC35

In January 2023, the cargo volume forecast and analysis value of DC14 DC10 and DC20 DC35 will be transported online. It can obviously get the forecast value of the goods on the line site in that month, and the fluctuation of the quantity of goods has obvious fluctuation, and the forecast value of the goods out of the line when excluding various assumptions. From the analysis of the data graph in Figure 3, it can be concluded that the cargo volume of the site was significantly low before the beginning of the month, and gradually increased later, with obvious fluctuation. From January 16, the fluctuation of the predicted cargo value was significantly reduced.

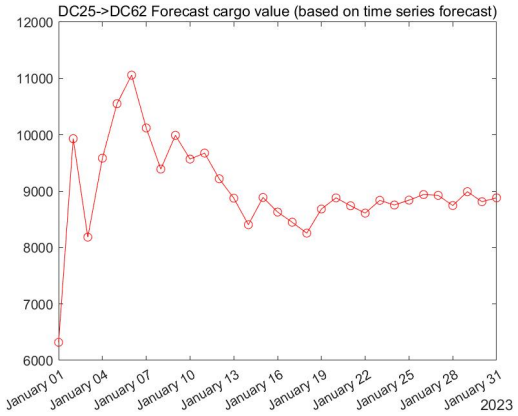

Figure 3 Prediction results of DC25-DC62

4.2 Error Analysis

To find the optimal parameters for the relevance criterion of AIC information, the result of the model is the validation of the ARIMA model as shown in Figure 4. Model parameters are shown in Table 3.

Figure 4 Results plot of model prediction fit and actual values

Table 3 Table of model parameters

ARIMA Model (0,1,1) test table		
Item	symbol	price
sample size	Dfresiduals	723
	N	726
Q statistics	Q6 (P value)	0.017(0.897)
	Q12 (P-value)	1.75(0.941)
	Q18 (P-value)	17.249(0.140)
	Q24 (P-value)	30.989(0.029**)
	Q30 (P-value)	40.377(0.019**)
Information criteria	AIC	16247.18
	BIC	16260.938
goodness of fit	R2	0.621

The results of this test include the number of samples, degrees of freedom, Q statistic and the goodness of fit of the information data model.① The ARIMA model requires that there is no autocorrelation coefficient for the residual of the model (the residual is white noise (P> 0.1)), and the model rechecks the model white noise from the P-value of Q quantity. The information criterion suggests that the two values of AIC and BIC can be used for multiple analytical model comparisons, and naturally the lower the better. R^2 represents the degree of fit of the time series, and the closer to the 1 effect, the better the performance.

5 CONCLUSION

This paper combines the ARIMA model, and discusses the feasibility of predicting the time series model. After parameter optimization and error analysis, the ARIMA model can better reflect the changing trend of the number of parcels transported by lines. This model can grasp the supply and demand relationship of the future market to a certain extent based on the historical data, and provide a scientific basis for enterprises and related departments to make strategic decisions. Thus, when using the huge number of sample data processing model for decision making, on the one hand can use big data analysis technology based on full sample prediction analysis, on the other hand can combine neural network, deep learning, such as artificial intelligence technology, get deeper information from the data, improve cognitive computing ability of data. In addition, with the continuous development of the e-commerce logistics industry, new influencing factors and challenges continue to emerge, which need to constantly update and improve the prediction model. In the future, more advanced time-series prediction methods and technologies, such as deep learning and machine learning, will be further explored to improve the prediction accuracy and efficiency. At the same time, we should pay attention to the new trends and new problems of the industry development, and constantly expand the research field and deepen the research content.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

FUNDING

The Scientific Research Fund of Yunnan Provincial Department of Education in 2024 (2024J1064).

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