The Application of Intelligent Technology in Electrical Automatic Control Engineering

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Abstract. With the rapid development of science and technology, intelligent technology is widely used in all aspects of people's life, which has brought a lot of convenience to people's life. The application of intelligent technology in electrical automation engineering can greatly improve the effect of electrical control. This paper discusses the application of intelligent technology in electrical automatic control engineering, hoping to be helpful to improve the overall level of electrical automatic control engineering.

Keywords: PID, fuzzy control, intelligent technology.

1. Introduction
With the economic development and social progress, electric power has become an indispensable part of people's production and life. As an essential equipment for power grid operation, intelligent technology is a particularly important part in electrical automatic control engineering [1]. Intelligent technology directly determines the control efficiency of electrical engineering automation, and even has an important impact on the overall development of electrical engineering. Only by ensuring the quality and efficiency of intelligent technology can we ensure the quality and efficiency of electrical automatic control engineering. Therefore, in the electrical automatic control engineering, we should strengthen the analysis and research of intelligent technology, and constantly optimize the intelligent technology, so that the operation quality and efficiency of the electrical control system can be better guaranteed.

2. Application advantages of intelligent technology in electrical automatic control engineering

2.1. Effectively reduce labor input
In the traditional electrical control engineering, it is often necessary to invest a lot of manpower to operate the equipment, because in the practical operation of the traditional electrical control engineering, it is often necessary to operate and observe a lot of instruments and circuits at the same time, as well as judge and analyze the relevant data. However, if the intelligent technology is applied to the electrical automatic control engineering, the electrical automatic control can be well realized. Through the data acquisition and calculation operation of the computer, the investment of human labor can be reduced to a great extent. At the same time, it can also reduce the operation difficulty and convenience of relevant equipment, so as to achieve efficient work and continuously improve the economic benefits of the enterprise.
2.2. Reduce the error of human operation
The application of intelligent technology in electrical automatic control engineering can also greatly reduce the error of human operation. Electrical automatic control engineering has high requirements on the technical level of operators. Once operation problems occur, they will directly affect the effect and quality of electrical automation control, and then affect the operation of the power system. The use of intelligent technology can effectively solve this problem, intelligent technology has a high degree of rigor, accuracy, through the application of intelligent technology, operators only need to use information technology can be accurate analysis of electrical system data. If there are security risks, the intelligent control system can also issue instructions in time to avoid problems in time.

2.3. Good consistency
The intelligent technology of electrical automation can use a pre-set program to control and operate electrical equipment, so that the products have good consistency. The basis of this function is to utilize the feedback function of intelligent electrical automatic control. In practice, it can adjust and proofread the changes and errors of electrical system in time. It is very convenient for information integration and expansion, greatly improving the intelligent operation of electrical equipment and enhancing the stability of the electrical automatic control system, it is of great significance and function to improve the production capacity and development of enterprises.

3. control strategy research and analysis
3.1. Collecting electrical equipment status parameters
The principle of electrical engineering automation control is a method to control the operation of electrical equipment according to the calculation of the deviation between the expected operating parameters of electrical equipment and the actual operating parameters, and then obtain the control amount through intelligent algorithm [2]. Based on this, the first step is to collect the current operating parameters of electrical equipment. The current operating parameters of electrical equipment are generally collected through various sensors. Sensor is a kind of use of front-end sensitive components to obtain the state quantity information, and then according to a certain rule to transform into electrical signals, and preprocessing, improve the quality of the signal, and finally analog-to-digital conversion, output detection value, complete the acquisition of state parameters.

3.2. Calculation method of control quantity
Based on the state parameters of electrical equipment collected in the above links, this chapter calculates the key control quantities. At present, there are mainly two kinds of control quantity calculation methods: one is PID technology, the other is fuzzy technology. The following is a specific analysis of these two commonly used technologies.

3.2.1. PID technology. PID is derived from the first letter of the three English words "proportion, integral and differential". Therefore, as the name implies, the control quantity is obtained through the operation of these three parts. The specific process is as follows:
Step 1: enter the given value;
Step 2: calculate the error between the given value and the actual value. Mathematical of error difference.
The expression is as follows:
\[ R (n) = k (n) - h (n) \]  
Where, R(n) is the error between the given value and the actual value; The given parameter k(n) is the expected state of the electrical equipment; h(n) is the actual value of the state parameters of electrical equipment detected by the sensor.
Step 3: divide the error into three parts: proportion, integral and differential. Among them, the function of "proportion" assigns a certain proportional relationship to the error. Once there is a deviation in the control system, this part will play a role immediately to adjust the proportional deviation. The function of integration is to remove the stability error between them. In short, the stability error in the actual operation of electrical equipment is offset by continuously accumulating the error. The function of differential is to reflect the regularity of deviation in the operation of electrical engineering equipment. According to the regularity, the deviation in the future can be predicted in order to adjust in advance and speed up the system response time.

Step 4: obtain the control quantity according to the operation of "proportion, integral and differential". The calculation formula is as follows:

\[
C(t) = f_p s(t) + \frac{f_p}{T_i} \int s(t) dt + f_p T_D \frac{ds(t)}{dt}
\]  

(2)

Where, \(C(t)\) is the obtained control quantity; \(f_p\) is the scale factor; Integral time constant \(T_i\); \(T_D\) is the differential time constant.

Step 5: control the operation of electrical equipment according to the obtained control quantity.

3.2.2. Fuzzy technology. Fuzzy technology is a method that uses mathematical fuzzy theory to deal with the error and obtain the control quantity. Next, the specific process of fuzzy technology is analyzed.

Step 1: blur. From the name of fuzzy technology, it can be seen that all processes are carried out in a fuzzy form. Therefore, first, the accurate value of the error between the given value and the actual value needs to be transformed into a fuzzy vector.

Step 2: knowledge base. The function of knowledge base is to provide basis for later fuzzy reasoning. Here, it mainly includes database and rule base. The former plays the role of storage, while the latter writes the rules used in reasoning.

Step 3: fuzzy reasoning. According to the fuzzy rules, the control variables of electrical equipment are deduced.

Step 4: the data obtained by reasoning with fuzzy rules is naturally in fuzzy form. In actual control, it is required to accurately control the data value. Therefore, after reasoning the fuzzy control variable, it needs to be converted back to the accurate value. This process is called defuzzification. At present, defuzzification mainly includes maximum membership method, weighted average method (center of gravity method), median method and so on.

The above two methods can calculate the control quantity of electrical equipment, which can be used alone or in combination [3]. The combined use method can make up for their respective shortcomings, which is a common core problem in the operation of many electrical equipment Cardiac control algorithm.

4. Test and analysis of application effect of Intelligent Technology
Based on the theoretical research results of electrical engineering automation control strategy based on Intelligent Technology in the above text, this chapter tests and analyzes the application effect.

4.1. Electrical equipment
At present, electrical engineering automation is mainly used in industrial control equipment. The common equipment in the industrial control system and the equipment most in need of automatic control is the servo motor. Many large mechanical equipment needs the drive of the servo motor to carry out operation and production. Therefore, this paper selects the servo motor as the control object. The main features of the selected servo motor are as follows:

1. The engine with servo control mechanism is adopted to realize the speed response of 2.5KHz;
2. The motor is equipped with 22-bit position encoder;
3. The servo amplifier supporting SSCNET III / H network supports multi axis integration and multi triaxial integration to reduce the installation space;
(4) Voltage level, three-phase or single-phase 200V, three-phase 400V, etc;
(5) Speed: 1000 r/min, 1500 r/min, 2000 r/min, 3000 r/min;
(6) The amplifier with universal interface can receive instruction pulse frequency of 4Mpps;
(7) One-key high-end servo adjustment function;
(8) 4 million pulse/RPM encoder.

4.2. Sensor selection
The main control of the servo motor is the machine speed, so choose a rotary speed sensor here. The sensor is a common speed acquisition device with low energy consumption and long working time.

4.3. Controller selection
In this experiment, a fuzzy PID controller is selected to control the servo motor, and its model is established by using Simulink in MATLAB software, as shown in Figure 1.

![Figure 1. Fuzzy PID controller model](image)

The control principle of the combination of fuzzy and PID control is to ensure the accuracy of the control result by using the input of fuzzy control result and PID control result.

4.4. Control Scheme Setting
The desired control scheme to set is shown in Table 1.

| Working condition | Expected speed of servo motor (r/min) |
|-------------------|--------------------------------------|
| A                 | 264.46                               |
| B                 | 303.40                               |
| C                 | 326.45                               |
| D                 | 381.15                               |
| E                 | 451.58                               |
| F                 | 501.24                               |
| G                 | 601.66                               |

4.5. Application effect of intelligent technology
According to the expected control scheme, the fuzzy PID intelligent controller is used to automate the control of the servo motor, and then the error between the actual output results and the expected results is counted. The error is less than 5r/min. It is considered that the control effect has reached an excellent level. The results are shown in Table 2.
Table 2. Application effect of intelligent technology

| Working condition | Expected speed of servo motor (r/min) | Error (r/min) |
|-------------------|--------------------------------------|--------------|
| A                 | 261.35                               | 3.11         |
| B                 | 301.41                               | 1.99         |
| C                 | 323.10                               | 3.35         |
| D                 | 383.52                               | 2.37         |
| E                 | 452.71                               | 1.13         |
| F                 | 503.54                               | 2.30         |
| G                 | 602.41                               | 0.75         |

As can be seen from Table 2, the use of fuzzy PID intelligent controller for automatic control of servo motor electrical equipment, the actual speed of the servo motor and the expected speed difference is not large, the error is within 5r/min, indicating that the application effect is good, to achieve the purpose of this study.

5. Conclusions
To sum up, as an important part of the power system, it is very necessary for the electrical automatic control system to run well, which can improve the safety, stability and efficiency of the power system. However, based on the analysis in this paper, in order to ensure the good operation of the electrical automatic control system, we should pay attention to the application of intelligent technology, so that it can play a full role in data collection, fault prediction, electrical control and other aspects.

Acknowledgments
This work was financially supported by NSFC71774114 fund.

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