Research on Automatic Operation and Maintenance Technology of Optical Fiber Communication System Based on Computer Control Network

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Abstract. The essence of optical fiber communication transmission technology is to use light as the carrier of information, and to achieve the purpose of information transmission through the optical fiber network. The communication mode based on optical fiber communication technology has been widely recognized in the field of industrial production and telecommunication transmission due to its good information transmission performance. However, with the expansion of the construction scale of optical fiber communication network and the improvement of user coverage, the disadvantages of the management and maintenance of the traditional optical fiber communication network are becoming more and more obvious. Therefore, this paper describes the characteristics of the optical fiber communication technology, and analyses the existing problems in the optical communication system and their causes. On this basis, this paper analyses the automatic operation and maintenance technology of optical fiber communication system. The analysis results in this paper provide some technical support for the deep integration of computer control technology and optical fiber communication automatic maintenance system.

Keywords: Optical Fiber Communication, Computer Control Technology, Automatic Operation and Maintenance

1. Introduction

At present, optical fiber communication technology has been deeply integrated with various transmission networks [1]. For example, in the military area, the optical fiber communication network carries out the signal transmission between military bases through the optical fiber local area network; in the enterprise area, the optical fiber communication network can realize the real-time transmission in
the video signal transmission and audio signal transmission, so as to complete the enterprise remote monitoring and teaching functions. However, the existing optical fiber communication network technology cannot fully adapt to the increasingly diverse communication needs. After data collection and field research, researchers found that there are still many disadvantages in the operation and maintenance system of the optical fiber communication network. Once the optical fiber communication network breaks down, it will not only have a negative impact on the user experience of customers, but also may lead to the leakage of some key information, which will cause serious losses to individuals or enterprises. Therefore, it is very urgent to use computer control technology flexibly to build a highly intelligent and highly automatic operation and maintenance system.

2. Overview of optical fiber communication

2.1. The principle of optical fiber communication

Optical fiber communication is a combination of communication technology and optoelectronic technology, which involves the way light is transmitted in the optical fiber waveguide and the protocol that is observed when signal transmission. The internal structure of the optical fiber is two layers of quartz glass with different optical properties. When light enters a light dense medium from a dense medium to a light sparse medium at a certain critical angle, the phenomenon of total reflection occurs. Optical fiber communication uses this phenomenon to transmit information in the fiber continuously forward in a way of total reflection. Light itself is also a kind of electromagnetic wave, and electromagnetic wave can satisfy the expression of the general solution of Maxwell’s equations. Different data can bring in corresponding special solution, and each special solution can represent an independent electromagnetic wave distribution. Therefore, in the process of light transmission, the different distribution of optical signals also represents the different information carried by the light.

2.2. Technical characteristics of optical fiber communication

(1) Optical fiber has the strong ability of anti-electromagnetic interference. In the process of information transmission, the environment of information users and the electromagnetic interference of the environment itself will affect the accuracy and convenience of information transmission. For example, in traditional cable communication technology, if it encounters thunderstorm weather, the electromagnetic interference is more serious, and the information is easily affected during the transmission process, which causes the information transmission frequency to weaken. Under the condition of optical fiber communication, the anti-electromagnetic interference ability of communication technology is enhanced, so it is not easy to be affected by electromagnetic interference in the process of specific information transmission. Even in the harsh natural environment, the quality and speed of information transmission can be well guaranteed.

(2) The communication capacity of optical fiber is large. Larger communication capacity is the most obvious feature of optical fiber communication technology. In the traditional wire device, if the information receiving frequency and information capacity are not equal, it is likely to cause equipment operation confusion and communication information confusion. The optical fiber transmission width is larger than the traditional cable and copper wire, so it can hold and transmit more information, and the information transmission efficiency is significantly improved. Figure 1 shows an example of a high-capacity communication network.
Figure 1. A high-capacity communication network

3. Existing problems in the maintenance and management of the optical fiber communication system

3.1. The Maintenance mechanism and management problems

Under the influence of traditional social development ideas and development ideas, the maintenance mechanism of optical cable communication lines in China is not perfect, and there are corresponding system and specification problems, which leads to a series of responsibility division problems, such as lack of management responsibility, untimely early warning management, etc. At the same time, methods to solve the problems are relatively backward, and it is difficult to improve the maintenance and management level of optical cable communication lines. The operation and maintenance system plays a key role in the line maintenance [3]. If the corresponding perfect mechanism cannot be established, it will lead to system development loopholes, and it is difficult to implement the system maintenance work. In addition, in the current operation and maintenance of optical cable, there is a problem of blind maintenance. Many companies pay too much attention to the construction of optical cable, which is difficult to improve the later maintenance and management level of optical cable projects, and management and maintenance means are relatively backward, which is not conducive to improving the quality level of line maintenance and management.

3.2. Cause analysis of the problem

Firstly, in general, in the application of optical transmission equipment and the transformation project of urban and rural networks, due to the more Transformation Times of communication poles and towers and the contempt of construction personnel, there are many changes in the erection of poles and towers, which are easy to affect the normal operation of optical transmission technology, causing transmission equipment failure and a series of problems [4]. Secondly, the construction personnel do not attach great importance to the optical fiber, and there are improper behaviours in the process of erection. In many places, there are illegal behaviours such as stealing optical fiber cables, which make the operation of optical transmission equipment adversely affected. Thirdly, in the design of optical transmission equipment, the supervision of the whole process before, during and after construction is ignored, and no scientific and effective line management measures are taken, such as inspection of optical cable lines, training of maintenance personnel, etc. At the same time, the route optimization of the line is not in place, and the operation pressure is too large, resulting in the increase of the probability of failure.
4. Key technologies of the automated operation and maintenance system

4.1. Building a perfect information management system

A perfect and reliable information management system can greatly improve the use ability of optical fiber communication intelligent operation and maintenance technology. Before establishing an information management system, the framework of information communication operation and maintenance needs to be conceived [5]. The main purpose of constructing resource information mode is to provide effective data information support for the operation of the optical fiber communication system, so when constructing the relevant framework, we need to take the actual business information as the construction basis. After the initial construction of the resource information model, the model needs to be adjusted continuously according to the actual situation. In the process of adjustment, the information in the resource information model needs to be compared and evaluated. The comparative evaluation of information can help technicians to find out the future development direction and law of optical fiber communication intelligent operation and maintenance technology, which is conducive to the further development of optical fiber communication intelligent operation and maintenance technology.

4.2. Establish an Intelligent optical fiber transmission and maintenance network

At present, the management and maintenance of China's optical fiber communication network are carried out in regions and sections, which makes it inconvenient for information exchange and management when managing the optical fiber communication network system [6]. Therefore, in order to improve the management ability of the optical fiber communication network, it is very important to build a systematic intelligent management network.

![Communication accuracy graph](image)

**Figure 2.** An intelligent network system to detect signal transmission accuracy

By inputting the details and lines into the intelligent network management system, the efficiency of inspection, the fault location and the maintenance can be greatly improved. In some developed cities abroad, there has been a mature intelligent management system of optical fiber communication network. The biggest characteristics of this system are convenient operation, timely alarm, the wide scope of maintenance, accurate positioning, etc. Figure 2 shows an example of using an intelligent network system to detect signal transmission accuracy.

When an area or a node of the optical fiber communication network breaks down, the intelligent system can give an alarm to the inspectors on the first time, and locate the fault location accurately.
according to the alarm location. In addition, the intelligent network can also display the node parameters of the fault location, which is convenient for the staff to analyse. At the same time, the intelligent network can improve the reliability of the operation of the optical fiber communication network by making statistics of the relevant staff and arranging the near staff for the fault maintenance on the first time. The intelligent network can also simulate and analyse the whole optical fiber communication network. After inputting the circuit diagram, real-time environment and other data, the intelligent network can analyse the most vulnerable positions in the optical fiber communication network, so as to help the relevant staff to strengthen the protection in these positions and establish more perfect emergency measures.

5. Conclusion

The emergence of optical fiber communication has directly pushed human society into the era of dramatic changes in the signal system. In order to give full play to the unique advantages of optical fiber communication technology in the field of communication, builders must integrate all kinds of advanced technologies into the optical communication network. At the same time, people should be aware that in the process of expanding the coverage of the optical fiber communication network, not only the management and maintenance of the communication network should be done well, but also the reliable operation of the communication system should be guaranteed to the greatest extent. Only in this way can we make a unique contribution to the structural transformation and upgrading of the national economy in the field of communication.

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