Monitoring Method of HF Communication Transmission Signal Based on Genetic Algorithms

Zhu Xiangxian

Electronics and Communication Engineering Department, Suzhou Institute of Industrial Technology, Suzhou, Jiangsu, China

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Abstract: Despite the continuous development of modern radio communication system, shortwave communication is still widely used. In the process of signal transmission, shortwave communication needs to ensure the quality and efficiency of the transmitted signal in order to ensure the accurate transmission of information and data. However, due to the natural characteristics of short-wave communication, it will cause many problems of transmission signal monitoring. Including the propagation is susceptible to interference, the shortwave band signal is dense, the data processing is difficult, the signal monitoring data is fragmented, and the response to the illegal signal processing is slow. In this regard, combined with the main technical characteristics of HF communication, based on genetic algorithm, the corresponding detection method improvement strategy is proposed. It is hoped that by adopting diversity receiving technology and setting reasonable and effective classification presupposition, the problems of signal fading interference can be significantly improved, and the optimization and perfection of transmission signal monitoring can be promoted.

1. Research Background

1.1 Literature review

Because it is not restricted by network hub and active relay, the ability of anti-destruction and autonomous communication of short-wave communication is strong. In this regard, many domestic scholars and industry experts have carried out research. Based on direct sequence spread spectrum (DSSS) multipath inter-symbol interference (ISI) filtering algorithm, Shao Hengye discussed the optimization model of shortwave communication. By extracting the time scale characteristics of communication signals, a direct sequence spread spectrum filter is constructed to optimize the interference suppression between multipath signals (Di, 2015). Xu Chi and Qiu Chuchu and other scholars analyzed the application status and new mode of frequency optimization technology for offshore short-wave long-distance communication from two aspects of separation and combination of prediction and detection. By sorting out the implementation process of the new application mode, it matches the application requirements of frequency optimization technology in long-distance communication at sea (Xu et al, 2015). Based on the future trend of HF communication, Dong Chengwan and Li Yingbin analyzed many kinds of commonly used HF communication technologies, and systematically combed the advantages and shortboards of HF communication technology (Dong and Li, 2016). However, many scholars have studied the monitoring of HF communication transmission signals. Zhang Runsheng and Li Guangfeng proposed Clover-2000 protocol signal detection technology based on spectrum template matching and instantaneous spectrum autocorrelation discrimination. It is found that the Clover-2000 protocol signal spectrum template can effectively detect the protocol signal by gradually adjusting the correlation coefficient of the maximum maintenance spectrum (Zhang et al, 2016). Gu Shuangchun and Shi Fang and other scholars believe that the study of 110A signal detection and recognition method has important practical value for short-wave radio spectrum monitoring. Aiming at the failure of the received signal with large frequency offset, phase difference is used to weaken the effect of frequency offset effectively, and to improve the detection performance of HF signal (Gu et al, 2018).

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1.2 Research purposes

In the modern communication system, digital transmission has become an inevitable trend in the communication industry. The natural advantages of short-wave communication technology make it have a long and vigorous vitality, and constantly active in production and life. The realization of signal transmission is also the essential purpose of the rise and development of short-wave communication. However, the channel transmission of HF communication is often unstable, which is not conducive to the fast and smooth transmission of data signals (Gu, 2017). At the same time, the frequency band of HF communication transmission signal is relatively narrow, and the channel will be slightly congested when transmitting signal, which will cause serious interference between transmission signals (Zheng, 2018). By reviewing the existing domestic research literature, it is found that the current research on the monitoring methods of HF communication transmission signals is not much, and the research based on genetic algorithm is basically blank. In this paper, based on genetic algorithm, the monitoring method of HF communication transmission signal is discussed. By sorting out the main technologies of short wave communication at the present stage, combining with the main problems faced by transmission signal monitoring, this paper puts forward new improvement ideas and application paths, hoping to provide some direction reference and theoretical supplement for the development and improvement of short wave communication technology.

2. Summary of the main technologies of HF communication at present

After the discovery of ionospheric and shortwave communication in 1924, it was widely used because of its good transmission performance and communication ability. Later, with the rapid development of a series of science and technology, shortwave communication, electronic information technology, digital information processing technology and other modern technological means jointly entered the era of digital communication. Short-wave communication technology has obvious advantages, including five significant features. Firstly, the automatic link in HF communication technology has the same waveform as that used in data transmission, which can obviously improve the flexibility of overall transmission. Second, the call channel and the data channel are independent of each other. Short-wave communication technology establishes an independent and interdependent relationship between call channel and data channel, so that they can maintain similar transmission characteristics. Channel separation, on the one hand, achieves the independent sharing of information traffic, on the other hand, can ensure the efficient and fast transmission of information (Zhao et al, 2018). Third, link establishment synchronization. Asynchronous mode is the way to establish the second generation HF communication link system. In the third generation communication technology, when establishing the link system, the set adopts the asynchronous and synchronous mode. In this way, the time of the signal residing in the channel is determined, so that the delay problem can be effectively reduced. Fourth, good business management ability. While establishing links, HF communication technology can automatically determine the anti-interference data system of both sides of communication, thus realizing the management function of information carrying. Fifthly, the communication capability is extremely outstanding (Wang et al, 2010). Short-wave communication technology is less limited, so it can achieve communication in harsh environment and ensure the normal transmission of signals.

Short-wave communication technology is a typical frequency adaptive technology. Good transmission performance drives the development of short-wave communication technology to a more comprehensive direction. Specifically, it can be divided into the following directions. One is short wave adaptive digital communication technology. By combining dedicated frequency selection system with adaptive communication, the frequency quality and communication quality can be greatly improved (Kong and Zhang, 2007). Second, high-speed modem technology. Commonly used modems send information through single carrier, which requires high equalization performance of the demodulator. Parallel system is used to realize multi-subcarrier transmission of data transmission, which is conducive to improving the efficiency of signal transmission. Third,

networking technology. With the increasing popularity of the Internet, shortwave communication has gradually realized networking (Liu and Sun, 2014). The realization of channel efficiency, automatic link establishment and network management means that shortwave communication technology has entered the network era.

3. Major Problems in Signal Monitoring of HF Communication Transmission

3.1 Propagation distance is long and easy to be disturbed

The transmission of HF communication mainly depends on the ionosphere for reflection propagation. After the transmission signal enters the ionosphere, the short wave is reflected to the ground to realize thousands of kilometers of communication transmission. In the process of transmission, the signal can also reflect the radio signal to the ionosphere through the ground, forming secondary reflection and multiple reflection. After several jumps of short wave signal, global communication is realized. Although long transmission distance is a significant advantage of short-wave communication, it has also become one of the main problems of transmission signal monitoring (Wei et al, 2015). Generally speaking, communication interference is mainly caused by atmospheric interference. When planets in the solar system produce magnetic storms, they will cause changes in the atmosphere ionosphere, thus affecting the quality of short-wave communication transmission signals. At the same time, due to the different sunshine conditions, the transmission signals in different periods will change, which is not conducive to the stability of signal monitoring. Once encountering severe weather such as rain and snow, the suspended particles in the atmosphere will change, and the quality of transmission signals will also be affected. In addition, the synchronous transmission of the same or near-frequency electromagnetic signals will also lead to the difference between signal transmission and reception, which may cause the instability of short-wave communication transmission signals.

3.2 Short-wave band signals are dense and data processing is difficult

The low economic cost of HF communication makes it widely used in many countries. With the rapid development of short-wave communication services, the signal density of short-wave band is also increasing at this stage. This situation leads to the difficulty of data processing and the complexity of data filtering and sorting when the short-wave communication transmission signal is processed in practice. The main reason for this problem is also the high signal density in the short-wave band of short-wave communication. Generally speaking, sometimes there will be multiple signals in the same channel. The same signal will be transmitted at different frequencies at the same time, or the same frequency and the same content will be broadcast at different places. These complex and changeable situations will result in very dense cross-over of transmission signals, which will lead to doubling the difficulty of data processing.

3.3 Signal monitoring data fragmentation, slow response to illegal signal processing

Monitoring the transmission signal of HF communication is a necessary means to deal with the irregularities in time. At this stage, the commonly used short-wave communication monitoring system in China is based on customized tasks and automatically collects signal data. However, the functions of the commonly used monitoring methods are not rich enough, and the monitoring elements are not comprehensive, which leads to the incompleteness, continuity and standardization of the collected data are not high. At the same time, the signal noise of the transmission signal in short-wave communication is low. In identifying and judging the transmission signal, real-time control and on-line monitoring are realized by experienced technicians. However, this kind of operation process can only carry out signal analysis in one link or stage, and it is difficult to achieve full-frequency and full-time signal analysis, which leads to the fragmentation of signal monitoring data and slow response to illegal signal processing.

4. Signal Monitoring Method for HF Communication Transmission Based on Genetic Algorithms

4.1 Diversified reception technology is used to effectively suppress signal fading interference

Short-wave communication transmission signal in the transmission path, will pass through the atmosphere ionosphere and through the ground reflection for jump transmission. In this process, it will pass through many objects in the natural and social environment, such as trees, high-rise buildings, vehicles and pedestrians, and so on. These obstacles will interfere with the transmission signal, and in serious cases will lead to the fading of the transmission signal. For this reason, the diversity receiving technology can be widely used in the monitoring of HF communication transmission signals. Specifically, it is to set up multiple receiving paths at the receiving end to classify, select and collect the transmission signals, so as to effectively suppress the fading interference of the transmission signals. In the actual monitoring of short-wave communication transmission signals, many kinds of diversity methods can be used, such as spatial diversity, using different antennas to achieve independent signal reception; frequency diversity, according to different signal frequencies, carries out independent signal reception; time diversity, according to the time point of signal transmission, enters. Line independent signal reception.

4.2 Promote single sideband modulation technology and significantly increase band data capacity

Single sideband modulation technology utilizes power and bandwidth to significantly improve and optimize bandwidth capacity. Generally speaking, using single sideband modulation technology, the source signal can be extended to twice the width of the modulation technology output signal. This can significantly improve the data processing difficulties caused by the high signal density for the monitoring of short-wave communication transmission signals. The promotion of single sideband modulation technology can avoid the problems of narrow bandwidth and energy carrier waste. At the same time, it will not lead to the increase of equipment complexity and transmission cost. According to the spectrum form of single sideband signal, it can be divided into three types. One is the prototype single sideband, which uses only one sideband to transmit messages. The second is to use bilateral band to realize independent sideband of multi-signal transmission. The third is the residual single sideband of one plus one main band and sub-signal transmission. By popularizing the single sideband modulation technology, the band data capacity can be increased, and the problems of signal interference and signal fading can be solved to a certain extent.

4.3 Setting up reasonable and effective classification presupposition to realize classification management of monitoring signals

In order to effectively carry out the monitoring of short-wave communication transmission signals, a reasonable signal classification management method should be established. Through the classified management of transmission signals, staff members are encouraged to monitor and analyze transmission signals. Specifically, the principle of scientific settings can be used to continuously optimize the classification management strategy, thus greatly improving the integrity, continuity and standardization of signal data. Moreover, the improvement of the time continuity of short-wave band monitoring is used to realize the reasonable distribution of monitoring spectrum and further improve the monitoring elements of short-wave communication transmission signals, thus significantly improving the confidence and availability of monitoring and analysis data. Classification presupposition is the core of the real monitoring work, which involves many parameters of the transmission signal. Including verification of signal frequency, categorization of frequency business, analysis of monitoring period, analysis of signal element integrity, and so on. The reasonable and effective classification presupposition of transmission signal monitoring settings can be adjusted according to the specific work content, and different key classification presuppositions can be set, so as to realize the classification management of monitoring signals.

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