

Research on Link Design and Power and Rate Control Technology of Short Wave Communication System for Marine Ships

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Abstract: At present, maritime operations have become the focus of China's socio-economic and military development. Ensuring smooth communication at sea and stable transmission of military and civil information security has become the basis for orderly development of maritime operations. Based on the ship short-wave communication system, this paper introduces the link design and power rate development of modern short-wave communication system, and points out the problems in link design and power rate control of current marine ship communication system. The corresponding optimization strategies are proposed in order to provide reference for improving the stability of short-wave communication for ships at sea.

1. Research background

1.1 Literature review

Under the background of China's rapid economic and social development, the navigation industry has been greatly promoted. More and more ships are entering the deep sea for operations. Zhang Hai bo scholars said that the ocean environment is quite complex, the vast coverage rate of ocean signals is extremely low, and the cost of satellite transmission is too high, thus promoting the development of ship short wave communication system (Zhang,2016). In military and civil areas, the stability of communication system is urgently needed. Once communication problems occur, they will cause serious consequences. Scholars such as Xu Shuo and Wang Yu advocate transmitting power through chirp signals to control the communication system of ultrashort wave fishing boats. By establishing AR model, it is shown that the algorithm can really save power consumption for the sending end (Xu et al,2015). Li Shuo, Hu Shanlin, Sun Wenxia and other scholars proposed the improvement strategy of wireless antenna based on the instability of short-wave communication antenna. They believe that the most difficult problem is the inability to determine the communication location between them (Li et al, 2013). Starting from the characteristics of HF communication, Zuo Wei scholars have studied the link layer protocol in detail. He described the current difficulties in link design and proposed amendments. He also discussed the development trend of HF communication system (Zuo, 2014). Ju Mao guang and Liu Shang lin specially studied HFGCS in the United States, analyzed the routing and IP carrying of HFGCS, and gave four suggestions for China's HF communication system. First, the IP protocol of shortwave communication. Second, the security of the output receiving port. The information of the third transceiver port is uniformly distributed. The fourth shortwave station controls routing (Ju and Liu,2013).

1.2 Purpose of research

With the rapid development of navigation industry, it is very beneficial for military and fishery to establish a good information transmission system. The communication system now used for ships at sea is short wave communication system. However, the transmission of information at sea is complex and prone to problems. Therefore, it is necessary to establish a stable and power-saving HF communication system. However, after reviewing the research achievements of domestic scholars on link design and power rate control technology of marine short wave communication system, the author finds that most scholars take single point as an example, and the research is more

one-sided. Based on the imperfect point of view of the short wave communication system of ships on the sea, this paper studies the link design and power rate, finds out the problems of information transmission loss, single regulation of power rate and data loss, and puts forward the solutions of ALE automatic link establishment, power rate joint control and error detection.

2. Current Situation of Ship HF Communication System

2.1 Short wave communication system

Ship short-wave communication system is mainly used for short-range communication, which transmits information by radio. The ship short wave communication system is mainly composed of the following four subsystems. The first subsystem is the short-wave adaptive controller, which monitors, evaluates and transmits changes in real-time through transmitters and receivers. The second subsystem communication controller is a communication interface device which monitors data transmission between the data circuit and the host computer. The third subsystem is personal computer, which converts application functions into commands and releases functions. The fourth kind of short-wave antenna, which is specially used for transmitting and receiving information in maritime communication, is because the relative dielectric constant and conductivity of sea water are relatively large and the transmission loss of information is relatively small. Now shortwave communication systems are widely used in the navigation industry (Tan et al,2016).

2.2 Short Wave Communication Protocol

Short wave communication protocol is also called link control protocol. In the ship short wave communication protocol, it specifically includes link establishment protocol, link maintenance protocol, short wave communication network layer and radio station. At present, the storage and output of information and the physical and virtual layers of shortwave covered in the second generation shortwave communication protocol cannot follow the fast developing society. Therefore, on the basis of the second generation shortwave communication protocol, the U.S. military revised and perfected the third generation communication protocol on August 31, 2008 (Meng,2014). The third generation communication protocol still supports small transmission and voice communication in the second generation communication protocol, but adds a data-intensive search function, realizes large-area high-quality transmission performance, and performs communication more quickly. The third generation shortwave communication protocol uses special radio monitoring to support the separation of the calling system and the listening system. After the link is successfully established, the signal can be quickly transmitted to the transmission channel to achieve timeliness of information.

2.3 The function of shortwave communication system

As the main means of ship information transmission, shortwave communication system has many functions to be realized. The ship short wave communication system is currently in the developing stage, and its functions are not perfect, but it also meets the emergency needs at this stage. The first information processing and display function. The short wave communication system receives a large amount of information at all times, including the real-time operation status information of the physical layer in the communication system and the communication information received and sent by users. Information processing requires recording the above information in real time, analyzing and processing the information in a statistical way to obtain the operation information of the communication system and realize information transmission. The function of displaying information is complete and gives the user feedback on the communication status and operation status at the current time point. The second frequency replacement function. Affected by the external environment, the short wave communication system will have the phenomena of poor signal quality and slow operation rate. At this time, frequency replacement is needed to realize efficient information transmission. The user can directly select the frequency or use self-frequency transmission to transmit the frequency to the communication system. The third is the frequency

prediction function. Generally, the software is used to forecast and record the frequency. The software can synthesize the historical communication records, automatically carry out analysis and research, and forecast the communication frequency (Zhang,2015).

3. Problems Existing in Link Design and Power Rate Control of Offshore Ship HF Communication System

3.1 Propagation loss of resources

The short wave communication system for offshore ships is still in its initial stage and needs to be continuously improved and revised. At present, the propagation path of radio waves is not single, and the environment between the collected information and the transmitted information is relatively complex. It is especially difficult to transmit radio waves from ships on the sea. During the transmission process, the radio waves will be affected by the physical characteristics of seawater channels and ionosphere, and can only be received through direct and scattering methods. There are three general modes of radio wave transmission: line-of-sight transmission and ground wave transmission to the last ionosphere for sky wave transmission. If a ship is engaged in sea sight distance communication, the communication distance it can receive must be within the effective sight distance range. Strictly speaking, radio waves cannot be transmitted in the air. The environment of ships on the sea is changeable. Wind waves and weather will affect the sea surface and affect the stability of receiving and transmitting radio waves. This phenomenon exists. This shows that in the process of transmitting information, the loss is very large.

3.2 Single control of power rate

In the short-wave communication system of offshore ships, researchers will adjust and control the transmission power and rate to avoid excessive loss of resources so as to save resources. However, a single regulation of power or rate will cause many technical problems. First, if only the power is regulated and controlled, the short wave communication system of offshore ships will not distinguish the work content, and there is no way to make the transmission rate reach the expectation. Second, if only power regulation is carried out, when the short-wave communication system of offshore ships uses the terminal to transmit information, it cannot reach the required fixed ratio of interference signal strength to target echo signal strength, and cannot reach this ratio. The short-wave communication system will independently determine that the information transmission is automatically abandoned, which will reduce the system capacity and service life after a long time.

3.3 Data Loss

When transmitting information, the sending end and the receiving end need to go through many links. There are two types of links. Physical lines and logic. However, these two link problems are urgent problems to be solved in the link design of short wave communication system. There are three main problems. The first problem is encapsulated into frames. When transferring data, the frame boundaries should be determined. That is to say, it is necessary to add a header and a trailer to the transmitted information and fix it into a frame. Unfixed framing can cause a lot of confusion. Such as byte loss and byte confusion. The second problem is transparent transmission. When the transmitted information forms a frame transmission, the information input through the keyboard can be transmitted through the frame. If the binary code of a byte in the data is the same as others, the data link will misjudge and lose some frames and important information to be transmitted. The third problem is bit error. This kind of problem occurs in the transmission process, for example, we transmit a piece of data 101010, when bit errors occur, the data is disordered, and the information received by the receiving end may be 010101.

4. Optimization strategy of shortwave communication system for offshore ships

4.1 ALE Automatic Link Establishment

In order to avoid resource loss in the process of information transmission, 3G-ALE system is used to establish automatic link, which can effectively improve service completion efficiency and avoid resource loss. ALE automatic link establishment can quickly establish one-to-one and one-to-many information transmission channels in a short time. It uses an encrypted band monitoring mechanism, which can monitor the information transmission link while the call channel works to minimize the loss in the information transmission process. ALE automatic link establishment has two ways, synchronous and asynchronous communication link establishment. Generally, synchronous communication link is used, which has lower delay and better performance than asynchronous communication. When ALE automatically establishes a communication link, it will automatically transfer the stored information to the terminal. When the user needs a voice call or enters the next protocol, this link will be transferred again in the form of command parameters and returned to the data link layer.

4.2 Power rate joint control

The ratio of interference signal strength to target echo signal strength reflects the level of transmit power, and the transmission rate is closely related to the ratio of interference signal strength to target echo signal strength. Therefore, the power consumption control of ship short wave communication system should start from this aspect. Strictly speaking, rate control indirectly affects the transmitting power of the ship's short wave communication system by controlling the frequency of short wave transmission signals. If the power rate is controlled jointly and the two are combined, the influence of the defect of controlling only single power or single rate on the short wave communication system is avoided, so as to ensure the transmission amount of information. There are two algorithms for dual control. It is the distributed power and rate control algorithm (DJPR algorithm) and the joint power and rate control algorithm (GAJPR algorithm) based on genetic algorithm. Generally, the range of joint power and rate control algorithms is relatively wide, and the optimal transmission channel can be found in a short time to improve the transmission performance of the system.

4.3 Error Detection to Avoid Data Loss

The problem of data loss can be avoided by systematic behavior of error detection. Although the link design of the short wave communication system for offshore ships is not ideal at present, many errors will occur in the transmission process. In order to ensure the stability and safety of short wave transmission process. At the beginning and end of short wave transmission, error detection should be carried out to avoid data loss. At present, the common error detection used in data link layer is CRC (cyclic redundancy check). The use of CRC reduces the possibility of problems to a certain extent, but in order to ensure the stability and reliability of the transmission signal, it is suggested to number the frames containing information and establish a storage and retransmission system on the basis of CRC transmission mechanism. When shortwave transmission has transmission errors, there are data backup and retransmission mechanisms to achieve reliable transmission.

5. Conclusion

This paper gives a detailed introduction to the link design and power rate control technology of the short-wave communication system for offshore ships, and makes a detailed analysis of the problems of the short-wave communication system at the present stage, and finally puts forward the corresponding solutions. With the rapid development of China's maritime industry, the stability and reliability of information transmission are the most urgent problems to be solved. These problems do not exist in military satellite transmission, but the cost of satellite transmission in marine fishery

and transportation is too high, and only the economical and relatively stable shortwave communication system can be used. At present, the shortwave communication system is not yet mature. It is urgent for professionals to study and propose solutions to solve the problems of the shortwave communication system for ships on the sea as soon as possible so as to contribute to the promotion of social economy.

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