

Research and Application of Integrated Maritime Search and Rescue Command System based on BeiDou Navigation Satellite System

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Abstract

With the development of marine economy, marine activities are increasing a lot. There are many risks in marine operation, staff falling into the water is even more frequent, rescuing becomes more challenging. Integrated maritime search and rescue command system based on BeiDou Navigation Satellite System, which is combined of distress alarm, search and rescue command, statistic analysis, short message function, send locate information for rescuing in-time and accurately, provide reliable assurance for rapid rescue.

Keywords

BeiDou Navigation Satellite System; Marine Operation; Maritime Search and Rescue Command System.

1. Introduction

The main drawbacks of traditional maritime rescue include lack of search and rescue equipment and facilities, rescue feedback not in-time, locate information not accurately, coordination of rescue system not efficient. Through the location information technology provided by the BeiDou system, with low power rescue dedicated bidirectional BeiDou terminal, send locate information for rescuing in-time and accurately, provide reliable assurance for rapid rescue, improve the survival rate of drowning personnel and maritime rescue capabilities. Enhancing the rescue capability of maritime accidents and disasters, reducing a large amount of manpower and material resources for maritime rescue, and significantly reducing or avoiding unnecessary casualties, has immeasurable social benefits and enormous economic value.

2. The Applications Advantages of BeiDou Navigation Satellite System

2.1 Traditional Maritime Search and Rescue

Generally speaking, there are many ship wrecks in maritime search and rescue. First, a distress alert is issued by a ship in distress. Ships and shore stations in the vicinity will receive the alert, and nearby ships will confirm receipt of the alert, or forward the alert to shore-based radio stations, the shore desk transmits the alarm to the ships near the ship in distress again, and organizes the ships to go to the scene to organize the search and rescue. In general, the first ship to arrive at the scene as the scene command, and the scene will be issued to the shore. At present, the commonly used search and rescue

methods are: Parallel Search and rescue, that is, several ships sailing in parallel lines to search and rescue; square search and rescue, when applicable to a ship, begin at the center of the wreck by traveling a certain distance in a certain direction, then turn 90 degrees, and continue to travel a certain distance (usually twice the distance of the first flight) , and so on, is also applicable to a ship case, the main turning angle is not 90 degrees but 120 degrees. The last is the air-sea integration of search and rescue, which requires the assistance of aircraft search and rescue.

2.2 Integrated Maritime Search and Rescue Command System based on BeiDou Navigation Satellite System

In this vast maritime area, sending an accurate distress signal one second earlier will ensure that search and rescue personnel can find the person in time and accurately, and improve the survival rate of the person in the water and the ability to rescue at sea. The BDS-RDSS-based personal search and rescue system at sea has been extended from the current ship-class applications to individual users. Because of the characteristics of the BDS, it can provide services to the coastal areas of our country and even the surrounding vast maritime areas. To enhance the rescue capability of maritime accidents and disasters, reduce a large number of manpower and material resources for maritime rescue, and substantially reduce or avoid unnecessary casualties, has the inestimable social benefit and the huge economic value.

The enterprises will give full play to their respective advantages, build a BDS ecosystem and a platform for coordinated development for central government-owned enterprises, achieve coordinated innovation and win-win sharing, and encourage technological innovation in the BDS + and + BDS sectors, efforts will be made to enhance cross-integration of the BDS with the strategic and cutting-edge technologies such as the Internet of things, unmanned aerial vehicles, artificial intelligence, 5G communications and blockchain, so as to promote the integration of the BDS into new infrastructure projects and the emergence of new business forms and industries. Unlike satellite navigation systems such as GPS, BeiDou Navigation System RDSS communications provide a mechanism for active location reporting. At present, the wide application of BeiDou Navigation in navigation security is still limited to ship class, and there are still many deficiencies in personal rescue. With its unique short message function, the BeiDou satellite successfully joined the Global Maritime Distress and security system. From the perspective of global maritime rescue work, the joining of the BeiDou system is undoubtedly revolutionary, and also means that, the international status of China's BeiDou system has been greatly enhanced once again.

3. The Applications of BeiDou Navigation Satellite System

3.1 The Research Content Construction

The research content construction of Integrated Maritime Search and rescue command system based on BeiDou Navigation Satellite System are BeiDou warning bit management platform see Fig. 1., Low-power life-saving dedicated two-way BeiDou Terminal see Fig. 2., method of sending and processing the dangerous call for help information, method for receiving and processing distress signal of search and rescue center.

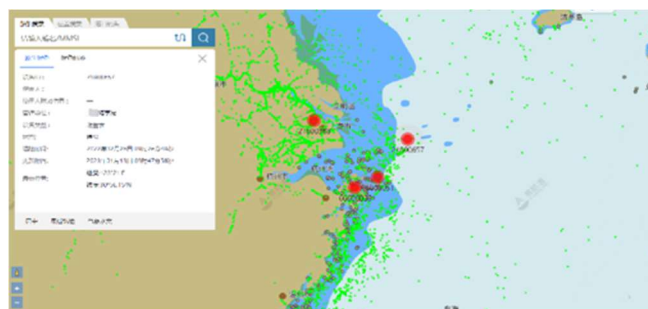


Fig. 1 BeiDou warning bit management platform



Fig. 2 Low-power life-saving dedicated two-way BeiDou Terminal

Combing through the maritime distress search and rescue process, organizational structure and processing characteristics, and studying how to use terminals to send and receive distress signals, alarm and treatment methods, ensure the distress signal can be reliable and timely sent to the search and rescue center. To study the method of reliable reception of distress and rescue information in search and rescue centres, and the composition and operation procedure and specifications of related equipment, so as to ensure that distress and rescue signals can be received round-the-clock and continuously, and that warning signals can be issued in a timely manner, form the working mechanism of search and rescue center.

3.2 Principles of Technology

Relying on the BeiDou satellite system, personal search and rescue terminals connect to the BeiDou transceiver antenna through the antenna interface, receive satellite navigation messages and transmit communications signals. The transmitting power amplifier module amplifies the uplink communication signal and transmits it to the BeiDou transceiver antenna for transmission. After the terminal falls into the water, the alarm information is sent to the information release platform through the BeiDou signal according to regulations. Technical specifications see [Table 1](#).

Table 1. Key technical indicators

Numble	Indicator 1	Indicator 2	Indicator 3
1	Transmit Power Eirp (effective omnidirectional radiant power)	EIRP is not less than 7DBW in the range of elevation angle of terminal antenna greater than 45 ° .	Effectively reduce the power consumption of equipment.
2	Battery working time	Working time is not less than 3 days in alarm state.	Guarantee 72 hours of golden rescue time.
3	Self-check function	start the self-test by pressing the button, detect whether the positioning and alarm functions are normal, and display the self-test results through the indicator light. No information is sent to the central platform during self-check.	Convenient for daily maintenance
4	Manual alarm function	Manual alarm can be activated by pressing a button.	In the dangerous time, the artificial alarm as a backup function, increase the sense of safety of people falling into the water.
5	Automatic warning function of falling water	Automatically start the alarm after falling into the water	Automatic alarm at terminal after touching water.
6	Environmental adaptability requirements	Protection level IP67	Have the highest level of protection.
7	Environmental adaptability requirements	Salt spray	It is suitable for continuous work in high salt fog environment.

4. Conclusion

Based on the BDS communication signals, an integrated search and rescue command system integrating distress alarm, search and Rescue Command and statistical analysis based on the electronic chart system has been built, making use of the short message function unique to the BDS RDSS, the BeiDou Navigation and positioning information is timely and accurately transmitted to the marine search and rescue, which realizes the accurate positioning of the people falling into the water and provides a reliable guarantee for the rapid rescue. The Lifesaving Beacon Terminal, which is designed with a BeiDou navigation chip, will be adapted to the ocean environment under extreme weather conditions. It will have manual and water-contact automatic triggering functions, and is small in size, low in power consumption and convenient to install, suitable for long-term reliable work in the marine environment, currently only the maritime and search and rescue sector use the relevant technology. The development of offshore wind power has been accelerated, and there is a huge space for its market promotion. It has promoted the formation of offshore operating standards and norms, which can be applied to offshore wind power, offshore oil drilling and other industries, will produce huge economic benefits.

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