Research on Communication Performance of Ship Network
Based on Artificial Intelligence

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Abstract. In view of the irreplaceable effect of waterway transportation on domestic economic and social development, the artificial intelligence technology and the ship communication technology are deeply integrated to create a modern intelligent ship to adapt to the increasingly high pursuit of modern transportation capacity. This paper analyzes the current situation of ship manufacturing and transportation, and discusses the feasibility and preliminary application description of the artificial intelligence technology that can be used in ship communication design. Finally, a new prospect for the application of intelligent technology in the field of fully intelligent ship technology is presented.

Keywords: introduction, modern, technology, application, network, reliability, design

In history, rivers, lakes and seas are indispensable in our lives. With the evolution of history, they still occupy a pivotal position in our social exchanges and transactions, and waterway transportation is one of the most important representatives. Exchanges and exchanges of economic, cultural and other aspects through waterways are beloved around the world because of its huge potential, ability and obvious cost advantages. Before the industrial revolution, waterway transport was the fastest mode of transport in the world. Now that the industrial revolution has gone through twice, in the age of electronic information, waterway transport has lost its reputation for being the fastest in the transport world, but the demand for transport of all kinds between the world's countries is increasing, and the other transport volume of this demand is insatiable, even the potentially huge waterway transport, is facing serious challenges in development. Waterway transportation has always been an important strategic resource, such as crude oil and iron ore, and the main mode of transportation of industrial materials [1]. As we lay our hands on development, we were confronted with the problem of the increasing number of ships going into the sea, the unprecedented prosperity of the logistics industry, the overcrowding of waterways and the neglect of the protection of the ecological environment in the course of development, which severely limited the number of exploitable routes. In the case of higher labor cost and slower and slower waterway route safety, there are many problems in waterway...
transportation, which need to be solved urgently.

In 2012, by Fraunhofer CML, for the first time, the "Munin" (maritime unmanned navigation through intelligence in networks) project, which is co operated by 8 research institutions, such as the division, marintek company and Chalmers University, is the unmanned bulk carrier.

1. The research of large-scale unmanned ship is carried out
The ship on the left side of the figure is an autonomous navigation ship. The navigation path, meteorological navigation and track parameters displayed in the computer system of the ship will be updated and stored in real time.

The ship monitors the surrounding environment through radar, AIS and infrared sensors. When encountering other ships or obstacles, the ship will conduct collision avoidance operations in accordance with the COLREGs rules. At the same time, all parameters monitored by the ship will be transmitted to the shore control center (SCC) in real time. When the ship is close to the land, it can communicate through GSM, 3G or 4G network. When the ship is far away, it needs satellite communication. In 2013, Rolls Royce, one of the largest ship equipment suppliers in the world, has emerged in research under way on unmanned cargo ships, and if all goes according to plan, unmanned cargo ships will appear on a certain channel for the first time in a decade [2]. In fact, advances in technology and information technology are unthinkable and may not take a decade at all. In September 2015, Lloyd's register of shipping (LR), the quinatique group and the University of Southampton jointly launched the global sea. Trends in foreign technology 2030 (gmt2030) report, which lists smart ships as one of the 18 key marine technologies. In order to follow the development trend of intelligent ships, regulate and guide the development of intelligent ships, China Classification Society in 2015

The specification for intelligent ships was issued, which clarified the specific requirements of intelligent ships in intelligent navigation, intelligent hull, intelligent engine room, intelligent energy efficiency management, intelligent cargo management, intelligent integrated platform, etc.

2. Development background of intelligent ship
The world has entered the development period of "industry 4.0". China issued "made in China 2025" in May 2015, with emphasis on high-tech ships and intelligent shipbuilding. Although the development of artificial intelligence is exciting, the degree of application to ship communication development is very shallow, and we still have a long way to go [3]. Intelligent ships face many technical, safety and environmental protection problems, with the current means and industrial manufacturing level cannot be overcome. The existing countermeasures for these problems are as follows:

2.1. Energy saving and emission reduction.
Protecting the environment and saving resources are the themes that the world is focusing on and promoting today. An important measure of these two measures is CO2 emissions, for which the relevant international authorities have specifically established evaluation criteria to advocate a joint global effort to reduce CO2 emissions, thereby reducing the rate of increase in greenhouse effectiveness. At the same time, environmental protection and resource conservation are mutually reinforcing, and progress on either side has a positive impact on the other. It is a resource- and environment-friendly measure to apply clean energy to ship use and manufacture, to upgrade engine manufacturing technology and technology, to strengthen ship aerodynamics research and to study energy efficiency control technology in depth.

2.2. Labor cost.
According to the latest shipping survey released by Moore Stephens, an international accounting and shipping consultant, the operating cost of ships is expected to increase by nearly 3% in 2014 and 2015,
of which the crew salary and maintenance cost are the main factors. Reducing ship Manning and even realizing unmanned operation is an important development goal of the shipping industry in the future. With the continuous improvement of the ship's intelligent level, the development of unmanned engine room duty, auxiliary driving technology and fault self diagnosis technology makes the ship's manning gradually less.

2.3. Ship safety. Collision on the ship
In the collision accidents, 89% ~ 96% of the accidents can be attributed to human's own reasons, including obvious and potential reasons. In case of safety accidents (sinking of "Oriental Star" in China and "time" in South Korea), serious consequences will be caused, such as casualties, leakage of dangerous goods, traffic interruption, etc. Intelligent ship condition monitoring and fault analysis, information warning and information perception and other intelligent technologies can improve the safety of ships. Intelligent ship is no longer a common technology, but a concrete embodiment of utilization, which includes sensor, robot technology, big data, new materials, communication technology, etc. mentioned in the report. All these modern technologies and technologies can be widely used in the development of intelligent ships.[4]

3. The concept of intelligent ship
According to the Specification for Intelligent Ships, ships are manufactured and operated using new science and technology and digital information, using advanced sensors, using advanced communications and Internet of things to monitor and locate ships throughout the course, and can automatically sense the state of the ship's operation, collect all kinds of data information of the ship, provide safety information and data for the operation of the ship, make the ship operation more in line with environmental standards, save energy and have more reliable performance. All in all, an intelligent ship is a ship that will think and judge and make decisions.

4. Intelligent ship-related technologies

4.1. Information perception technology
The advanced information sensing devices of intelligent ships can be used to receive and collect all kinds of information of their own and their environment, and the advanced communication system can keep the ship in touch with the dispatch department at any time, so that the safe navigation of the ship can be guaranteed to a greater extent. The means of perception is more mature. Surrounding environment information includes surrounding ships and obstacles information, surrounding meteorological conditions, water depth, video monitoring information, audio monitoring information, water flow speed and direction, navigation mark position, navigable area, etc. Figure 1 shows the basic composition and schematic diagram of AIS.
Figure 1. The basic composition and schematic diagram of AIS

The main indexes of AIS network communication performance are network capacity \( M \), network channel load rate \( SR \), network throughput \( TP \), network utilization \( Ps \), network blocking rate \( Pr \). When the total number of channel slot appointments for the AIS system \( Ne(t) \) is less than 80% of the total number of slots, the launch success rate of the system is greater than 90%.

\[
N_e(t) \leq 2250 \times 80\%
\]

The number of ships that the system can hold is:

\[
M = \sum_{i=1}^{m} M_i(t) \tag{1}
\]

In practical calculation, it is necessary to consider the difference between static and dynamic messages issued by ships in AIS network system in the process of communication.

\[
SR = \frac{N_e(t)}{2250} = \frac{1}{2250} \left[ \sum_{i=1}^{m} 60 \times RR_i \times M_i(t) \right] + \frac{60 \times 2 \times RR_i \times M(A)}{2250} + \frac{60 \times 3 \times RR_i \times M(B) + \alpha}{2250} \tag{2}
\]
The probability of an appointment conflict in any free slot can be shown by the formula:

$$P_c = 1 - \left(1 + \gamma \right) e^{-\gamma}$$

Based on inter-frame allocation calculations, the following formulas can be worked out:

$$P_f = \frac{1}{5} \sum_{T=3}^{5} = 0.218$$

$$P_s = \frac{N_t}{n} = \gamma e^{-\gamma} = SR \times e^{-SR} \times 100\%$$

The throughput TP can be calculated by the following formula:

$$TP = \frac{N_t}{N_e} = e^{-\gamma} = e^{-SR} \times 100\%$$

4.2. Technical means of controlling energy efficiency

In 2007, the world's marine ships discharged CO2 up to 1.04 billion tons, including 870 million tons of CO2 emitted by international shipping, accounting for 3.3% and 2.7% of the total global CO2 emissions in that year, respectively. To improve ship energy efficiency and reduce ship.

4.3. Route planning technology

A variety of factors need to be taken into account in the planning of routes, including the throughput of ships in the region and the distribution and density of shipping lanes in the region not under its jurisdiction, as well as the navigation planning of the ship company. According to these factors, the navigation route of the ship is planned in real time. Try to optimize the route and achieve the purpose of safety, efficiency, green and environmental protection method. A variety of intelligent technology algorithms have been integrated in ship path planning. Simulated annealing, particle swarm optimization algorithm and other intelligent algorithms are able to solve the problem of random travel time.

5. Conclusion

To be rich, first to build roads, whenever transportation plays an irreplaceable role in the development of the national economy, waterway transportation is the most important, economical and efficient form of transportation. This means that in any era, the development of transportation should keep up with the pace of economic development. Only by following the progress of science and technology and transforming the most advanced science and technology into productive forces in a timely manner, can the transportation industry not delay the economic retreat. The use of intelligent ships is beginning to take shape, and its in-depth research and future prospects will be very important.

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