

Original Research Article

Influence of Artificial Intelligence on Improve Navigation Safety of Ships and Its Practical Application

Yue Yan

School of Information Engineering, Jiangsu Maritime Institute

Abstract: This paper deeply discusses the positive role of artificial intelligence technology in improving the safety of ship navigation and its application examples in practical operation. Firstly, this paper summarizes a number of applications of artificial intelligence in the field of ship navigation safety, and clearly points out the obvious advantages and challenges it brings. Furthermore, the paper analyzes in detail the key links such as the ship's automatic driving system, the risk assessment and early warning system in the navigation process, and the accident emergency treatment and rescue system, and how to skillfully use artificial intelligence technology to improve the overall safety performance. Through in-depth analysis of typical cases in this field at home and abroad, this paper comprehensively summarizes the remarkable application effect of artificial intelligence technology in the practice of ship navigation safety. These research results not only show the broad application prospect of artificial intelligence, but also provide strong theoretical support and practical guidance on how to further improve the safety of ship navigation, which has far-reaching guiding significance for ensuring the safety and stability of maritime transportation.

Keywords: artificial intelligence; Safety of ship navigation; Automated driving; Risk assessment; Emergency treatment

1. Introduction

With the rapid development of science and technology, artificial intelligence (AI) has been widely used in all walks of life, and its influence and practical application in the field of ship navigation safety have become increasingly prominent. Ship navigation safety has always been the focus of the global shipping industry, and the introduction of artificial intelligence technology provides new possibilities for improving ship navigation safety. The purpose of this paper is to explore the influence of artificial intelligence on improving the navigation safety of ships and analyze its application cases in practice. Through in-depth study, we expect to provide useful reference and enlightenment for the safety improvement of ship navigation.

2. Overview of the application of artificial intelligence technology in ship navigation safety.

2.1. The main application of artificial intelligence technology in ship navigation safety

The application of artificial intelligence technology in ship navigation safety has been increasingly extensive, and it has become an important means to improve navigation safety. By integrating advanced algorithms and data analysis technology, artificial intelligence technology can play a significant role in ship navigation, monitoring, early warning and accident response. In ship navigation, artificial intelligence technology can accurately analyze the navigation environment, automatically optimize the route and avoid potential dangerous areas. For example, using the deep learning algorithm, the system can learn and understand the complex marine

meteorological model, predict the changes of storms and ocean currents, and thus adjust the navigation strategy in advance. Ship monitoring system also benefits from artificial intelligence technology^[1]. By analyzing the data of ship's running state, mechanical performance and cargo condition in real time, the system can predict potential faults and give warnings in advance. This predictive maintenance not only reduces the risk of ship failure, but also improves the operational efficiency. In terms of accident response, artificial intelligence technology can quickly analyze the cause of the accident and provide the optimal response plan in an emergency. For example, in the event of a collision accident, the system can quickly assess the degree of damage, guide the crew for emergency treatment, and coordinate with the shore rescue agencies efficiently. In addition, artificial intelligence technology can also assist the crew to make decisions. In the complex navigation environment, the artificial intelligence system can provide a variety of alternative schemes, and analyze the potential risks of each scheme to help the crew make more informed decisions^[2].

The application of artificial intelligence technology in ship navigation safety not only improves the navigation safety, but also enhances the efficiency and reliability of ship operation. With the continuous progress of technology, these applications will be more extensive and in-depth in the future^[3].

2.2. Advantages and challenges of artificial intelligence technology in ship navigation safety

The application of artificial intelligence technology in ship navigation safety has obvious advantages, but it also faces some challenges. Its advantages are mainly reflected in the following aspects: First, artificial intelligence technology can accurately perceive and predict the navigation environment of ships through big data analysis and machine learning. This is helpful for ships to make quick and accurate decisions in complex and changeable water environment and improve the safety of navigation^[4]. Artificial intelligence technology can optimize the navigation route and speed of ships, reduce fuel consumption and emissions, and realize green navigation. This will not only help to reduce environmental pollution, but also improve the economic benefits of ships. In addition, artificial intelligence technology can also realize real-time monitoring and early warning of ship equipment, discover and solve potential safety hazards in time, and improve the maintenance efficiency and navigation reliability of ships. However, the application of artificial intelligence technology in ship navigation safety also faces some challenges. First of all, the research and application of technology needs a lot of capital investment and talent support, which may pose greater economic pressure for some small and medium-sized shipping companies. The reliability and stability of artificial intelligence technology need to be further improved, especially in extreme weather and complex water environment, its performance may be affected to some extent. In addition, with the wide application of artificial intelligence technology, the legal and regulatory systems related to ship navigation safety also need to be constantly improved and updated to meet the development and application needs of new technologies. Generally speaking, the application of artificial intelligence technology in ship navigation safety has broad prospects and great potential, but it also needs to be constantly improved and improved in technology research and development, capital investment, laws and regulations^[5].

3. Artificial intelligence technology to improve the safety performance of ship navigation.

3.1. Application and influence of ship automatic driving system

Ship autopilot system, also known as ship autopilot or intelligent ship navigation system, is an outstanding

representative of modern artificial intelligence technology in the shipping field. The application of this system has significantly improved the safety performance of ship navigation. By integrating advanced sensors, algorithms and control systems, the automatic driving system can monitor the surrounding environment of the ship in real time, including key information such as current, wind direction and ship status, and make quick and accurate decisions, adjust navigation routes or take evasive measures based on these data. With the support of the ship's automatic driving system, human errors in the navigation process are greatly reduced. Traditionally, ship driving requires long-term monitoring and operation by the crew, and people's fatigue and distraction may lead to safety accidents. The automatic driving system can work continuously all day, keep a high degree of vigilance, and ensure that the ship can maintain the best navigation condition in all kinds of complex sea conditions. In addition, the ship automatic driving system can also seamlessly connect with the traffic management system on the shore, and realize real-time information exchange and cooperative operation between ships and ports and other ships. This not only improves the efficiency of navigation, but also ensures the smooth flow of information during navigation, which is convenient for rapid response and disposal in emergency situations^[6].

The application of ship automatic navigation system plays an important role in improving the safety performance of ship navigation. It reduces the potential safety hazards caused by human factors, improves the automation and intelligence level of ship navigation, and provides strong support for the safe development of modern shipping industry. With the continuous progress of technology, it is believed that the ship automatic driving system will be more mature and perfect in the future, which will provide a more solid guarantee for the safety of ship navigation^[7].

3.2. Application and influence of ship navigation risk assessment and early warning system

In the field of ship navigation safety, artificial intelligence technology has brought revolutionary changes to risk assessment and early warning system. Traditional risk assessment often relies on manual experience and limited data analysis, while modern artificial intelligence technology can realize real-time analysis and processing of multiple information such as marine environment, ship state and navigation behavior through deep learning, data mining and pattern recognition^[8]. Specifically, the application of artificial intelligence technology in ship navigation risk assessment is mainly reflected in the ability to process massive data and simulate complex environment. Through the integration and analysis of multi-source information such as ship navigation history data, marine meteorological data and traffic flow data, artificial intelligence can build a high-precision risk assessment model, thus predicting the safety risks of ships under different navigation conditions. This forecasting ability can not only help the crew identify potential risks in advance, but also provide decision support for the ship management company and optimize the navigation route and time. At the same time, the early warning system is also an important application of artificial intelligence technology in the field of ship navigation safety. By monitoring the state of the ship, the marine environment and the dynamics of the surrounding ships in real time, the early warning system can warn the crew in time when the risk is about to occur or has already occurred, reminding them to take corresponding countermeasures^[9]. This real-time feedback and quick response mechanism greatly improves the safety and reliability of ship navigation.

The application of artificial intelligence technology in ship navigation risk assessment and early warning system not only improves the accuracy of risk assessment and the timeliness of early warning, but also provides

a strong guarantee for the safety of ship navigation. With the continuous progress of technology and the continuous expansion of application scope, artificial intelligence will play an increasingly important role in the field of ship navigation safety^[10].

3.3. Application and influence of emergency treatment and rescue system for ship accidents

In the emergency treatment and rescue of ship accidents, the application of artificial intelligence technology has brought revolutionary changes to improve the safety of ship navigation. The traditional emergency treatment of ship accidents mostly depends on the experience and judgment of personnel, but in the complex and changeable marine environment, it is often difficult for human factors to fully cope with various emergencies^[11]. The intervention of artificial intelligence technology has significantly improved the efficiency and accuracy of ship accident emergency treatment through big data analysis, pattern recognition and machine learning. First of all, artificial intelligence can monitor the running state of the ship in real time, and analyze the key information of the ship's navigation trajectory, speed, load and so on through the data collected by sensors. Once an abnormal situation is detected, the system can respond quickly and automatically start the emergency handling program. This greatly shortened the time from accident discovery to emergency response, and won a valuable time window for rescue work. Artificial intelligence technology has shown great ability in accident cause analysis. Through deep mining and pattern recognition of accident data, the system can quickly locate the cause of the accident and provide decision support for rescuers. This data-based analysis is more accurate and reliable than traditional empirical judgment, which is helpful to reduce the risk of secondary accidents. Artificial intelligence also plays an important role in ship accident rescue command. Through intelligent algorithm, the system can optimize the allocation of rescue resources and realize the rapid dispatch and coordination of rescue forces. This not only improves the rescue efficiency, but also ensures the safety of personnel and reduces unnecessary losses during the rescue process^[12].

The application of artificial intelligence technology in ship accident emergency treatment and rescue system has significantly improved the safety performance of ship navigation. Through real-time monitoring, accurate analysis and intelligent command, artificial intelligence technology provides a strong guarantee for the navigation safety of ships, which enables ships to respond more quickly and accurately in the face of emergencies, thus ensuring the safety of ships and personnel^[13].

4. Application cases of artificial intelligence technology in ship navigation safety practice.

4.1. Typical case studies at home and abroad

In the practical application of ship navigation safety, the typical case analysis of artificial intelligence technology at home and abroad shows its great potential and practical results. Taking a large domestic shipping company as an example, the company introduced advanced artificial intelligence technology, and through intelligent monitoring system and big data analysis, it can monitor and predict all kinds of parameters in the process of ship navigation in real time. The system can detect abnormal conditions in time, such as mechanical failure and sudden change of weather, so as to give early warning and reduce the possibility of accidents. At the same time, these data can also provide scientific basis for ship maintenance and further improve the overall performance of the ship^[14]. Internationally, a well-known ship design company has developed a set of ship

navigation safety assessment system by using artificial intelligence technology. The system integrates many algorithms such as deep learning and machine learning, which can simulate the navigation state of ships in different sea areas and different weather conditions and provide more accurate safety performance evaluation for ship design. This not only shortens the design cycle of the ship, but also greatly improves the navigation safety of the ship. These typical cases show that artificial intelligence technology plays an increasingly important role in the practice of ship navigation safety. Through real-time monitoring, prediction and evaluation, artificial intelligence technology can effectively improve the navigation safety of ships and reduce the risk of accidents. At the same time, with the continuous progress of technology and the expansion of application scope, artificial intelligence will play a more important role in the future ship navigation safety field.

4.2. Enlightenment and reflection of successful cases

In the field of ship navigation safety, the successful application of artificial intelligence technology provides us with valuable enlightenment and reflection. Through in-depth analysis of these cases, we can find that artificial intelligence technology has played an important role in improving the navigation safety of ships. These successful cases show that when artificial intelligence technology is closely combined with ship navigation safety, it can not only improve the navigation efficiency of ships, but also effectively reduce the probability of accidents. However, we must also realize that artificial intelligence technology is not everything. In practical application, we must choose and use artificial intelligence technology reasonably according to the actual situation and demand of ship navigation. At the same time, we should also see that there are often complex technical support and teamwork behind these successful cases. Therefore, when popularizing and applying artificial intelligence technology, we must pay attention to technology research and development and personnel training to ensure the advanced and practical technology. In addition, successful cases also tell us that the application of artificial intelligence technology in the field of ship navigation safety is a continuous optimization process. With the continuous progress of technology and the constant change of the navigation environment of ships, we must constantly update and improve the artificial intelligence technology to meet the new needs and challenges.

The application case of artificial intelligence technology in the practice of ship navigation safety provides us with valuable enlightenment and reflection. We should make full use of the experience and lessons of these successful cases to promote the wide application and development of artificial intelligence technology in the field of ship navigation safety. At the same time, we should also keep a clear head, take seriously the problems and challenges that may be encountered in the application of artificial intelligence technology, and make greater contributions to the cause of ship navigation safety.

5. Summarize

This paper discusses the influence of artificial intelligence technology on improving the navigation safety of ships and its practical application. By summarizing the main applications of artificial intelligence in ship navigation safety, this paper analyzes the advantages and challenges it brings. This paper further discusses the application and influence of artificial intelligence technology in ship automatic driving, navigation risk assessment and early warning, accident emergency treatment and so on. Through the analysis of typical cases at home and abroad, the enlightenment and reflection of successful practice are summarized. The future research direction and application prospect are put forward in the part of research prospect and suggestion. This paper

aims to provide theoretical support and practical guidance for promoting the wide application of artificial intelligence technology in the field of ship navigation safety.

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