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Regular Category
Beginners

Artificial Intelligence in Maritime Transports



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Introduction

Maritime transport is essential to global trade, facilitating the movement of goods and raw materials across the world's oceans. Approximately 90% of global trade is conducted by sea, highlighting its critical role in international commerce. However, this industry faces significant risks and operational challenges, including adverse weather conditions, unpredictable sea states, and human error, which can lead to accidents such as collisions, groundings, and spills, posing significant threats to human life, the environment, and economic stability. Given these challenges, there is growing interest in leveraging advanced technologies, particularly Artificial Intelligence (AI), to enhance maritime safety and risk management. Navigation systems can improve the work of the navigation officer by providing Integrated Data to support decision-making, while Artificial Intelligence can play a significant role in managing a vessel's energy consumption and reducing fuel consumption, thereby lowering harmful emissions.

There is a wide range of applications of Artificial Intelligence in maritime transport systems, including:

Navigation Systems – Artificial Intelligence algorithms support navigation decision-making to prevent collisions and improve the accuracy of a vessel's position, thereby enhancing navigational safety.

Hazardous Materials Handling – AI-based tools that provide information on the segregation and isolation requirements for hazardous cargo eliminate the possibility of human error, thereby preventing the risk of explosions, fires, and marine pollution.

Risk Analysis and Management – Artificial Intelligence algorithms enable risk management on board vessels during maritime operations, mooring operations, technical inspections, routine operations, and repairs at shipyards.

Crew Resource Management – Tools that support the effective management of work schedules at sea and in port, as well as onboard maintenance activities, while ensuring compliance with crew rest-hour requirements in relation to working hours.

Predictive Maintenance – The management, monitoring, and execution of repair and maintenance activities require effective time management and planning based on the vessel's operating conditions. Artificial Intelligence algorithms that analyse historical inspection and maintenance data improve the planning and management of upcoming inspections, eliminating the possibility of necessary repairs and periodic maintenance being overlooked.

Energy Efficiency – Artificial Intelligence that supports route planning between ports and controls the use of the main engine and revolutions per minute (RPM) can significantly reduce fuel costs while protecting the marine environment by reducing exhaust emissions. Sustainable energy consumption should not be limited to the vessel while at sea; it should also be taken into consideration during its stay in port.

The application of Machine Learning, as a key subfield of Artificial Intelligence, can be considered a component of the digital transformation process aimed at promoting green practices throughout the maritime port supply chain. In the field of environmental sustainability, emissions and energy consumption are among the most frequently studied issues.

Navigation Systems with Artificial Intelligence Enhancement

Artificial Intelligence algorithms are crucial for optimizing shipping routes, significantly enhancing both safety and efficiency in maritime operations. These algorithms process extensive datasets, including real-time weather conditions, ocean currents, vessel traffic, and historical shipping routes, to determine the most efficient and safest routes for vessels. By continuously updating and recalculating routes based on the latest available data, Artificial Intelligence ensures that vessels can avoid hazardous conditions such as severe weather, high-traffic areas, and navigational obstacles. Furthermore, AI-based route optimization minimizes fuel consumption by selecting the most efficient routes, thereby reducing operational costs and mitigating environmental impact. This capability not only enhances the profitability of maritime operations but also aligns with global efforts to reduce greenhouse gas emissions and promote sustainable shipping practices.

AI systems use a variety of technologies and processes to optimize shipping routes. Data collection is the first step, involving sensors and other sources that gather real-time information about weather conditions, ocean currents, and vessel positions. This data is then processed by Machine Learning algorithms, which analyze it to identify patterns and predict future conditions. The AI system evaluates multiple possible routes, considering factors such as distance, fuel consumption, and safety risks. It then ranks these routes based on efficiency and safety criteria, providing recommendations to the vessel's navigation team.

AI systems are essential for the real-time detection and avoidance of collisions, significantly improving navigational safety. These systems integrate data from radar, Automatic Identification Systems (AIS), and other advanced sensors to maintain comprehensive and up-to-date situational awareness of the vessel's surroundings. Advanced Machine Learning algorithms analyze this data to identify potential collision risks involving other vessels or obstacles. Once a potential collision is detected, the AI system provides immediate alerts and recommends evasive maneuvers to the crew. This capability is particularly critical in congested waterways and during complex maneuvers in ports. By enabling timely and informed decision-making, AI-based collision avoidance systems contribute to accident prevention, ensuring the safety of the vessel, its crew, and its cargo.

Artificial Intelligence technology is also instrumental in monitoring and responding to environmental conditions that affect navigation. These systems collect data on various environmental factors, including weather conditions, sea state, visibility, and tidal movements, all of which can significantly affect a vessel's route and operational safety. AI algorithms analyze this data to predict adverse environmental conditions and recommend the necessary adjustments to the vessel's course or speed. For example, if severe weather is forecast along the planned route,

the AI system may recommend alternative routes to avoid the storm. This proactive approach enables vessels to navigate safely under challenging conditions, reducing the risk of weather-related accidents and helping ensure timely arrival.