



## Editorial

# Recent Developments and Knowledge in Intelligent and Safe Marine Navigation

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## 1. Introduction

Marine navigation is the lifeblood of international trade and the global economy, facilitating over 80% of worldwide commerce [1]. The maritime industry's pivotal role in sustaining global trade cannot be overstated. In a rapidly evolving technological landscape, intelligent and safe marine navigation has emerged as a critical domain within the maritime sector [2]. The integration of cutting-edge technologies, including artificial intelligence (AI), machine learning (ML), and big data analytics, holds the promise of significantly enhancing the intelligence and safety of ships navigating our oceans [3]. These advances are not only transforming the ways in which ships traverse vast sea expanses but also revolutionizing maritime logistics, fleet management, and environmental monitoring [4,5].

With the advent of AI and ML, predictive algorithms are now being employed to optimize routes, thereby reducing fuel consumption and minimizing the environmental impact [6]. Big data analytics enables the processing of massive amounts of data from various sources, such as satellite imagery, oceanographic data, and automatic identification system (AIS) data, providing insights that were previously unattainable. This convergence of technology and marine expertise is paving the way for autonomous ships, which promise to further revolutionize the industry by enhancing efficiency, safety, and reliability [7,8]. Furthermore, the integration of IoT (Internet of Things) devices in maritime operations is facilitating the real-time monitoring and maintenance of critical ship components, thus preventing failures and ensuring smoother operations at sea [5]. Cybersecurity, too, has become a paramount concern, with these technological integrations necessitating robust security protocols to safeguard navigational and operational data from cyber threats [9].

As we enter this new era of safe, intelligent, and sustainable navigation, it is evident that the maritime industry is on the brink of a technological revolution [10]. The potential benefits extend far beyond the shipping companies themselves, impacting global trade and environmental conservation and even reshaping international regulatory frameworks [11]. In essence, the fusion of technology with traditional maritime practices is not just a trend but also a transformative movement, setting the course for a more efficient, safe, and sustainable future in marine navigation.

## 2. An Overview of the SI and Published Articles

In response to these transformative developments, the *Journal of Marine Science and Engineering* (JMSE) proudly presents this Special Issue (SI), entitled “Recent Developments and Knowledge in Intelligent and Safe Marine Navigation”. This SI serves as a platform to showcase original contributions that explore and apply emerging and frontier technologies to bolster the intelligence and safety of operational ships in real-world conditions.



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This SI brings together a collection of research papers that not only contribute to academic discourse but also have substantial practical relevance to the maritime industry. The insights and innovations presented within this SI are vital to ensuring the continued advancement of intelligent and safe marine navigation. The contributions discuss recent developments on big data analytics and big data fusion for ship detection (contributions 3 and 6); ship-to-ship collision avoidance using deep reinforcement learning approach (contributions 5 and 9); navigation risk evaluation (contributions 2 and 4); ship system identification for the development of digital twins of autonomous ships (contribution 8); intelligent route planning (contribution 7); and artificial intelligence transportation robots (contribution 10). These methods draw from a confluence of expertise, merging insights from ship science, big data science, AI, and their interdisciplinary interactions. Expanding on this knowledge, this SI also delves into the realm of advanced environmental monitoring techniques, leveraging AI to predict and mitigate the impacts of maritime activities on marine ecosystems (contribution 8). It further explores the integration of IoT and sensor networks for enhanced shipboard/offshore monitoring and diagnostics (contribution 3), with potential to enhance predictive maintenance and operational efficiency. Additionally, this SI addresses the critical aspect of cybersecurity/fake ship license plates (illegal ship behaviors) in maritime operations (contribution 1), providing novel strategies that can be employed to protect sensitive navigational and operational data in an increasingly connected and digitalized maritime environment. It also includes case studies and reports on real-world applications, highlighting the practical implementation of these technologies in various maritime settings. These studies provide invaluable insights into the challenges and successes of integrating high-tech solutions in the dynamic and often unpredictable marine environment.

### 3. Conclusions

This SI, “Recent Developments and Knowledge in Intelligent and Safe Marine Navigation”, stands as a testament to the innovative spirit and forward-thinking approach of the maritime industry. It encapsulates a diverse array of research and developments that are not only pushing the boundaries of maritime science but also exploring a potential course for safer, more efficient, and sustainable marine navigation in the future.

We are greatly appreciative of the authors who have contributed their original research to this SI. Their commitment to enhancing marine navigation technology is clearly reflected in the quality and innovation of the papers they have presented. This collection demonstrates the collective efforts being undertaken to improve safety, intelligence, and sustainability in our oceans. This SI is more than a collection of academic papers; it is a hub where innovative ideas and transformative technologies in the maritime domain meet. Each contribution enriches our understanding of maritime science and expands the possibilities of marine navigation and safety. We encourage readers and researchers from across the world to explore the articles published in this SI. Whether you are a professional in the industry, an academic, or an enthusiast in marine science and engineering, these pages offer a wealth of knowledge and inspiration. The research and practical applications presented here are likely to shape the future of maritime navigation and safety.

In essence, this SI reflects the ongoing progress in this field and serves as an indicator of the potential for a more informed, efficient, and environmentally mindful maritime future. We anticipate that the insights offered in this collection will inspire further research, collaboration, and innovation globally, contributing to the ongoing advancement of intelligent and safe marine navigation.

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