

Editorial

Advances in the Performance of Ships and Offshore Structures

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The domain of maritime engineering is continually evolving with a focus on optimizing the performance and safety of ships and offshore structures. Ensuring the structural integrity, efficiency, and sustainability of vessels and offshore installations is crucial for operational success in challenging marine environments [1,2].

This Special Issue brings together a diverse collection of 13 high-quality contributions that reflect the latest innovations and research efforts in this dynamic field. It seeks to explore recent developments in the design, materials, technologies, and operational strategies that positively impact the efficiency, safety, and environmental aspects of marine vessels and offshore installations. The scope of this Special Issue spans a wide range of topics, including hydrodynamic modeling, structural integrity, renewable energy platforms, inspection strategies, and intelligent control systems. These studies collectively highlight the interdisciplinary nature of marine engineering and its evolving challenges in the face of environmental, operational, and technological demands.

Recent developments in the field have emphasized the integration of high-fidelity simulations, experimental validation, and data-driven methods to improve the design and operation of marine structures [3,4]. However, gaps remain in understanding complex interactions between environmental loads and structural responses, optimizing inspection and maintenance strategies, and integrating smart technologies into traditional engineering workflows [5–7]. This Special Issue aims to bridge these gaps by showcasing multidisciplinary approaches and novel methodologies.

Several papers focus on the hydrodynamic behavior and structural response of vessels and offshore platforms. In contribution 1, Sun and colleagues proposed a phase-lag-based control method for T-foils on trimarans. Through numerical simulations, they demonstrated significant reductions in vertical motion and improved seakeeping performance, offering a promising solution for high-speed multihull vessels. In contribution 2, Cartwright et al. employed Smoothed Particle Hydrodynamics (SPH) coupled with Finite Element Analysis (FEA) to simulate ship responses under wave loading. Their model captures fluid–structure interaction with high accuracy, providing insights into stress distribution and motion behavior in dynamic sea states.

The structural safety and damage mechanisms of ships were addressed in contribution 3 by Zhou et al., who conducted experimental grounding tests on model ships encountering multiple rocks. Their findings provide valuable data for understanding bottom raking damage and resistance forces during grounding events. In contribution 4, Silva-Campillo and Pérez-Arribas examined the buckling behavior of perforated plates in wellboat cargo holds. Their findings support weight reduction strategies while maintaining structural integrity and offer practical guidance for inspection accessibility in confined marine spaces.



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In the realm of offshore renewable energy, Tay et al. explored in contribution 5 the integration of wave energy converters (WECs) with floating wind turbines (FWTs). By comparing semi-submersible, spar, and barge platforms, they identified optimal configurations for hybrid renewable energy systems in offshore environments. In contribution 6, Li and Zou developed a system-level reliability growth model for offshore wind farms (OWFs), optimizing inspection planning through probabilistic fatigue analysis and Bayesian inference.

The Special Issue also features contributions to advanced materials and underwater technologies. In contribution 7, Ge and colleagues investigated the stability of fiberglass-reinforced plastic (FRP) pipes on muddy seabed, proposing empirical formulas and design strategies to prevent floating and fracture during construction. In contribution 8, Zhang et al. introduced an underwater detection robot for pile foundation structures. By integrating hydrodynamic modeling and image segmentation algorithms, the robot enhances autonomous inspection capabilities in turbid water conditions, supporting smart infrastructure monitoring.

Artificial intelligence (AI) and data-driven methods are increasingly shaping maritime safety. In contribution 9, Boko et al. applied neural network models to predict offshore vessel detention risks during port state control inspections, improving decision-making and resource allocation in maritime operations.

In terms of motion prediction and uncertainty quantification, Li et al. proposed in contribution 10 a Bayesian framework to integrate monitoring data with simulation outputs for floating offshore wind platforms. This method reduces uncertainty in short-term motion forecasts, supporting real-time operational decisions. In contribution 11, Mu et al. addressed the stability of small rescue boats under turbulent sea conditions by designing a hydraulic interconnected suspension system, significantly improving rocking resistance and operational safety.

In contribution 12, Chen et al. presented a numerical investigation on residual stress and distortion in welded tubular joints used in offshore platforms. Using ANSYS (MAPDL version 2022 R2) simulations, they evaluated mesh refinement and boundary conditions, offering practical insights for fabrication quality control in marine structures. In contribution 13, Zhang and colleagues explored the dynamic ultimate strength of ship structures using a two-step approach. By correlating static and dynamic load capacities, they provided a robust method for assessing structural resilience under impact and fatigue conditions.

Together, these contributions reflect the cutting-edge research and practical innovations that are driving the evolution of ship and offshore structure performance. The integration of computational modeling, experimental validation, intelligent systems, and sustainable design principles underscores the multidisciplinary efforts required to meet the challenges of modern marine engineering.

Looking ahead, future research should focus on integrating digital twins and real-time monitoring systems to enable predictive maintenance and adaptive control. There is a growing need to design structures capable of withstanding extreme environments, including Arctic conditions, deep-sea pressures, and multi-hazard scenarios. AI will play an increasingly central role in automating structural analysis, risk assessment, and performance optimization. Meanwhile, sustainable materials and circular design principles, such as recyclable composites and modular construction, will be essential for reducing long-term environmental impact.

This Special Issue serves as a testament to the vibrant and evolving landscape of marine engineering. We hope it will serve as a valuable resource for researchers, engineers, and practitioners working toward safer, smarter, and more resilient marine systems.

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List of Contributions

1. Sun, Y.; Wang, Y.; Zhang, D.; Wu, Z.; Jin, G. Numerical Research on a T-Foil Control Method for Trimarans Based on Phase Lag. *J. Mar. Sci. Eng.* **2024**, *12*, 1209. <https://doi.org/10.3390/jmse12071209>.
2. Cartwright, B.; Melchers, R.; Renilson, M. Modelling Sea-Surface Wave Motion and Ship Response Using Smoothed Particle Hydrodynamics and Finite Element Analysis. *J. Mar. Sci. Eng.* **2024**, *12*, 1919. <https://doi.org/10.3390/jmse12111919>.
3. Zhou, Z.; Zhu, L.; Liang, Q. Dynamic Responses and Damage of a Model Ship in Multi-Rock Grounding. *J. Mar. Sci. Eng.* **2024**, *12*, 1908. <https://doi.org/10.3390/jmse12111908>.
4. Silva-Campillo, A.; Pérez-Arribas, F. Structural Influence of the Cargo Holds of a 3000 m3 Wellboat on a Double-Bottom Floor. *J. Mar. Sci. Eng.* **2024**, *12*, 994. <https://doi.org/10.3390/jmse12060994>.
5. Tay, Z.; Htoo, N.; Konovessis, D. A Comparison of the Capture Width and Interaction Factors of WEC Arrays That Are Co-Located with Semi-Submersible-, Spar- and Barge-Supported Floating Offshore Wind Turbines. *J. Mar. Sci. Eng.* **2024**, *12*, 2019. <https://doi.org/10.3390/jmse12112019>.
6. Li, L.; Zou, G. A System-Level Reliability Growth Model for Efficient Inspection Planning of Offshore Wind Farms. *J. Mar. Sci. Eng.* **2024**, *12*, 1140. <https://doi.org/10.3390/jmse12071140>.
7. Ge, L.; Luan, Y.; Chen, H.; Chen, S. An Experimental Study on the Force Characteristics and Stability of an FRP Pipe Floating in Mud. *J. Mar. Sci. Eng.* **2024**, *12*, 1895. <https://doi.org/10.3390/jmse12111895>.
8. Zhang, W.; Zhu, K.; Yang, Z.; Ye, Y.; Ding, J.; Gan, J. Development of an Underwater Detection Robot for the Structures with Pile Foundation. *J. Mar. Sci. Eng.* **2024**, *12*, 1051. <https://doi.org/10.3390/jmse12071051>.
9. Boko, Z.; Stanivuk, T.; Radanović, N.; Skoko, I. Machine Learning-Driven Prediction of Offshore Vessel Detention: The Role of Neural Networks in Port State Control. *J. Mar. Sci. Eng.* **2025**, *13*, 472. <https://doi.org/10.3390/jmse13030472>.
10. Li, N.; Zou, G.; Feng, Y.; Ali, L. Probabilistic Prediction of Floating Offshore Wind Turbine Platform Motions via Uncertainty Quantification and Information Integration. *J. Mar. Sci. Eng.* **2024**, *12*, 886. <https://doi.org/10.3390/jmse12060886>.
11. Mu, X.; Du, H.; Wang, W.; Xiong, W. Enhancing the Stability of Small Rescue Boats: A Study on the Necessity and Impact of Hydraulic Interconnected Suspensions. *J. Mar. Sci. Eng.* **2024**, *12*, 1074. <https://doi.org/10.3390/jmse12071074>.
12. Chen, B.; Liu, K.; Xu, S. Recent Advances in Aluminum Welding for Marine Structures. *J. Mar. Sci. Eng.* **2024**, *12*, 1539. <https://doi.org/10.3390/jmse12091539>.
13. Zhang, D.; Luo, Y.; Zhang, Y.; Ma, Y.; Zhu, K.; Zeng, S. A Comprehensive Review of an Underwater Towing Cable Array: A Discussion on the Dynamic Characteristics of the Towing Cable Array During the Outspread Process. *J. Mar. Sci. Eng.* **2024**, *12*, 1880. <https://doi.org/10.3390/jmse12101880>.

References

1. Sadiq, M.; Ali, S.W.; Terriche, Y.; Mutarraf, M.U.; Hassan, M.A.; Hamid, K.; Ali, Z.; Sze, J.Y.; Su, C.L.; Guerrero, J.M. Future Greener Seaports: A Review of New Infrastructure, Challenges, and Energy Efficiency Measures. *IEEE Access* **2021**, *9*, 75568–75587. [CrossRef]
2. Ringsberg, J.W.; Darie, I.; Nahshon, K.; Shilling, G.; Vaz, M.A.; Benson, S.; Brubak, L.; Feng, G.; Fujikubo, M.; Gaiotti, M.; et al. The ISSC 2022 Committee III. 1-Ultimate Strength Benchmark Study on the Ultimate Limit State Analysis of a Stiffened Plate Structure Subjected to Uniaxial Compressive Loads. *Mar. Struct.* **2021**, *79*, 103026. [CrossRef]

3. Tatsumi, A.; Fujikubo, M. Ultimate Strength of Container Ships Subjected to Combined Hogging Moment and Bottom Local Loads Part 1: Nonlinear Finite Element Analysis. *Mar. Struct.* **2020**, *69*, 102683. [[CrossRef](#)]
4. Wang, S.; Guedes Soares, C. Statistical characterization on slamming and green water impact onto a chemical tanker in extreme sea conditions. *Mar. Struct.* **2025**, *103*, 103818. [[CrossRef](#)]
5. Tang, H.; Wan, Q.; Ren, H. Numerical study of trimaran wave load based on time-domain Rankine method. *Brodogradnja* **2023**, *74*, 107–129. [[CrossRef](#)]
6. Wang, M.; Qiao, D.; Zhou, X.; Tang, G.; Lu, L.; Ou, J. Dynamic responses analysis of submerged floating tunnel under impact load. *Brodogradnja* **2024**, *75*, 1–12. [[CrossRef](#)]
7. Chen, B.Q.; Liu, K.; Yu, T.; Li, R. Enhancing Reliability in Floating Offshore Wind Turbines through Digital Twin Technology: A Comprehensive Review. *Energies* **2024**, *17*, 1964. [[CrossRef](#)]

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