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Editorial

Advances in Maritime Safety

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1. Introduction

Due to the nature of business, maritime safety plays a paramount role in preventing damage to property and danger to life in the maritime industry. Despite enormous legal, technical, and technological developments, maritime accidents continue to occur in all water and connected port areas. On the one hand, technological advancements, such as 24,000 TEU mega container ships, e-Navigation services, and MASS (maritime autonomous surface ships), including smart technology contribute to improving maritime safety; on the other hand, they introduce new challenges such as cybersecurity, training needs, a lack of corresponding international regulation, etc.

The aim of this Special Issue was to collect recent research in the field that contributes to the improvement of maritime safety. This issue is composed of thirteen articles with different topics and approaches. While six articles focus on navigation and marine-traffic-related matters, three articles focusi on ship stability and construction stages to improve safety, and three more articles discuss safety culture and accident prevention. Additionally, one article studies a model to predict fuel consumption. A brief description of each manuscript is given in the following section.

2. Papers Details

Kim et al. [1] performed a case study to identify the user requirements for standardizing the UI of GPS plotters in South Korea following the IMO guidelines to standardize the user interface (UI) of navigation equipment, such as radio detection and ranging (RADAR) and the electronic chart display and information system (ECDIS), which mandate the unification of various terminologies and icons to improve usability. Additionally, they performed a survey to ascertain how frequently the navigational functions in a GPS plotter are used. Consequently, they attempted to derive standardized list that can be applied to both the functions of the GPS plotters and the obtained navigation information, which contribute to the improvement of the UI across different types of plotters.

Kim et al. [2] highlight the need for models to predict the energy efficiency of a ship in real time as the interest in eco-friendly ships increases. They present models that can predict fuel consumption using in-service data collected from a 13,000 TEU class container ship, along with statistical and domain knowledge methods to select the proper input variables for the models. To implement the prediction model, either an artificial neural network (ANN) or multiple linear regression (MLR) was applied. The proposed model aims to provide valuable information for ship operators to support decision making, and thus maintain efficient operating conditions.

Liu et al. [3] studied the emergency evacuation route planning of cruise ships, which is crucial for all crew members and passengers during emergencies. They propose an improved ant colony system (IACS) to better plan the evacuation routes of cruise ships, which are usually very crowded. The proposed IACS aims to solve the multipath planning in cruise ships by considering crowd density and speed. Furthermore, an increasing flow

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method is proposed in order to improve the efficiency of the proposed algorithm of the IACS. The numerical experiments of Liu et al. demonstrate that the proposed method fulfills the requirements of evacuation analysis guidelines for new and existing passenger ships (MSC.1/Circ.1533) and can effectively and efficiently plan emergency evacuation routes on cruise ships.

Chae et al. [4] focus on marine accidents and appropriate countermeasures to prevent known types of accidents by investigating the status and issues associated with the implementation of countermeasures using importance–performance analysis (IPA), Borich's needs assessment, and a locus for focus models based on previously identified causes of ship accidents. The results of their study reveal that there is:

i. A need to enhance education and training on specific knowledge, understanding, and proficiency (KUP) regarding ship stability, emergency response, and type specific training.
ii. The need for a system of monitoring a seafarer's KUP, even while onboard a vessel is identified. Furthermore, the necessity to improve a seafarers' working environment is discussed.
iii. Difficulties in solving incorrect practical aspects of safety and efficiency, such as the costs associated with the implementation of safety regulations, were identified as the main reasons for the causes of the "not amended yet" sector after accidents.

Kim [5] conducted semi-continuous spatial statistical analysis tests (the normal distribution test, kurtosis test and skewness test) to understand vessel traffic flow characteristics since high vessel traffic in fairways is likely to cause frequent marine accidents, and understanding vessel traffic flow characteristics would help to prevent marine accidents in fairways with such high traffic. The author conducted a vessel traffic survey in a designated area (Busan North Port) for seven days and collected data using an automatic identification system, converted using semi-continuous processing methods, and used to conduct three methods of spatial statistical analysis. The analysis results reveal the vessel traffic distribution and its characteristics, such as the degree of use and lateral positioning on the fairway based on the size of the vessel. Following a generalization of the results, the author attempted to derive the traffic characteristics of vessels on the fairway. He aimed not only to reduce maritime accidents by identifying ship movement characteristics in the specific area, but also to establish a foundation for autonomous ships research.

Jung [6] investigated South Korean seafarers' safety culture awareness to compare the differences between those who work on ships engaged in domestic and international voyages. She conducted a questionnaire survey with 261 Korean seafarers using seven indicators representing the safety climate used in aviation and maritime fields. The results of her study reveal that seafarers engaged in ocean-going navigation had a higher awareness of management involvement, organizational commitment, learning, and reporting systems, which yielded more positive effects than those engaged in domestic navigation. Furthermore, she proposed that the survey methodology used in her study can be used to measure the effectiveness the maritime safety climate and, consequently, improved the policies and educational programs.

Park et al. [7] proposed an enhanced machine learning method to estimate ship collision risk and to support more reliable decision-making for ship collision risk. In order to estimate the risk of ship collision, they applied the conventional support vector machine (SVM), which has the advantage of the SVM to resolve the uncertainty problem by using the collected parameters of ships. Afterwards, they proposed and applied the relevance vector machine (RVM), which can present reliable probabilistic results based on Bayesian theory to estimate collision risk. Consequently, the authors presented results demonstrating that the estimation model using RVM is more accurate and efficient than the model using SVM.

Vassalos et al. [8] provides a full description and explanation of the probabilistic method for a ship damage stability assessment. Moreover, the authors provide comparisons in the results between statistical and direct approaches and make recommendations on how these results can be reconciled for a better understanding of the implicit assumptions

during the ship design and operation. The authors highlight further research developments on the damage stability of passenger ship and recent developments related to flooding risk (safety level) assessment. Research in this direction has created a new approach that combines all flooding hazards (collision, bottom, and side groundings) to assess potential loss of life. The manuscript concludes by providing recommendations on the way forward for ship damage stability and flooding risk assessment

Woo et al. [9] discuss the importance of securing a ship's stability and loading software or equipment that could help to monitor the stability parameters and calculate ships' intact stability parameters. Afterwards, the authors propose a simple evaluation methodology for intact stability (SEMIS). This proposed methodology simply evaluates the safety of ships' stability according to GM. The authors studied the stability parameters of 336 loading conditions of 19 model ships and derived the empirical formulas of SEMIS. Afterwards, the authors verified the proposed methodology and calculate the stability parameters of two model ships under 28 loading conditions. The results of the various calculations reveal that the developed SEMIS efficiently evaluates ship stability using only GM.

Park et al. [10] proposed a methodology for predicting the ship's trajectory, which is based on an intelligent collision avoidance algorithm. The authors attempted to identify the pattern of the ship trajectory with a density-based spatial clustering of applications with noise (DBSCAN) to improve prediction performance. Furthermore, the authors applied the spectral clustering method, which reflects a similarity between individual trajectories. Hence, the authors attempted to measure the similarity by the longest common subsequence (LCSS) distance. By using bidirectional long short-term memory (Bi-LSTM), the authors develop the prediction model of a ship's trajectory. Moreover, authors compare the performance of the proposed model with that of the long short-term memory (LSTM) model and the gated recurrent unit (GRU) model. The authors obtained input data by preprocessing techniques, such as filtering, grouping, and the interpolation of the automatic identification system (AIS) data. The results reveal that the prediction accuracy of Bi-LSTM is higher compared to the LSTM and GRU.

Wang et al. [11] focused on the installation of a stern tube, which is one of the tasks in shafting installation that requires large boring machinery and generates noise; it is harmful to workers' physical and mental conditions. The authors utilize a problem hierarchy analysis to redefine problems before work using feasible solutions. After refining and analyzing, the authors proposed using an "integrated Stern Tube" which decreased 49% of the cost and 71% of the work period in a dock.

Zou et al. [12] identifies a safety evaluation indicator system and evaluation standards and establishes an after-collisions safety evaluation model of maritime ships based on the extension cloud theory. The proposed model combines the extension cloud model, the analytic hierarchy process, the entropy weight method, and game theory. The authors evaluated the situation safety of two collisions using the proposed model. The results suggest the effectiveness of the model. Furthermore, the authors discuss and made suggestions regarding crew training, the improvement in ship's self-rescue ability, and establishment a complete marine emergency response rescue system in order to ensure the safety of the lives and property of marine personnel.

Aydogdu [13] discussed the necessity of a thorough investigation of large vessel passages through narrow channels and confined waterways following the MV Ever Given accident in Suez Canal. In this study, he utilized a bridge simulator for risk assessment safety criteria and the environmental stress (ES) model to highlight the levels of risk that occur during the passage of large vessels, and finally, necessary measures are recommended to mitigate this risk. The Istanbul Strait, which is one of the most critical and difficult waterways to navigate in the world, is given as a case study.

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