Editorial

Ship Collision Risk Assessment

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Ship collision accidents are one of the most frequent events, and cause serious damages to health, structural safety and the environment. To prevent accidents and reduce damages, performing risk (frequency × consequence) assessment protocols are required in order to produce reliable and reasonable designs. This Special Issue aims to deliver new and practical techniques for obtaining risk measures for calculating ship collision frequency or consequences.

The Special Issue, ‘Ship Collision Risk Assessment’, introduces 12 papers which include newly developed approaches to reduce the risk to a ship in the fields of the material, structural capacity/layout, avoidance, navigation/algorithms, etc. [1–12].

Lee and Park [1] presented a new criteria for ship collision avoidance of Maritime Autonomous Surface Ships (MASS) based on Seafarers’ Awareness-based Ship Domain (SASD) using an adaptive neuro-fuzzy method. In comparison with an Automatic Identification System (AIS), they demonstrated the efficiency of the proposed method.

Vukša et al. [2] introduced a model to calculate a ship’s collision probability using the Monte Carlo simulation and a Bidirectional Long Short-Term Memory neural network (Bi-LSTM) for the efficiency and safety of marine traffic. This article presents the processing, validation, and determination of the collision probability.

The collision risk of Liquified Natural Gas (LNG) carriers is much higher than general commercial ships because LNG is high combustible. Therefore, a leak of gas from a collided structure should be investigated to prevent sequential accidents such as fire, explosion, a weak structure, etc. Nubli et al. [3] performed a consequence analysis of the gas leak from a collision-induced cracked structure of an LNG bunkering ship considering various damage scenarios. Based on gas-dispersion simulations, they identified the hazardous parameters of gas release from the collision.

Hwang and Youn [4] developed a new methodology for establishing a practical collision-avoidance system considering geographic information. This method objectively categorizes the collision risk by using clustering algorithms, AIS and Electronic Navigational Chart (ENC) data. Additionally, it guides a direction for determining test beds.

Kim and Sohn [5] proposed empirical formulae to predict the collision damage of an oil tanker depending on collision speeds and dynamic fracture strains. Once a reference structural damage case is obtained from nonlinear Finite Element Analysis (FEA), various collision environments can be considered by using these formulae.

The Singapore Strait is one of the busiest and most important waterways in the world. Additionally, there are lots of collision accidents. A spatial and statistical analysis of operational conditions in the Singapore Strait were conducted by Yildiz et al. [6]. They developed a ‘Marine Accidents Density Map’ for the Singapore Strait by adopting the Geographical Information System (GIS).

Yu et al. [7] proposed a Double Broad Reinforcement Learning based on Hindsight Experience Replay (DBRL-HER) for the collision-avoidance system. Additionally, the proposed method overcomes the limitation of the existing Broad Reinforcement Learning (BRL) approach and improves the efficiency and accuracy of decision making.
Ohn and Namgung [8] suggest requirements for the optimization of local path planning of autonomous ships to compensate for disadvantages of traditional path-planning algorithms. It covers the open sea, restricted waters and multi-ship interactions. They showed the applicability of the developed requirements when considering representative path-planning algorithms.

Park et al. [9] revealed the effect of local damage by collision on the residual longitudinal ultimate strength of a box-shaped hull girder. They artificially damaged the structure assuming the ship collision, and performed an experimental test considering other initial imperfections (e.g., initial deflection, welding residual stress). Additionally, the effect of the damage on the girder’s strength was investigated from the tests and nonlinear FEA.

Chen et al. [10] improved the Bald Eagle Search (BES) algorithm by using a self-adaptive hybrid approach. In addition, they presented the Pigeon-Inspired Optimization (PIO) to neutralize the disadvantages of the traditional BES method. The results of their study gave the shortest safe and smooth paths in different environments.

Sviličić and Rudan [11] introduced a two-way modelling technique for nonlinear FEA considering the influence of maneuvering. They adopted the Abkowitz maneuvering model in a subroutine of FEA, and the hydrodynamic forces produced by the maneuvering were calculated and applied to the structural analysis at each time step. This determined an optimized selection of hydrodynamic derivatives.

Finally, Yang et al. [12] proposed a data-driven intelligent prediction approach for obtaining a structural response of honeycomb-reinforced pipe piles of offshore platforms by collisions. They combined the Artificial Neural Network (ANN) and Dynamic Particle Swarm Optimization (DPSO) for developing the proposed method.

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