

Maritime transport has experienced continuous growth in recent decades. On the one hand, this allows for the efficient transportation of goods between countries at a lower cost than other means of transportation. On the other hand, the international fleet is constantly growing (including maritime transport), which leads to an increased probability of accidents of various types. One of the most common types of accidents is the collision of a ship with another ship. The consequences of such a collision can be enormous, including loss of life and an environmental disaster (if we think of oil pollution from tankers).

Since it is impossible to prevent such accidents completely, there is a trend to consider possible collision scenarios during the design phase of a ship, which is a fairly new approach. To reach that aim, researchers developed different risk-based ship design frameworks. However, they have their shortcomings. One of the main approaches considered the assumed size of the damage from historical data and analysed the possible consequences. Although this contributed significantly to the field, the proactive approach in ship design is not considered. The newbuild vessels are already different from the previous build ships, bearing in mind that rules are constantly developing and there are determining the structural calculations. Still, some questions remain unanswered related to the ageing of the ship structure, especially in the context of corrosion degradation. Almost no studies have examined the impact of ship age on the potential extent of damage in the event of a collision with another ship and the possible consequences. In addition, the uncertainties in modelling (both epistemic and aleatory) are rather not considered, and the credibility of the proposed models remains problematic (lack of validation).

The main aim of the proposed project is to develop a risk-based ship design framework. The following research questions are given:

1. How should the risk-based ship design framework look like to account for the collision risk accounting for the uncertainties in modelling?
2. How does corrosion influence the crashworthiness of ship structure?
3. How does wave loading influence the strength of ship structure during the collision?
4. Which collision scenarios should be considered based on the historical data of maritime accidents?
5. How could the proposed framework be validated?

To achieve the outlined goal, several research tasks are proposed. Task 1 aims to develop the concept of a risk-based ship design framework. In Task 2, the simplified corrosion model that could be used in a large-scale model of the entire ship structure will be developed. Although the model should be as simple as possible, it should not miss the physical significance of the phenomenon. Computer simulations of ship motion in waves will be performed in Task 3, leading to information on loading that will be applied to the structural model. In Task 4, simulations of multiple collision scenarios between two ships are performed. As a result, a novel distribution of the extent of damage is obtained. This forms the basis for Task 5, in which the behaviour of the ship in damaged condition will be simulated, accounting for possible consequences (braking of hull girder, oil spill). In Task 6, the meta-model that will bond collision scenarios with possible consequences will be developed. Finally, in Task 7, the risk-based ship design framework validation method will be proposed.