Seakeeping optimization of bulbous bow vessels through genetic algorithms

MARINE 2023

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ABSTRACT

During navigation, a ship may be affected by several excitation forces, such as waves. As a response, the vessel experiences different movements. Seakeeping describes the behaviour of a ship under certain sea state. This involves, among others, ship motions and how well-suited a ship is for specific environmental conditions. The Response Amplitude Operator (RAO) of the ship is an important parameter in seakeeping. It is a transfer function relating the wave excitation and ship motion. By studying the seakeeping behaviour of a ship, the amplitude of its movements can be obtained, as well as other features such as how comfortable it is to be onboard a vessel (Motion Sickness Index, MSI), added resistance in waves, etc. Seakeeping is usually studied through numerical tools which require some computational time, and it is strongly influenced by weight and volume distribution in the vessel and distance to its centre of mass.

The main purpose of the bulb of a ship is the reduction of hydrodynamic resistance. However, given its volume and position in the vessel, the bulb is likely to affect seakeeping performance. Therefore, finding the most optimal shape of the bulb is a problem of particularly high importance [1]. This work proposes the implementation of an efficient metaheuristic search strategy using Genetic Algorithms (GA) [2] to tackle such a problem. The bulb shape is parametrized with a few variables, and the GA strategy is used to find the combination of variables that results in the best seakeeping performance. The obtained results confirms that metaheuristic search strategies are much more efficient and cost-effective than some traditional ship design methods based on limited experimental data or brute force approaches.

REFERENCES

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