Parametric Study of the Impact of Hull Form Deformations of an Inland Ship on its Hydrodynamic Performances in Shallow Water Using CFD

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Abstract  This paper presents the study of the impact of parametric hull form deformations of an inland ship on its hydrodynamic performances in shallow water using CFD. The parametric hull form deformation is performed by the in-house hull modeling software OptNav. Total resistance and delivered power of all designs are evaluated through resistance and self-propulsion computations using ISIS-CFD solver. The CFD computations take into account the shallow water effects. The impact of each deformation on the total resistance and delivered power is investigated by the comparison between initial and deformed hull forms. The results indicate that particular deformations have significant impact on the hydrodynamic performances and are beneficial to the hull form design.

Key words  parametric deformation, shallow water, resistance, self-propulsion, actuator disk

Introduction

The current context makes ship designer pay more attention to ship energy efficiency optimization. EEDI (Energy Efficiency Design Index) has to respect IMO requirements which are more and more severe. IMO MARPOL regulations ask for environmental friendly ships with lower fuel consumption and greenhouse gas emissions. New build ship demand is going down and ship designers have to propose innovative and efficient designs in order to stay competitive. Nowadays, thanks to the increase of computer power and the maturity of CFD (Computational Fluid Dynamics) methods, ship designers can go further in hull form optimization in order to improve the ship energy efficiency. At the preliminary design stage, the evaluation and optimization of hydrodynamic performances using CFD analysis is an added-value for ship designers.

The development of CFD solvers and HPC (High Performance Computing) resources enables to perform accurate analysis of complex flows around the hull surface in short time. Numerous works have been performed on hull form optimization study using CFD solvers [1-5].

This paper presents the study of the impact of parametric hull form deformations of an inland ship on its hydrodynamic performances in shallow water using CFD. The hull form deformations evaluation is a part of a hull form optimization process. Total drag and delivered power are evaluated resistance and self-propulsion computations performed using ISIS-CFD software. The impact of hull deformations is investigated