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Bow thruster unsteady effects reduction, a numerical study

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ABSTRACT

This study is a continuation of the work described in our previous paper [1], which provides a detailed overview of studies on the hydrodynamics of bow thrusters, with an emphasis on analyzing non-stationary hydrodynamic effects. Consequently, here, we focus on the methods and results related to reducing unsteady effects in bow thrusters using passive methods. The investigation explores the implementation of two advanced technical measures: rounding the tunnel entrance and introducing a newly designed protective grille.

The results of the study revealed a substantial reduction in the separation zone at the tunnel entrance, accompanied by a significant decrease in cavity volume. These changes were directly linked to notable reductions in pressure and thrust pulsations. This demonstrates the efficacy of the proposed passive flow control methods in mitigating unsteady hydrodynamic forces.

Furthermore, the findings indicate that the application of these measures can lead to a meaningful decrease in acoustic emissions and vibrations, which are critical factors in improving the operational performance and environmental compatibility of bow thrusters. The study underscores the potential of combining innovative design strategies with advanced numerical simulation tools to achieve enhanced performance and reduced environmental impact in marine propulsion systems.

Numerical study is performed using URANS (Unsteady Reynolds-Averaged Navier-Stokes) $k-\omega SST$ and hybrid URANS-LES (Large Eddy Simulations) SLH (Shielded LeMoS Hybrid) [2] turbulence models. OpenFOAM code [3] was utilized for the simulations.

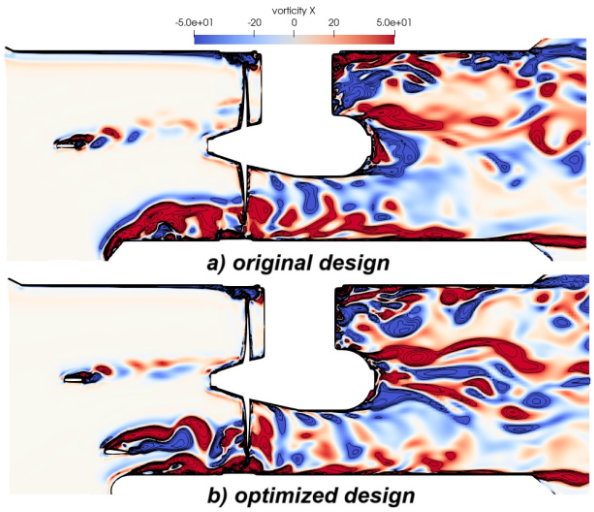

Figure 1: Instantaneous distribution of the transversal component of vorticity ω_x in the vertical cross section of the thruster.

References

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