Resistance Decomposition of a Self-propelled Ship in Full Scale

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ABSTRACT

The simulation of ships at full scale includes several physically challenging aspects for Computational Fluid Dynamics such as wall roughness [1], free-surface effects, and interaction effects (e.g. between the hull and propeller) when considering self-propulsion scenarios where the propeller is included. On the other hand, the high Reynolds number (around 10^9) observed in these flows results in a high computational cost for CFD, due to the thin boundary-layer that develops along the hull, requiring an extremely large cell count if wall functions are not used. A third obstacle lies in the lack of measured data to compare the results against [2], which makes validation of the results impossible.

In this paper, the flow around the JoRes 1 vessel is considered, for which measured data at full-scale is available through the efforts of the JoRes project [3]. Several sets of simulations with the Reynolds-Averaged Navier-Stokes equations are performed for this geometry, with a focus on the friction and pressure components of the resistance: a self-propulsion setup, fully resolving the propeller, a double-body setup with the propeller, to shed some light on the resistance due to the waves and a double-body setup without the propeller, which will be used in order to investigate the propeller-hull interaction. Different approaches for the surface roughness are considered as well, and grid refinement studies are performed in order to quantify the numerical error. The distinct simulation setups will assist in understanding the relative importance of each aspect, and provide a clearer picture in the comparison of the results obtained in the complete self-propulsion simulations with the sea trial data.

REFERENCES

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