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Sail-Induced Resistance Comparison for the KVLCC2 and the KCS

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ABSTRACT

Wind propulsion is a promising way of decarbonasing the merchant fleet. The number of ships equipped with one or several wind propulsion systems has significantly increased in the recent years, with more than 60 ships equipped since 2010. Adding a wind-propulsion system on a merchant ship generates an aerodynamic propulsion force which is wanted, but also an additional aerodynamic side force. This side force is responsible for the creation of an added resistance, due to higher leeway and rudder angles, that can reduce the manoeuvrability as well as the course keeping ability (Kramer and Steen, 2022). This so-called sail-induced resistance must thus be evaluated to know the real benefits of the wind propulsion system and to avoid manoeuvrability issues. This study evaluates the sail-induced resistance for two ship geometries: KVLCC2 (320-meter-long tanker) and KCS (230-meter-long containership). The sail-induced resistance is computed by resolving the steady-state force balance of the ship, using the open-source performance prediction program `xWASP_CN` developed by Charlou et al. (2023). The 4 DOF MMG manoeuvring model (Okuda et al., 2023) is used because it has already been validated through model-scale free running tests for both ship geometries. First, a validation of the implementation of the MMG model in the performance prediction program is proposed by comparing simulated and experimental results of turning-circle manoeuvers for both ships. Then, the sail-induced resistance is computed for each ship by applying a side force which is proportional to the straight-ahead resistance of the ship. The results are made non-dimensional to ease the comparison between the two ships.

Keywords: wind propulsion, sail-induced resistance, KCS, KVLCC2, MMG manoeuvring

References

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