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A Validation Study of Full-Scale CFD Simulation for Sea Trial Performance Prediction of Ships

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Abstract

Shipping is a critical component of global trade but also accounts for a substantial portion of global greenhouse gas emissions. Recognising this issue, the International Maritime Organisation (IMO) has implemented new measures aimed at determining the energy efficiency of all ships and promoting continuous improvements, such as the Energy Efficiency Existing Ship Index (EEXI). As Computational Fluid Dynamics (CFD) can be used to calculate the EEXI value, RISE-SSPA and Flowtech have developed a CFD-based method for predicting full-scale ship performance with SHIPFLOW v7.0, which meets the new requirements of IMO. The method is validated through an extensive comparison study that examines the delivered power and propeller rotation rate between full-scale CFD predictions and high-quality sea trials using 14 common cargo ships of varying sizes and types. The comparison between the CFD predictions and 59 sea trials shows that both delivered power and RPM can be predicted with satisfactory accuracy, with an average comparison error of about 4% and 2%, respectively. The numerical methods used in this study differ significantly from the majority of the state-of-the-art CFD codes, highlighting their potential for future applications in ship performance prediction. Thorough validation with a large number of sea trials is essential to establish confidence in CFD-based ship performance prediction methods, which is crucial for the credibility of the EEXI framework and its potential to contribute to shipping decarbonisation. Development Of a CFD-based Full Scale Performance Prediction Procedure