RANS Simulations of Cavitating Azimuthing Thrusters

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Numerical simulations of the flow along azimuthing thruster units are becoming more mature these days. A number of steps have been made during the last decade in RANS simulations. Initially the full scale unit performance, being thrust output and power requirement, has been determined for the steady-state condition. Next the time dependent forces, which are a result of the blades passing the strut, have been quantified. These analyses have been made initially for a single unit with uniform inflow and afterwards for two units, where the jet of the upstream thruster is directed towards the second unit. This results in significant interaction effects. The third major step is the implementation of a cavitation model in the RANS simulations. Due to the presence of the strut upstream of the propeller, a non-uniform inflow velocity is seen by the propeller. This results in severe loading variations on the blade during a revolution, which can result in large fluctuations of the cavitation volumes.

In the process of implementation of cavitation modeling in the numerical simulation, model scale experiments, with a propeller diameter of 250 mm, have been carried out to get a set of high quality reference data for the unit, operating at different conditions. These conditions have been simulated on model scale with a RANS-CFD model. Good agreement between the experimental results and the numerical results has been found. Afterwards the calculations have been repeated for the actual full scale geometry, with a propeller diameter of 3900 mm. Apart from the known Reynolds scaling effects, also the effects of the hydrostatic water column become more pronounced for the full scale geometry.

In the presentation the results from the validation process, which includes the meshing strategy among others, and the comparison between the full scale and model scale results will be presented. Detailed analysis of the source term of the cavitation model revealed interesting phenomena regarding the buildup of the cavitation and the implosion of the cavity. Possible benefits of this numerical feature will be discussed.

Author Company:
Wartsila
Author Name:
Norbert Bulten & Maarten Bijlard
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