Unsteady Cavitation Simulation on Kappel Propeller with a Hull Wake Field

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Up-to-date marine propellers are designed to accompany a certain extent of cavitation for optimum propulsive efficiency, but excessive extent and certain types of cavitation have the risk of high hull pressure pulse, blade surface erosion and thrust break down. Propeller cavitation becomes unsteady and complex due to the interaction of the propeller flow and the non-uniform wake field behind the hull.

The Kappel propeller is an innovative tip-modified propeller, which shows higher propulsive efficiency and lower hull pressure pulse than conventional propellers. Unsteady cavitation simulations on Kappel propeller by CFD and BEM is validated against model test results from a cavitation tunnel.

Cavitation is simulated by using Eulerian multiphase cavitation model built in STAR-CCM+. Instead of adding a hull model, a measurement of hull wake field is applied to the velocity inlet as three velocity components in a cylindrical coordinate system. Propeller rotation is modelled by the rigid body motion. RANS solver is used with the Gamma ReTheta transition model and the k-? SST turbulence model.

CFD shows higher accuracy in simulating viscous turbulent flows and cavitation distributions, compared to BEM. Accurate cavitation prediction by CFD enables design of Kappel propellers to be more optimum in terms of both propulsive efficiency and cavitation safety.

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