CFD analysis of cascade effects in marine propellers with trailing edge modification

Propeller blades are different from a single hydrofoil in isolation due to cascade effects that blades mutually affect hydrodynamic characteristics of each other in proximity. Propeller design programs based on lifting-line theory and blade element momentum theory take into account cascade effect by using cascade correction theory, which has been developed on the basis of wind tunnel tests for a row of evenly spaced airfoils. Cascade effects of marine propellers have been investigated by inviscid flow solvers such as boundary element methods and vortex lattice methods, but it has not been investigated intensively by viscous flow solvers, although RANS CFD is prevalent in marine industries nowadays. In the current work, the cascade effect of a marine propeller is analyzed by CFD simulations on a threedimensional propeller model with varying the number of blades. The influence of trailing-edge configurations on the cascade effect is also investigated by simulating CFD with varying trailing-edge thickness and slope. The reason why the trailing-edge is handled rather than other parts of blade geometry is that it can be modified without altering overall blade thrust significantly, because the loading on the aft part of a blade section near a trailing edge is relatively low, compared to the other part.