Experimental and numerical Investigation of Blade Geometry Effect on Propeller Cavitation and Noise

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ABSTRACT

With Modern ships developing to larger size and higher speed, propeller cavitation performance has become more and more important for designers. One of the key objectives of propeller optimization is to delay propeller cavitation inception and increase ship critical speed. In this research, the effects of propeller blade geometry on cavitation and noise were studied by model tests and numerical simulations. Section thickness distribution, skew and rake are considered. DTMB 4381 propeller was used as the initial model, and DTMB 4382 propeller was used to study effect of skew angle. Based on 4382 propeller, another three propellers were designed. The section thickness near leading and trialing edges (keeping the maximum thickness) is increased on 4382-1 propeller. Then different skew distribution is used on 4382-2 propeller. And Tip rake is used on 4382-3 propeller.

Propeller model tests were carried out in SJTU Cavitation Tunnel. Hydrodynamic performance, cavitation inception and noise tests were carried out. The experimental results show that the hydrodynamic performances of five propellers are very close, and the cavitation performances improve from 4381 propeller to 4382-3 propeller. Further, the noise of five propellers at different conditions were compared.

The hydrodynamic performances were simulated by solving the Reynolds-averaged Navier-Stokes (RANS) equations using the Fluent software. The boundary layer grids were set on blades. The y+ of blades range from 1 to 1.5, and *SST k-ω* turbulence model was used. The numerical results show that the hydrodynamic performances of five propellers are close. The strength of tip vortex decreases from 4381 propeller to 4382-3 propeller. Further, the section pressure and flow around blade tip were compared to investigate effect of section profile, skew and tip rake.

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