

Investigation of Validation Method for Twisted Hydrofoils in Cavitating Flow

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ABSTRACT

This study investigates the cavitating flow around a twisted NACA 0009 hydrofoil using both Reynolds-Averaged Navier-Stokes (RANS) and Detached Eddy Simulation (DES) methods to assess their capabilities in capturing unsteady cavitation phenomena. Numerical results were validated against experimental data provided by Foeth (2008a) under a cavitation number of 1.07 and an angle of attack of -2° . While the RANS method provided accurate predictions for lift and drag coefficients with lower computational cost, it failed to capture the transient nature of cavitation. In contrast, the DES method successfully resolved the periodic cavitation cycles and demonstrated improved capability in visualizing dynamic cavitation behavior. A time step sensitivity analysis was also conducted, revealing that larger time steps enhance the visibility of cavitation cycles but may lead to overprediction of the cavitation region. Overall, the findings highlight that although RANS is sufficient for hydrodynamic performance evaluation, DES is more suitable for analyzing unsteady cavitation dynamics around hydrofoils.

Keywords: Cavitation, Twisted, Hydrofoil, RANS, DES