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Numerical Simulation of Free Surface Water Wave for the Flow Around NACA 0012 Hydrofoil and Wigley Hull Using VOF Method

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Abstract : Steady three-dimensional and two free surface waves generated by moving bodies are presented, the flow problem to be simulated is rich in complexity and poses many modeling challenges because of the existence of breaking waves around the ship hull, and because of the interaction of the two-phase flow with the turbulent boundary layer. The results of several simulations are reported. The first study was performed for NACA0012 of hydrofoil with different meshes, this section is analyzed at h/c= 1, 0345 for 2D. In the second simulation, a mathematically defined Wigley hull form is used to investigate the application of a commercial CFD code in prediction of the total resistance and its components from tangential and normal forces on the hull wetted surface. The computed resistance and wave profiles are used to estimate the coefficient of the total resistance for Wigley hull advancing in calm water under steady conditions. The commercial CFD software FLUENT version 12 is used for the computations in the present study. The calculated grid is established using the code computer GAMBIT 2.3.26. The shear stress k-ωSST model is used for turbulence modeling and the volume of the fluid technique is employed to simulate the free-surface motion. The second order upwind scheme is used for discretizing the convection terms in the momentum transport equations, the Modified HRICscheme for VOF discretization. The results obtained compare well with the experimental data.

Keywords : free surface flows, breaking waves, boundary layer, Wigley hull, volume of fluid
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