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Development and Demonstration of CAD/CFD/Optimizer Integrated Simulation-Based Design Framework by Using High-Fidelity Viscous Free-Surface RaNS Equation Solver

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Summary: This paper, for the first time, describes development and demonstration of a CAD/CFD/optimizer-integrated simulation-based design (SBD) framework by introducing an advanced CAD system direct control approach and a high-fidelity viscous free-surface CFD method. The CAD used in the present study is NAPA, which is one of the most accepted CAD systems in the domestic and foreign shipyards. The CFD method is FLOWPACK version 2006 developed by the present authors, a Reynolds-averaged Navier-Stokes equation solver which is capable for predicting viscous wavemaking effects by using free-surface tracking approach. The adopted nonlinear optimization scheme is based on genetic algorithm; currently, Message Passing Interface based parallel and serial computation architectures are implemented; and in this paper, results from the latter will be presented. The above-described three components are integrated to realize the most advanced-level SBD framework ever reported. An overview of the present method is given, and results are presented and discussed for shape optimization of DTMB Model 5415 and catamaran test cases to show capability of the present SBD framework for single- and multi-objective optimizations, respectively. Finally, prognoses of our future work will be addressed.

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