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A variational finite element formulation for predicting turbulent cavitating flows over flexible marine propellers SURAJ KASHYAP, RAJEEV JAIMAN, University of British Columbia — The phenomena of cavitation are omnipresent in nature and engineering applications. We propose a novel variational finite element framework for high Reynolds number cavitating flows in deforming geometries. Goal is to predict accurate velocity and pressure fields in turbulent cavitating flows for use as input in predicting acoustic field. A stabilized finite mass-transfer model for cavitation is coupled in partitioned iterative manner with 3D Navier-Stokes equations in Arbitrary Lagrangian-Eulerian(ALE) framework. A Positivity Preserving Variational(PPV) scheme is applied for monotone, bounded solutions. Proposed framework enables hydrodynamic study of flexible propeller blades in cavitating conditions and structural response to flow excitations. Method is first validated for a collapsing spherical vaporous bubble, benchmarked against analytical solutions of the Rayleigh-Plesset equation. We then apply it with a hybrid RANS-LES model to simulate cavitating flow around a NACA66 hydrofoil section at Re=800000; predictions compared with experiment. Finally, proposed framework is extended to study flow over flexible 3D propeller blade and coupled hydroelastic results discussed.

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