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Sharp Interface Immersed-Boundary/Level-Set Cartesian Grid Method for Large-Eddy Simulation of Two-Phase Flows with Surface-Piercing Moving Bodies[1] JIANMING YANG, FREDERICK STERN, IIHR - Hydroscience and Engineering, University of Iowa, Iowa City, IA 52242-1585, USA — A sharp interface Cartesian grid method for the large-eddy simulation of two-phase flows interacting with surface-piercing moving bodies is presented. The method is based on a sharp interface immersed boundary formulation for fluid flows with moving boundaries and a level set based ghost fluid method for two-phase interface treatment. A four-step fractional step method is adopted and a Lagrangian dynamic Smagorinsky subgrid-scale model is used for large-eddy simulations. The combination of immersed boundary method for solid/fluid boundaries and ghost-fluid method for fluid/fluid interfaces is discussed in detail. A variety of test cases with different scales ranging from bubble dynamics to ship hydrodynamics are performed for verification and validation purpose. Several examples of interest such as water exit and entry of a circular cylinder, landslide generated waves, and ship waves are demonstrated to showcase the accuracy and efficiency of our method. Approaches for extending it to high Reynolds number ship flows by means of wall-layer modeling are also discussed.

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