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A 3D GPU-accelerated MPI-parallel computational tool for simulating interaction of moving rigid bodies with two-fluid flows ASHISH PATHAK, MEHDI RAESSI, University of Massachusetts Dartmouth — We present a 3D MPI-parallel, GPU-accelerated computational tool that captures the interaction between a moving rigid body and two-fluid flows. Although the immediate application is the study of ocean wave energy converters (WECs), the model was developed at a general level and can be used in other applications. Solving the full Navier-Stokes equations, the model is able to capture non-linear effects, including wave-breaking and fluid-structure interaction, that have significant impact on WEC performance. To transport mass and momentum, we use a consistent scheme that can handle large density ratios (e.g. air/water). We present a novel reconstruction scheme for resolving three-phase (solid-liquid-gas) cells in the volume-of-fluid context, where the fluid interface orientation is estimated via a minimization procedure, while imposing a contact angle. The reconstruction allows for accurate mass and momentum transport in the vicinity of three-phase cells. The fast-fictitious-domain method is used for capturing the interaction between a moving rigid body and two-fluid flow. The pressure Poisson solver is accelerated using GPUs in the MPI framework. We present results of an array of test cases devised to assess the performance and accuracy of the computational tool.

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