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An Efficient Immersed Boundary Method and Multiphase Flow Framework for Simulating Wave Energy Converter Devices[1] KAUSTUBH KHEDKAR, Doctoral Student, NISHANT NANGIA, PhD, RAMAKRISHNAN THIRUMALAISAMY, Doctoral Student, AMNEET BHALLA, Prof at Department of Mechanical Engineering, SDSU — Simulating marine engineering applications with moving bodies involve complex fluid-structure interactions (FSI). In such cases, the fictitious domain/immersed boundary methods are found to be computationally efficient than the body-conforming grid techniques. In the fictitious domain Brinkman penalization (FD/BP) technique, the fluid equations are extended into the solid domain along with an additional penalization force enforcing rigidity of the body. Two level-set functions are defined to track the solid, liquid, and gas phases. A robust and second-order accurate multiphase flow solver that preserves stability in the presence of high-density ratio flows is implemented. We demonstrate that the FD/BP technique can capture the complex wave-structure interaction (WSI) phenomena, which is not possible using linear potential flow theory when simulating wave energy converter (WEC) devices. Results include 2D and 3D simulations of an inertial sea wave energy converter (ISWEC) device. Obtained results conclude that the FD/BP technique, along with the multiphase flow framework discussed, efficiently captures the device physics. A strategy to include energy-maximizing control of WECs within the FD/BP framework is also presented.

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