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Fluid-structure interaction simulation of floating wind turbines interacting with complex, large-scale ocean waves[1] ANTONI CALDERER, XIN GUO, LIAN SHEN, FOTIS SOTIROPOULOS, St. Anthony Falls Lab., University of Minnesota — We develop a numerical method for simulating coupled interactions of complex floating structures with large-scale ocean waves and atmospheric turbulence. The Fluid-Structure Interaction (FSI) solver integrates the curvilinear immersed boundary method of Borazjani et al. (JCP 2008) with the level-set method of Kang et al. (Adv. in Water Res. 2012) and is capable of simulating the coupled dynamic interaction of arbitrarily complex bodies with airflow and waves. The large-scale wave model is based on the two-fluid coupled approach of Yang et al. (JCP 2011), which employs a high-order spectral method for simulating the water motion and a viscous solver with undulatory boundaries for the air motion. The large-scale wave field solver is coupled with the near-field FSI solver by feeding into the latter large-scale waves via the pressure-forcing method of Guo et al. (JCP 2009), appropriately adapted herein for the level set method. We validate the model under both simple wave trains and three-dimensional directional waves and compare the results with experimental and theoretical solutions. Finally, we demonstrate the capabilities of the new solver by carrying out large eddy simulation of a floating offshore wind turbine platform interacting with realistic ocean waves.

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Antoni Calderer
St. Anthony Falls Lab., University of Minnesota

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