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Investigations of Bergy Bits and Ship Interactions in Extreme Waves Using Smoothed Particle Hydrodynamics

Authors : Mohammed Islam, Jungyong Wang, Dong Cheol Seo

Abstract : The Smoothed Particle Hydrodynamics (SPH) method is a novel, meshless, and Lagrangian technique based numerical method that has shown promises to accurately predict the hydrodynamics of water and structure interactions in violent flow conditions. The main goal of this study is to build confidence on the versatility of the Smoothed Particle Hydrodynamics (SPH) based tool, to use it as a complementary tool to the physical model testing capabilities and support research need for the performance evaluation of ships and offshore platforms exposed to an extreme and harsh environment. In the current endeavor, an open-sourced SPH-based tool was used and validated for modeling and predictions of the hydrodynamic interactions of a 6-DOF ship and bergy bits. The study involved the modeling of a modern generic drillship and simplified bergy bits in floating and towing scenarios and in regular and irregular wave conditions. The predictions were validated using the model-scale measurements on a moored ship towed at multiple oblique angles approaching a floating bergy bit in waves. Overall, this study results in a thorough comparison between the model scale measurements and the prediction outcomes from the SPH tool for performance and accuracy. The SPH predicted ship motions and forces were primarily within ±5% of the measurements. The velocity and pressure distribution and wave characteristics over the free surface depicts realistic interactions of the wave, ship, and the bergy bit. This work identifies and presents several challenges in preparing the input file, particularly while defining the mass properties of complex geometry, the computational requirements, and the post-processing of the outcomes.

Keywords : SPH, ship and bergy bit, hydrodynamic interactions, model validation, physical model testing
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