CFD-based analysis and sensitivity study of a two-body hinged raft wave energy converter

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Abstract

The two-body hinged raft wave energy converters (WECs) offer significant potential for harnessing ocean wave energy to generate electricity. Optimization of these devices is crucial for efficient energy conversion, and computational fluid dynamics (CFD) simulation can serve as a pivotal tool since nonlinear wave interactions and wave-structure dynamics can be simulated. Validation of CFD models for a 1:20 model-scale WEC from Crestwing will be shown with solutions to address some of the challenges in CFD-based WEC simulations. For instance, the calibration of a simplified damper model with time-varying damping to approximate the highly nonlinear power take-off (PTO) system, and the simulation of complex motion using overset mesh technique with adaptive mesh refinement (AMR). The numerical results correspond appropriately with the model test results (3-10 % difference in terms of absorbed power). Flow visualizations of the nonlinear effects will be presented with a sensitivity study of mass, center of mass and width of the device. These results contribute to the optimization of the WEC for a higher capture width ratio (CWR) and a lower levelized cost of energy (LCOE).