Experimental Validation of the Hydrodynamic Coefficients for an Oscillating Water Column Wave Energy Converter

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Abstract

Resulting from the action of wind over open water surfaces, water waves contain colossal amounts of energy that has not yet been harnessed. Seen as a very promising source for renewable energy generation, many studies have tried to make wave energy a cost competitive source by investigating optimal designs of wave energy converters (WECs) and implementing arrays of actively controlled WECs to benefit from the hydrodynamic interactions between WECs. To date, most of the attempted approaches to design optimal arrays of controlled converters have relied on the application of standard wave-body interaction software also known as boundary element method (BEM) solvers to obtain the WEC's hydrodynamic coefficients that are crucial for the analysis of array interactions and power absorption. This work intends to provide a methodology to experimentally derive the hydrodynamic coefficients of a scaled oscillating water column (OWC) WEC for evaluating the accuracy of such solvers and providing reliable data for various applications including the optimization of array layouts and WECs control. The OWC WEC was designed, constructed and tested at the O.H. Hinsdale Wave Research Laboratory (HWRL) as part of the US Department of Energy funded Advanced Laboratory and Field Arrays (ALFA) project. With the goal of optimizing OWC's array layout and coordinated arrays' control to maximize the energy production, water surface elevation (WSE) was measured under different wave conditions at multiple locations around a single WEC to investigate its hydrodynamic coefficients, such as scattering and radiation. Once assessed, these experimentally derived frequency domain parameters can be used directly to evaluate the viability of the computational results derived from a standard wave-body interaction software such as WAMIT, or as inputs to the simpler and significantly faster interaction theory.

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