NUMERICAL MODELING OF A MULTIBODY WEC USING CONSTRAINT EQUATIONS

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Hydrodynamic motion analysis of a multiple body Wave Energy Converter (WEC) [1], is modeled using WEC-Sim and an in-house code. The device consists of a spar and a float connected by a hinge. In WEC-Sim [2], which is a well-known WEC performance evaluation software, the connection between bodies that form the WEC device is modeled using Simulink/Simmechanics MATLAB toolbox. In this presentation we describe a method whereby connections between the bodies – in this case a hinge – is modeled by suitably modifying the equations of motion of the two bodies, using constraints imposed by the hinge.

The linear constraints described in Sun et.al [3] are incorporated in the equations of motion. For further improvement in realistic seas, the exact (and nonlinear) constraints are derived for the WEC device. An in-house code was setup using either the linear or nonlinear constraints to model the motion response of the device in regular seas. Results for motions from the in-house solver, which uses the modified equations of motion, are compared with those of WEC-Sim, in regular waves. It is shown that WEC-Sim follows the nonlinear constraints exactly, and the in-house code that uses the nonlinear constraints compares well with the WEC-Sim results.

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REFERENCES

[1]Le-Ngoc, L., Gardiner, A. I., Stuart, R. J., Caughley, A. J., Huckerby, J.A. (2010) *Progress in the development of a multi-mode self-reacting Wave Energy Converter*, OCEANS 2010 IEEE

[2]Ruehl, K., Michelen, C., Lawson, M., Yu, Y., Kanner, S. (2014) *Preliminary verification and validation of WEC-Sim, an open-source Wave Energy Converter design tool*, OMAE2014-24312.

[3]Sun, L., Eatock Taylor, R. and Choo, Y.S. (2011) *Responses of interconnected floating bodies*. The IES Journal Part A: Civil & Structural Engineering, 4 (3). pp. 143-156.