NUMERICAL MODELING OF A TETHERED BALLAST FOR POINT ABSORBER WAVE-ENERGY CONVERTER TECHNOLOGY

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A known issue with existing point absorber wave energy converter (WEC) technology is a rigid spar and heave plate (typically all steel) utilized for ballast. Due to its size, this spar bears design and deployment complexities coupled with construction and transportation costs. The presented research explores replacing the spar with an alternative lighter weight tethered ballast capable of providing similar functionality. The primary element of the tethered ballast is an asymmetric drag device (ADD) which provides maximal drag characteristics while ascending the water column and minimal drag characteristics while descending the water column [1].

A numerical model was developed for a point absorber utilizing a tethered ADD via MATLAB. The governing equations of motion were defined accounting for relevant forces on the WEC system in an ideal wave environment; including forces presented by the power take-off (PTO) mechanism. This research specifically explores a ball screw PTO with a 3-phase alternator, however, the ADD aims to be applicable for a number of point absorber PTO configurations.

Through simulation with the numerical model, there are two primary outcomes to this research. One is to determine the optimal configuration for maximized power generation. The second is to prove the tethered ADD provides similar ballast to the existing rigid spar and heave plate.

Results of the numerical model will guide prototype development for laboratory testing and eventual field tests. The tethered ADD under development will be applicable to a wide range of point absorber technologies and will significantly reduce the costs of point absorber WEC technology; particularly for small-scale, low-energy applications.

REFERENCES

[1] MacDonald, Daniel. Provisional Patent #62/266,217. University of Massachusetts Dartmouth, North Dartmouth, MA. December 11, 2015.

Preprint submitted to 2018 6th Annual Marine Energy Technology Symposium.
Received February 14, 2018.