POWER DISSIPATION ANALYSIS OF A HEAVING POINT ABSORBER EXCITED BY WAKES

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A demonstration-scale heaving point absorber, the miniWEC, is deployed for open water testing. The miniWEC consists of a cylindrical float tethered to a variety of heave plates and is intended to advance knowledge of heave plate dynamics and serve as a testbed for WEC control [1]. Wave-induced heaving of the float, reacting against the submerged plate, generates torque and rotation on a shaft using tether line tension via pulley and spindle. The equilibrium position of the float and a restoring force is maintained and supplied by a bank of parallel springs. Its power take-off (PTO) hardware consists of an adjustable viscous damper, simulating the dynamic response of a rotary generator while dissipating shaft power. A rotary torque sensor and encoder between the damper and main shaft measures dissipated power. Fluctuations from equilibrium of heave plate tether tension represent force input to the PTO system and are measured with a load cell. Similarly, spring tension is measured with a separate load cell. Wakes produced by a circling vessel excite the system resulting in oscillations of the PTO shaft with peak periods of 2.5 s and 3 s. Forces and torque during these oscillations are compiled to create probability distributions of dissipated shaft power for the various heave plate configurations tested, shown in Figure 1. Maximum dissipated power was 120 W. Bearing friction and spindle slipping are found to significantly decrease useful power generation. This analysis is utilized to specify an electrical PTO consisting of a permanent magnet linear generator sized to allow generation and reactive power control in similar or more energetic seas during future deployments.

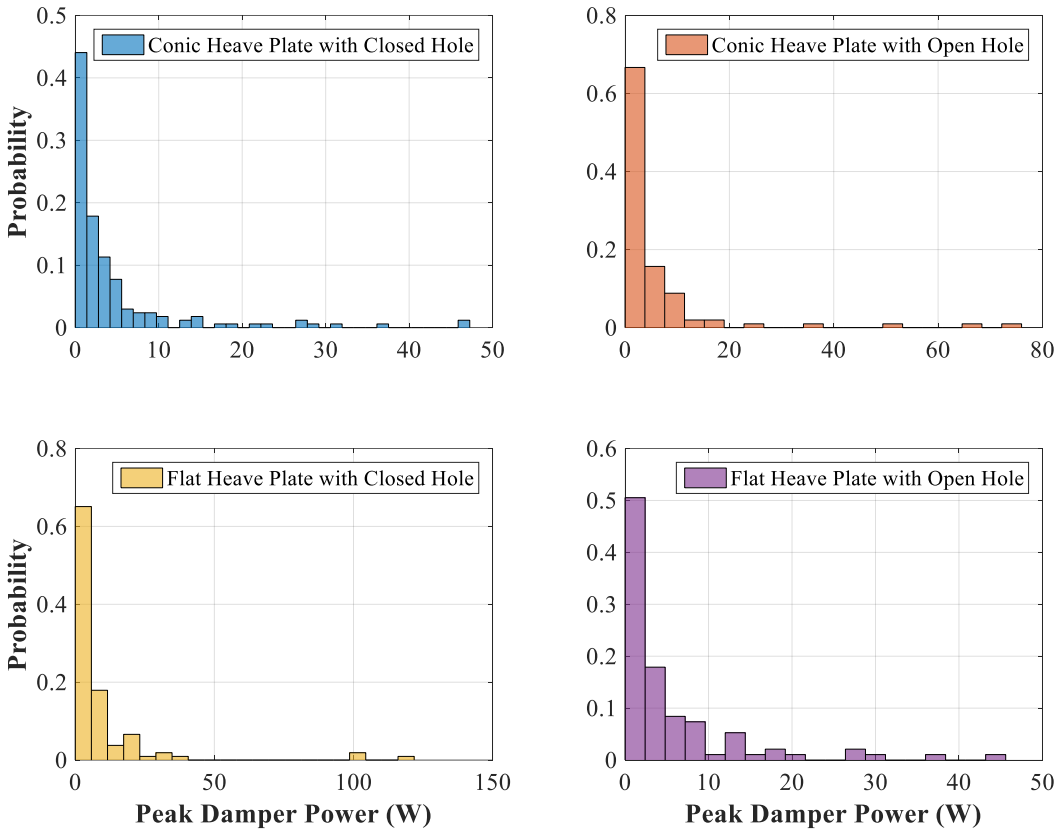

FIGURE 1. PEAK DAMPER POWER DISSIPATION FOR FOUR HEAVE PLATE CONFIGURATIONS.

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REFERENCES

[1] Brown, A., Thomson, J., Rusch, C., "Hydrodynamic Coefficients of Heave Plates, with Application to Wave Energy Conversion", Submitted to Journal of Oceanic Engineering, December, 2016