Title of Diploma Thesis

Performance of an Oblate Spheroid-Shaped Wave Energy Converter

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ABSTRACT

The present Diploma Thesis focuses on the investigation of the performance (hydrodynamic behavior and power absorption) of a new heaving Wave Energy Converter (WEC) having the shape of a "squashed" spheroid (oblate spheroid-shaped WEC). The required hydrodynamic analysis is conducted in the frequency domain using WAMIT software. Initially, four heaving WECs of different geometries, i.e. cylinder, hemisphere, "squashed" (oblate) spheroid and "pointy" (prolate) spheroid, are taken into account and their performance is assessed and compared under the action of regular waves. All examined WECs are assumed to oscillate freely along their vertical axes (heave motion), while wave energy is absorbed through a linear Power Take-Off (PTO) mechanism (modeled as a linear damping system), actuated from the WEC's heave motion. The results of the aforementioned assessment/comparison demonstrate that the oblate spheroid-shaped WEC corresponds to the best examined geometry, since it shows the best absorption ability among the rest examined WEC geometries. Next, the effect of various parameters (water depth, draft, radius) on the hydrodynamic behavior and energy absorption of the oblate spheroid-shaped WEC is investigated, while, additionally, its performance is assessed in the presence of a vertical, bottom-mounted wall of finite-length and of negligible thickness. In the latter case, two shapes of walls are examined; a rectilinear and a Γ-shaped wall. In the case of the rectilinear wall, the performance of the oblate spheroid-shaped WEC is assessed for two different wall lengths and for three differences distances of the WEC from the wall. For the Γ-shaped wall, focus is given on the effect of the distance of the WEC from the wall on its performance. Finally, by utilizing the TMA spectrum (inclusion of water-depth effects on the spectral density), the energy absorption of the oblate spheroid-shaped WEC with and without the presence of the wall is assessed for various sea states.

Among the various conclusions it is worth to note that as the draft of the oblate spheroid decreases and its radius increases, approaching the "flat disk" shape, the absorbed ability of the WEC increases, attributed, mainly, to the increase of the PTO's damping coefficient.

Keywords: Wave Energy, Wave Energy Converter, Oblate Spheroid, Response, Absorbed Energy, Vertical Wall.