Title of Diploma Thesis

Time-domain Performance Investigation of an Array of Wave Energy Converters in front of a Vertical Wall

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ABSTRACT

This diploma thesis investigates the performance (hydrodynamic behavior and power absorption) of an array of three, semi-immersed, oblate spheroidal heaving Wave Energy Converters (WECs), placed in front of a bottom-mounted, vertical wall of finite length under the action of regular and irregular waves. The modeling of the system and the analysis of the hydrodynamic behavior of the array is conducted numerically in the time domain by deploying the WEC-Sim software program. A prerequisite was the solution of the corresponding diffraction/radiation problem in the frequency domain, by utilizing the conventional Boundary Integral Equation method. This was achieved by applying the WAMIT software. The performance of the array is initially studied considering various parameters, starting with the wave characteristics, such as the period, height and angle of the incident waves. Thereafter, the effect of the configuration of the array (linear and isosceles triangle arrangement), its position in relation to the wall (middle or end of the wall, at different vertical distances from it), as well as the existence of the wall itself, is investigated. The results demonstrate that the placement of the array at larger distances from the wall favors waves with periods closer to the resonance, leading to hydrodynamic interactions that improve the hydrodynamic behavior of the array and thus its power absorption ability. The opposite holds true when placing the bodies close to the wall, where the array works more efficiently for waves with periods far from resonance. Compared to isolated arrays, the presence of the wall affects positively the array's power absorption ability in certain period ranges, depending mainly on the array's distance from the wall. Finally, the change of the incident wave angle, from perpendicular to the wall waves to oblique waves, leads to significant losses in total power absorption.

Keywords: Wave energy, Wave energy converters, Vertical wall, Hydrodynamic interactions, Power absorption.