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Numerical Modelling and Performance Analysis of an Oscillating Wave Surge Converter for Renewable Power Generation Applications

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ABSTRACT

Energy is the driving force of the modern world and attention for renewable energy increases day by day due to various disadvantages associated with fossil fuels in addition to the risk of depletion of fuel sources. Wave energy is a freely available high-density energy source around the clock which attracts the interest of researchers all over the world. In this study, Oscillating Wave Surge Converter (OWSC) type wave energy converter was numerically modelled and investigated using Smoothed Particle Hydrodynamic (SPH) method. OWSC is based on a mechanism of bottom-hinged floating flap attached to a damping system which enables to absorption of energy from the incident wave. Basic rectangular-shaped flaps with different damping coefficients were simulated in a 3-D regular wave tank for a given wave condition. The simulation results revealed that the energy conversion efficiency of the OWSC is a strong function of the damping coefficient and there is an optimum damping coefficient for given wave parameters of a particular OWSC. Proceeding the study, an optimum damping coefficient was calculated and keeping the flap volume constant another series of simulations was carried out for different geometric shapes of the flap to analyse their effect on the energy extraction efficiency. The study reveals that a concave-shaped flap could increase the energy conversion efficiency by 27% with a small increase in hydrodynamic forces acting on the flap compared to a rectangular flap. On the other hand, a semi-cone-shaped flap reduced the hydrodynamic forces by 42% while energy conversion efficiency was also reduced by 33%. The findings of this research will facilitate the engineer to choose which geometric shape of the flap to be used in OWSC while compromising between the energy conversion efficiency and devise survivability or cost of device structures.

Keywords: *Damping coefficient, Geometric shapes, OWSC, SPH, Wave energy*