
Development of a Small-scale On-shore Sea Wave Energy Extraction Device for Electricity Generation

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Under the backdrop of non-renewable energy sources being depleted rapidly at ever-increasingly consumption rates, renewable energy technologies have to be developed to meet future energy challenges. Out of many conventional renewable energy sources, sea wave energy is one of the least developed renewable energy sources in the world, which has a higher energy density and availability when compared with many other renewable energy sources. Accordingly, this work is aimed to develop an efficient and low-cost sea wave energy converter (WEC), customised to on-shore deployment as a scaled-down model. The capacity of the WEC is 35 W (wave to the device), and converts wave energy into electricity. The device was designed based on a novel concept to extract both the kinetic and potential energies from the sea waves via a set of flaps and a floater connected rigidly to each other, fitted to a bottom-hinged 3-DOF frame via a universal joint. The frame is mounted on the sea bed and it can move in a 3D space covering an inverted conical working envelope as sea waves interact with the device from different directions. Potential energy contained within sea waves is captured by the floater in a translational heaving motion while the flaps capture the kinetic energy in a surge motion. The device was fabricated locally and deployed at a coastal location at Ginthota, Galle as an on-shore setup facing the waves of about 1 m wave height and wave period of 20 seconds. After several trials, it was observed that 1.450 W of stable electrical power could be extracted from the device, yielding an overall efficiency of 4.14%. However, wave irregularities, sand particle interaction and frictional losses in mechanical links were observed to hinder the device performance. Future works of this research will focus on further optimisation of the device by employing both numerical simulations and experimentation.

Keywords: Renewable energy, Sea wave energy, Sea wave energy conversion, Wave energy converter