Experimental testing of wave energy converters for the WECfarm project

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This abstract refers to an ongoing Master Thesis, conducted by Bono the Witte and Hendrik Claerbout, at the department of Civil Engineering of Ghent University (Belgium) on the optimal geometric configuration of multiple WECs in a WEC array. A new experimental campaign within the WECfarm project is planned in a new wave basin which has been constructed in Ostend, Belgium; the Coastal & Ocean Basin (COB). WECfarm will deliver a database for validation of new advanced numerical models which are worldwide employed for WEC array modelling. At this time (November 2020), dry-testing takes place at Ghent University of one single WEC. The importance of dry-testing is to check the proper working of all mechanic, electronic and control aspects before deploying the WEC in a wave flume or wave basin. The working principle of the WEC is the one of a point absorber operating in heave. The power take-off consists of a rack and pinion system in combination with a rotational Permanent-Magnet Synchronous Motor (PMSM). To control the WEC, a Simulink 'Real Time torque control' model is used. This model is built on a development computer and subsequently loaded on a Speedgoat Performance real-time target machine. In this context, real-time is the capability of the algorithm to execute within a prescribed update rate. The input of the control model consists of the position, velocity, acceleration of the buoy and the vertical force on the buoy. These are obtained with a laser sensor, motor encoder, accelerometer and configuration of three loads cells, respectively. The output of the control model is the torque to deliver to the motor. Within the present Master Thesis a single WEC is scheduled to be tested at the wave basin of Aalborg University, as part of the WECfarm collaboration with Aalborg University, Denmark (dr. Francesco Ferri). The test matrix will contain diffraction tests, radiation tests and power absorption tests. It will also contain (extreme) wave conditions to induce non-linear effects. If possible within the timeframe of this Master Thesis (to be completed by June 2021), a second WEC will be constructed which will be identical to the first one that is currently tested. Following that, an array of two WECs will be firstly dry-tested and secondly tested in the wave flume at Ghent University with a focus on interaction and control strategy. These steps will allow us to make recommendations for the WEC array experimental set-up where up to five WECs will be employed, which will be experimentally tested at COB wave basin in 2022. During the present Master Thesis, there is close collaboration with other Master Thesis work at Ghent University focusing on control strategies and on the testing of one single WEC in order to fully characterize the hydrodynamic performance of the WEC. The obtained dataset of the 3D testing of the first WEC at the wave basin of Aalborg University will serve as input for numerical model validation that is currently taking place at Ghent University based on Smoothed Particle Hydrodynamics methods.

Keywords: WECfarm; WEC; WEC array modelling; Experimental testing; Wave bassin