Effects of hydrodynamic interactions and control within a point absorber array on electrical output

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Deliverable D4.4
Introduction

D4.4 is dealing with control of arrays of WECs to harvest wave energy. It consists of the paper "Effects of Hydrodynamic Interactions and Control within a Point Absorber Array on Electrical Output" which was submitted to the Elsevier journal *International Journal of Marine Energy* on 28/05/14. Expected publication date is by the end of 2014.

Abstract from the draft paper:

A significant role is envisaged for ocean wave energy to meet the different renewable energy targets set by various governments and world bodies. To make use of this potential, the industry will soon be moving from sea testing of individual wave energy converters (WECs) to the deployment of arrays and farms of WECs.

The total power extracted by an array of WECs is influenced by the hydrodynamic interactions between them, especially when the WECs are spaced very closely. By proper control of the power take-off (PTO) forces and moments acting on the WECs within the array, the hydrodynamic interactions between the WECs and the total power extracted by the array can be modified.

In this paper, different resistive and reactive PTO control strategies, applied to a time-domain wave-to-wire model of a three-float Danish Wavestar device, are compared. The time-domain, as opposed to frequency-domain, modelling approach allows the use of constraints on the maximum PTO moment to be applied in order to make the study more realistic. The effects that PTO control has on the hydrodynamic interactions between the floats and on the total power generated by the device, when placed in a range of irregular sea states, are studied. It was found that the performance of the three-float device improved as the sophistication of the PTO control strategy and the level of hydrodynamic interactions taken into account in the control problem increased. From among the different control strategies tested in this work, fully-coordinated array control (matrix control) was found to maximise the average power generated by the array.

Fully-coordinated control potentially enables wave farm developers and device designers to explore the opportunities of connecting and maximising energy yields from installations that will be necessary to contribute to meeting the 2020 and 2050 targets for offshore renewable energy.