ERPem
Edinburgh Research Partnership in Engineering and Mathematics

Test Plan to quantify sea state parameters influence over WEC's performances

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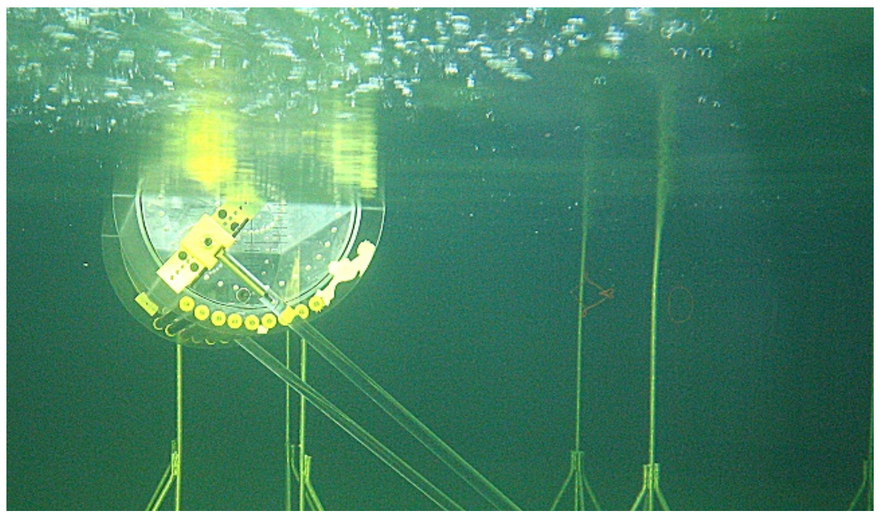
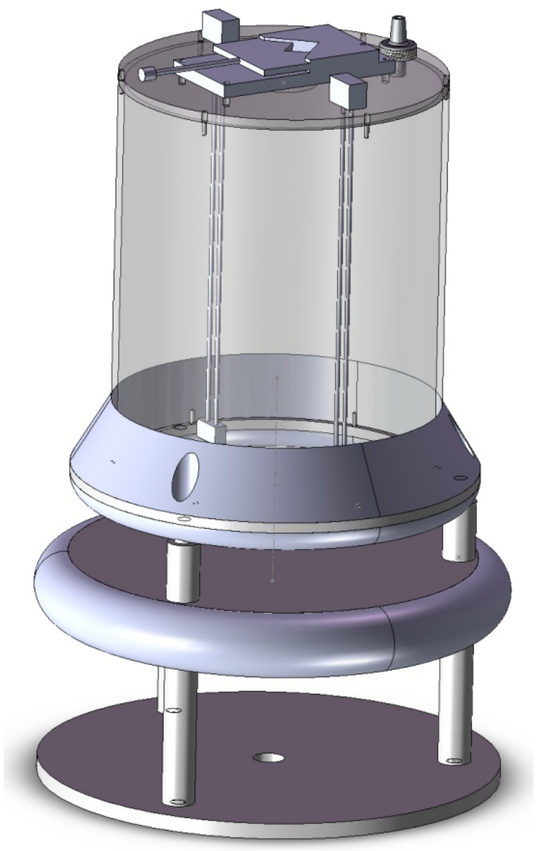
Introduction

In regard of the infinite variety of sea states at a given location, a statistical description of a location wave climate matching with the performance description of a WEC is needed to "forecast" its production.
This PhD project aims to identify which of the directional sea state statistical parameters are the most relevant for WEC production estimation. This project is limiting itself to offshore devices.
An experimental approached is selected, using several type of devices to get an overview of the most influential parameters independently of the type of WEC.



Desalination version of the Salter Duck
This new version of the Duck mainly developed by Jorge Lucas will be used as a fully directional device that can aligned itself with the wave main direction of propagation.



OWC model from Queen's University Belfast.
Using the same models for these experiments as the ones by Matt Folley in Belfast will increase the confidence in the results and could create added value trough the results comparisons

The Devices

Models of 3 type of devices are selected, with resonating period around 1Hz to match the Edinburgh Curved wave tank.

- A OWC as a omni-directional device.
- A pair of OWCs forming a single device as a weekly directional device
- A model of the Desalination Duck as a fully directional device

1st Test Phase *March 2010*

The first phase of testing will be exploring the spectral parameters associated to single peak directional spectra. The main direction of propagation is not taken into account on the ground that most directional WEC can align themselves with it. More work will be needed on arrays as this hypothesis cannot be done in this case.
A full factorial design will be used for this phase, helping the understanding of the effect of interaction between parameters

Parameter List:

- Energy Period Te (3 levels)
- Frequency spreading (2 levels)
- Angular Spreading (2 levels)
- Direction of propagation shift (2 levels)

The goal of this phase is to reduce the number of parameters needed to describe one wave system in order to simplify the design of experiment for the 2nd phase of test involving sea state with two wave systems

2nd Test Phase

The second and final phase of testing (July/August 2010) will aim to explore the sea state in its full complexity, considering sea states composed of one or two wave systems and their relative position in the plan *(f,θ)*. Parameters relative to the wave system positioning will be added to the ones retained during the first phase

Added Parameter List:

- Energy Ratio between wave systems
- Energy period difference between wave systems
- Main direction of propagation between wave systems

Final aims

These tests will hopefully help select the most influential parameters needed to describe a directional sea state, in order to outgrow the estimation based solely on T_e and H_{m0} scatter diagram.
If the results shows no statistically significant influence of some parameters, it will be a good indication that they can be safely discarded in further study.
Finally, the results might show that looking for a general set of parameters fitting all type of WEC is not possible, and that every performance estimation should be done with a device specific method.

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