Electric power from ocean waves - Improving the performance of overtopping devices

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Problem definition

Overtopping wave energy converters (WECs) are based on wave run-up on a slope and overtopping into a reservoir that is emptied into the sea through a turbine. Increasing the efficiency of overtopping WECs requires the prediction of the volumes of water - on a wave-by-wave basis - that enter the reservoir. Experimental testing and numerical simulations are being used to determine the individual volumes and to set up a prediction strategy based on realtime measurements of parameters of incident waves in front of the device.

Experimental Testing

Physical model tests (1:30) have been carried out in a wave flume at AAU (DK) for a fixed nearshore 2D-structure.

Variables are water depth, slope angle, wave conditions (regular and irregular). The test set-up is optimized to determine the individual overtopping volumes wave-by-wave very precisely.

Output results

From both experimental and numerical tests the same output is acquired: a series of individual overtopping volumes and a series of individual wave heights measured in front of the device.

The prediction strategy correlates both series and is under development. Digital filter techniques are currently used to derive the transfer function between both curves.

The relation between both series depends on the structure geometry and the wave phenomena occurring between the point of wave measurement and the point of overtopping at the crest of the slope.

Numerical Simulations

A numerical tool is being developed using a commercial CFD-solver (FLOW-3D®) to support and extend the prediction strategy.

It consists of a numerical wave flume, with wave generation using an internal mass source and wave absorption using a numerical sponge layer. Preliminary results for regular waves are available.

However, further optimization is required for irregular wave generation and wave-structure interaction.

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