# Modelling of an Oscillating Water Column in DualSPHysics

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The topic of this research is the numerical modelling of the Oscillating Water Column (OWC) of Ocean Energy Systems (OES) in DualSPHysics [1,2]. OES aims to verify and validate numerical models for Wave Energy Converters (WECs) (http://www.oceanenergysystems.org/oes-projects/wave-energy-converters-modelling-verification-and-validation/). One of these studied WECs is the OWC experimentally tested by the Korea Research Institute of Ship & Ocean Engineering (KRISO).

In a first phase a DualSPHysics model for the OWC was simulated without any damping caused by the orifice. Since the inside chamber of the OWC has a rectangular shape, this simulation was carried out in 2D. Good agreement was achieved between numerical and experimental results.

In a second phase the cases with Power Take-Off (PTO) system, or with orifice, were considered by applying a force on the free water surface inside the OWC chamber. This force was applied on a thin rectangular plate, floating on the free water surface inside the OWC chamber (Fig. 1). The PTO force is introduced by using the coupling of DualSPHysics with Chrono-Engine [3]. In order to get an estimate for the PTO force the method developed by Harry Bingham and Kim Nielsen was applied [4].

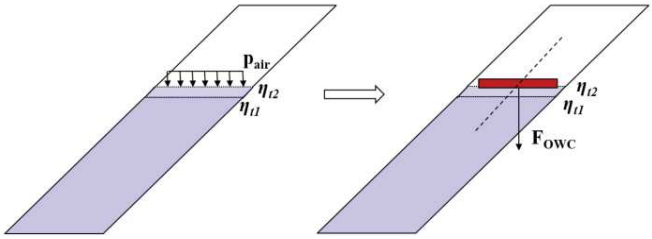


Figure 1: The pressure originating from compressed air is replaced by a force acting on a floating plate

In a third step, the accuracy of the water surface elevation, air flow and air pressure obtained from the DualSPHysics simulations was improved by adding the effect of air compressibility and by conducting 3D simulations.

**References**

[1] Park et al., (2019), “Experimental and numerical analysis of performance of oscillating water column wave energy converter applicable to breakwaters”, OMAE 2019
[2] Crespo et al., (2015), “DualSPHysics: Open-source parallel CFD solver based on Smoothed Particle Hydrodynamics (SPH)”, Computer Physics Communications no. 187: 204-216
[3] Canelas et al., (2018), “Extending DualSPHysics with a Differential Variational Inequality: modeling

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fluid-mechanism interaction", Applied Ocean Research no. 76: 88-97
[4] Bingham et al., (2015), "Hydrodynamic analysis of oscillating water column wave energy devices", Journal of Ocean Engineering and Marine Energy no. 1: 405–419

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