Numerical modelling of a wave energy converter for the WECfarm project

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This abstract refers to my ongoing master's thesis at the Civil Engineering department of Ghent University (Belgium) on numerical modelling of Wave Energy Converters (WECs). The numerical modelling is performed using the open-source software DualSPHysics [1]. This program applies smoothed particle hydrodynamics (SPH), which is a non-linear Lagrangian meshless method. This means that the fluid is described as a set of particles for which the physical properties are determined using Navier-Stokes equations as opposed to a Eulerian model where the fluid is discretized into control volumes.

The objective of this thesis is to implement the so-called "Master WEC", developed at Ghent University for the upcoming WECfarm project with arrays of point absorber type WECs, in the numerical domain and simulate the involved physical processes. One of the challenges in simulating a WEC compared to a normal floating body is the power take-off (PTO) system which is necessary to capture the wave energy and convert it into electricity. The modelling of this PTO system is done by coupling Project Chrono (an open source physics simulation engine) to DualSPHysics [2]. Initially one single WEC will be modelled and the dynamic response, the PTO system and the wave field effects will be simulated. As such this research is situated in the topics of "Working Group 1: Numerical hydrodynamic modelling for WECs, WEC arrays/farms and wave energy resources".

Subsequently these results will be validated using experimental data obtained from wave flume tests. Since a single WEC will not generate a sufficient amount of power the goal is to construct WEC arrays within the WECfarm project. As such, once this single Master WEC model is validated, additional WECs will be implemented in the numerical domain and the interaction between multiple WECs will be studied. This should allow further research into different array geometries and different WEC spacings. This thesis runs in parallel with two additional experimental theses at Ghent University which will enable back and forth interaction between both numerical modelling and experimental scale testing.

References

[1] Crespo et al., (2015), "DualSPHysics: Open-source parallel CFD solver based on Smoothed Particle Hydrodynamics (SPH)", Computer Physics Communications no. 187: 204-216
[2] Canelas et al., (2018), "Extending DualSPHysics with a Differential Variational Inequality: modeling fluid-mechanism interaction", Applied Ocean Research no. 76: 88-97

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