Development of a fluid-structure interaction system within DualSPHysics for flexible oscillating structures with applications to wave energy converters (WEC)

Joe El Rahi[1], Iván Martínez-Estévez[2], José Domínguez[2], Vasiliki Stratigaki[1] Alejandro Crespo[2], Peter Troch[1], Tomohiro Suzuki[3],Moncho Gómez-Gesteira[2]

[1] Department of Civil Engineering, Ghent University, Ghent, Belgium
[2] EPHYSLAB, University of Vigo, Campus Sur, 32004, Ourense, Spain
[3] Flanders Hydraulics Research, 2140 Antwerp, Belgium
E-mails: Joe.ElRahi@ugent.be; ivan.martinez.estevez@uvigo.es; jmdominguez@uvigo.es; Vicky.Stratigaki@ugent.be; alexbexe@uvigo.es; Peter.Troch@ugent.be; tomohiro.suzuki@mow.vlaanderen.be; mggesteira@uvigo.es

Among the numerical tools used in the modelling of wave energy converters, the smoothed particle hydrodynamics (SPH) method has emerged as a powerful tool to accurately model the behavior of WEC farms and other energy devices using fully non-linear simulations with high resolutions [1]. One software package in which this method is implemented is DualSPHysics (http://dual.sphysics.org), which has been extensively applied in studying a range of WEC devices, from oscillating surge to heaving point absorbers and wave attenuators [2,3]. The current configuration in the numerical model captures the hydrodynamic loads applied on the structures (energy devices) and the respective motion response generated for both fixed and floating wave energy converters. However, it misses out on modelling the deflection and stresses generated in the structure, which are two decisive parameters for defining design loads and accurately modelling behavior [4]. In this work, the aim is to develop a coupling with a finite element method solver in order to deliver a package which solves the fluid-structure interactions. As a result a single tool will be created that incorporates both the motion and structural loading of WECs. This is achieved through the expansion of the coupling interface with the structural solver Project Chrono (https://projectchrono.org/) to include elastic material and finite element solvers. The coupled model will provide a comprehensive tool which includes: (i) motion response from waves, (ii) non-linear deflections of structural elements, and (iii) generated internal stresses. In terms of application, the modelling accuracy of WECs will be improved by including the deflections and subsequent damping of the structural elements (especially for WECs such oscillating wave surge converters) Additionally, cables and other elastic elements will substitute the linear spring currently used in modelling of point absorbers and mooring lines of floating WECs and structures.

References

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