Hydrodynamic modelling of wave-structure interaction processes using OpenFOAM

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Numerical tools such as boundary element methods based on linear potential flow theory are frequently used for simulating floating structures: wave energy converters or dredging and offshore installation vessels for example. At this moment, non-linear viscous models such as the open source computational fluid dynamics (CFD) toolbox OpenFOAM are very popular amongst academic researchers. During the last years, the marine industry is showing an increasing interest in using CFD models for designing structures or optimising installation processes.

The PhD work of Brecht Devolder [1] is an academic example of recent developments in OpenFOAM for the marine, offshore and coastal engineering sectors. Fundamental research and thorough modelling resulted in (i) more accurate results by developing and implementing enhanced turbulence models for two-phase free surface flows [2,3] and (ii) accelerated simulations by developing a novel coupling algorithm between the motion of a floating structure and the flow field around it [4]. This coupled model is applied, for the first time ever, to simulate an array of nine individual heaving point absorber wave energy converters subjected to regular waves [5].

Currently, a research project is running between KU Leuven (campus Bruges) and the DEME group, and focusses on CFD simulations of realistic floating structures using OpenFOAM. Further developments are related to the use of overset meshes, multiple degrees of freedom motions, mooring lines and combined wave-current simulations. All the developments presented need thorough verification and validation and are required to open up the possibility to perform CFD simulations of any coastal and offshore structure with reasonable calculation times or to optimise their design and efficiency.

References

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