Modelling 3D floating bodies and fluid flow interactions using Smooth Particle Hydrodynamics Method

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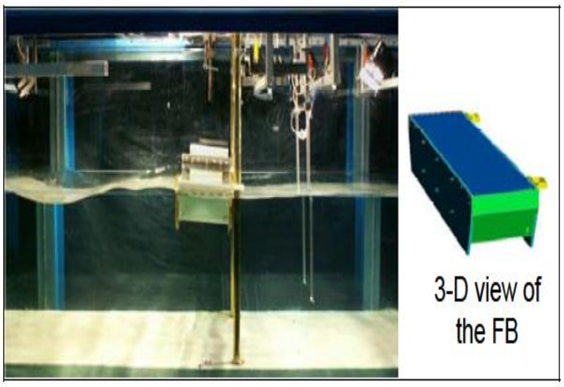
ABSTRACT

The dynamics of floating offshore structures is of particular importance when considering the high cost of installing and maintaining such structures. With oil platforms and wind turbines venturing into ever deeper waters, the risk of rogue wave impacts upon these structures is high. Accurate prediction of the interaction of floating bodies with surface waves is therefore necessary. This paper investigates the interaction of fluid and a floating object using a weakly compressible smoothed particle hydrodynamics (SPH) scheme coupled with a Newtonian dynamics solver to consider the floating body.

The “Rotation Matrix” method [1] describes the 3D motion of rigid bodies within our SPH framework. The derivation of the rigid-body equations is based on the conservation of linear momentum, angular momentum and rotational energy. Whilst our current investigation is limited to cubic bodies, the approach we have used is easily extendible to bodies of arbitrary shape. We have validated this implementation of floating body dynamics with data from laboratory experiments, showing accurate predictions for the motion of the floating object in the 3D case. Important SPH parameters and schemes have also been studied in order to find the best parameter setting for simulating free surface fluid flow in general, as well as for floating body interaction specifically. Our numerical calculation provides a more consistently correct comparison with the experimental data when compared to other literature [3].



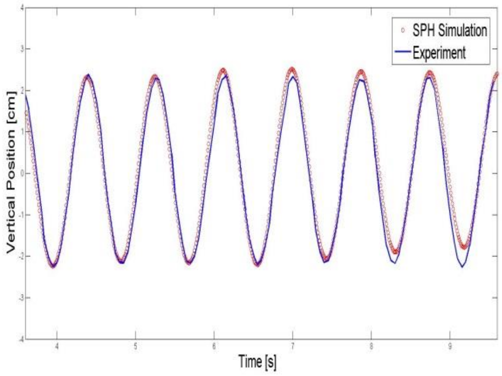


Fig.1 (Left) Wave flume test with floating breakwater [2]. (Right) Comparison between numerical result (red) and experimental data (blue) of vertical heave motion of the floating breakwater.

REFERENCES

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[3] S. Manenti, P. Ruol, “Fluid-Structure Interaction in Design of Offshore Wind Turbines: SPH Modelling of Basic Aspects”, *Proc. Int. Workshop Handling Exception in Structural Engineering*, Nov. 13–14 2008, Sapienza University (Italy) DOI: 10.3267/HE2008.