Wave-body interaction based on a robust SPH method

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ABSTRACT

In the present work, a robust SPH method is introduced to investigate the violent wave-body interaction phenomenon, which is very significant in the field of ocean engineering. In the SPH method, the discretized governing equations are derived based on the conservation of energy, which ensures good numerical stability. Numerical diffusive terms are added in the governing equations to achieve stable pressure approximation. In the solid wall boundary condition, dummy particle boundary is extended for modelling the wave maker and the freely moving floating body, which is very convenient and accurate for the boundary wall with irregular shape. The position updating of the floating body is improved for higher accuracy. In the numerical investigations, a numerical water wave tank is built. Both flap and piston wave makers are modelled and tested. A dissipation domain is designed as a wave absorber in order to prevent the water wave reflection. The simulations of nonlinear water waves are validated by both other numerical results and experimental data. Moreover, a floating body interacting with nonlinear wave is simulated and the motions of three degrees of freedom are compared with experimental data. The numerical results demonstrate that, the improved SPH method is very robust in modelling those wave-body interactions with violent free surface deformations and it can be further applied in some practical applications.

REFERENCES

1. M.B. Liu, J.R. Shao and H.Q. Li, An SPH model for free surface flows with moving rigid objects. *International Journal for Numerical Methods in Fluids*, **74**, 684-697 (2014).
2. P. Sun, F. Ming and A. Zhang, Numerical simulation of the interaction between free surface and rigid body using a robust SPH method. *Ocean Engineering* (2015).
3. B. Bouscasse, A. Colagrossi, S. Marrone and M. Antuono, Nonlinear water wave interaction with floating bodies in SPH. *Journal of Fluids and Structures*, **42**, 112-129 (2013).
4. S. Adami, X. Hu and N. Adams, A generalized wall boundary condition for smoothed particle hydrodynamics. *Journal of Computational Physics*, **231**, 7057-7075 (2012).