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Numerical solutions of wave-body interactions for stationary surface-piercing body by the GFDM-based numerical wave flume

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A meshless numerical wave flume is developed in this study to investigate the fully nonlinear wave-body interactions for stationary surface-piercing body. The adopted meshless numerical wave flume [1-2] is formed by combing the potential flow theory, the generalized finite difference method (GFDM), the second-order Runge-Kutta method, the semi-Lagrangian approach, the sponge layer, the ramping function and the wavemaker. The GFDM, a newly-developed domain-type meshless method, is truly free from mesh and numerical quadrature, so the GFDM is very effective in dealing with the moving-boundary problem of wave-body interaction. The GFDM and the second-order Runge-Kutta method are responsible for the spatial and temporal discretizations, respectively, while the movements of computational nodes at every time step are determined by following the semi-Lagrangian approach. In order to form a stable numerical wave flume, the sponge layer, which is also known as the numerical beach, is placed in both ends of the flume, as the ramping function and the wavemaker are arranged at the inlet of flume. Using the proposed meshless numerical flume and the Bernoulli's equation, the time history of forces and moment of the fully nonlinear wave-body interactions are computed to record the mean drift load on the stationary surface-piercing body. The numerical results of a single barge are compared with other numerical solutions [3] and experimental data to verify the merits of the proposed meshless numerical model for the fully nonlinear wave-body interactions. Besides, several factors, which might influence on the accuracy of the numerical results, are systematically investigated in this study.

REFERENCES

[1] T. Zhang, Y.F. Ren, Z.Q. Yang, C.M. Fan and P.W. Li, Application of generalized finite difference method to propagation of nonlinear water waves in numerical wave flume, *Ocean Engineering,* Vol. **123**, pp. 278-290, 2016.
[2] C.M. Fan, C.N. Chu, B. Šarler and T.H. Li, Numerical solutions of wave-current interactions by generalized finite difference method, *Engineering Analysis with Boundary Elements*. (in press)
[3] W.C. Koo and M.H. Kim, Fully nonlinear wave-body interactions with surface-piercing bodies, Vol. **34**, pp. 1000-1012, 2007.