XI International Conference on Computational Methods in Marine Engineering

Numerical Simulation of Wave-Body Interactions with the evolution of Focused Waves Using HOS-CFD coupling Method

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ABSTRACT

The study of focused waves is critical due to their concentrated energy, which can pose significant threats to marine structures. Current research primarily concentrates on the interactions between waves and structures at the focal position. Nevertheless, some scholars have noted that the maximum heave of the structure does not occur at this position. A thorough understanding of wave-body interactions in focused waves is essential for conducting safety assessments.

Since the potential theory is inadequate for simulating green water phenomena, many studies of focused wave-structure interactions are based on the Computational Fluid Dynamics (CFD) method. However, the CFD method costs large computing resources and brings computational errors due to numerical dissipation. Therefore, this study adopts the High Order Spectral-Computational Fluid Dynamics (HOS-CFD) coupling method. While maintaining the accuracy and efficiency of numerical simulation, it enables the study and analysis of structural motions at various positions throughout the evolution of the focused wave.

In this study, wave generation is initially accomplished using the HOS method. Simulations of the interaction between the floating body and the focused wave are then conducted in HOS-CFD coupling method (Zhuang et al., 2023). The results are validated against data from the experiments (Zhao et al., 2012). Subsequently, numerical simulations of wave-body interactions at various positions near the focused position are performed. The influences of body's motions (surge, heave, pitch) are analysed. A mooring system is utilized to restrict the floating body. The green water phenomena will be analysed to illustrate the relationship among the distances to the focused position. Conclusions are drawn from these analyses.

References

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