Numerical and Experimental Investigation of Moored-Floating Structures in Regular Waves

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ABSTRACT

In this paper, an experimental and numerical study of a floating object is presented. The incorporation of both experimental and numerical tools for the investigation of a simple floating object provides the opportunity to validate the proposed numerical model in detail.

The experiments are performed in the wave flume of the Leibnitz Universität Hannover, Germany. The flume is capable of generating high-fidelity waves with a wide range of parameters. A wave absorber at the end of the tank prevents wave reflections. The study consists of a free-floating box which is placed in the middle of the flume. A soft mooring line system is attached to the box in order to prevent motion perpendicular to the incoming wave direction. Heave and pitch motion are measured for different wave heights and periods. Additionally, measurements under consideration of mooring are presented. For this purpose, different rope mooring systems are attached to the box, and the motion of the moored-floating body in different wave conditions is analysed.

In a second step, numerical simulations of the same setup are presented. The applied numerical tool is the open-source CFD model REEF3D. The solver has been widely used to study various problems in the field of wave hydrodynamics and fluid-structure interaction. It solves the incompressible Reynolds-averaged Navier-Stokes equations for two-phase flows. A level set method is used to model the free surface between water and air. The numerical model is based on a finite difference method on a staggered structured grid. It applies a fifth-order WENO convection scheme and a third-order TVD Runge-Kutta scheme for the time propagation. Floating structures are represented by an immersed boundary method based on the ghost cell method [1]. The model includes analytical, quasi-static and dynamic mooring models which are used for this study [2].

REFERENCES

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