

An Experimental and CFD Study of the Extreme Waves Impact on OC3-Hywind Spar Floating Offshore Wind Turbine

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The study presents a combined wave tank experiment and Computational Fluid Dynamics(CFD) study on the OC3-Hywind Spar Floating [1] offshore wind turbine under extreme wave conditions. Focused wave is adopted in the present study as one of the effective ways to model the extreme wave. The main objectives of this study are to demonstrate how the focused waves could represent the extreme waves and the difference of focused waves approach and other wave types to model extreme waves, i.e., irregular waves.

The experimental tank test was carried out with a 1/74 scale model both in irregular and focused wave conditions in Kelvin Hydrodynamics Laboratory at the University of Strathclyde. The irregular waves are designed by using identical wave spectrum with focused waves in the wave tank, and it will be helpful to determine the viability of using different wave types to represent high amplitude waves. The study provides a comparison of the dynamic responses, motion RAOs of the floater between focused waves and irregular waves.

In addition, an in-house CFD code[2][3][4] based on an open-source CFD framework OpenFOAM [5] is adopted to simulate the fluid flow around the Spar-FOWT in a numerical wave tank under regular and focused wave conditions. Firstly, for code validation, the dynamic response of the Spar-FOWT is simulated under regular waves and the results are compared with the existing research [6]. Next, the focused wave with the identical wave spectrum provided by the experimental test is generated in our numerical wave tank without the floating structure. After the validation of the focused wave generation, the wave-structure interaction and the dynamic response of the Spar-FOWT is investigated under the focused wave. The results show good agreement with the tank test which demonstrates the capacity and the fidelity of our CFD tools.

Reference:

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