CFD simulations of the wave energy converter Crestwing

Gergely Kovacs[1], Daniela Leibetseder[2], Rune Pilgaard Bloom[3], Yanlin Shao[1], Jens Honore Walther[1]

[1] Technical University of Denmark, Department of Civil and Mechanical Engineering, Building 403, Anker Engelunds Vej 1, 2800 Kgs. Lyngby, Denmark
[2] TU Wien, Faculty of Mechanical and Industrial Engineering, Institute of Fluid Mechanics and Heat Transfer, E322, Getreidemarkt 9, 1060 Vienna, Austria
[3] Crestwing Ltd., Silovej 8, 9900 Frederikshavn, Denmark

Ocean wave energy has the potential of contributing significantly to the industrial energy production and export, both as a standalone solution by using wave energy converters (WECs) in wave energy parks, and in combination with offshore wind energy. For comparison the power intensity of wind is 0.4-0.6 kW/m2, solar is 0.1-0.2 kW/m2 and wave power intensity is about 2-3 kW/m2 [1, 2].

The wave energy converter Crestwing is an attenuator type of WEC with proven technology originating from the shipbuilding industry [3]. Although both model and full scale tests have demonstrated a high efficiency, many avenues are open for optimizing efficiency and minimizing costs to drive down the levelized cost of electricity. Effective energy harvesting is only conceivable by interpretation of underlying physics and optimization of key parameters of a WEC such as the hull shape. For these goals we use state-of-the-art CFD simulation tools based on fifth-order Stokes wave theory, overset mesh technique and dynamic fluid body interaction. At the conference we will present verification and validation of the CFD model relying on existing model tests and use the CFD results to highlight the key components of the Crestwing WEC [4, 5].

References

[1] H. P. Nguyen, C. M. Wang, Z. Y. Tay, and V. H. Luong. Wave energy converter and large floating platform integration: A review. Ocean Engineering, 213:107768, 2020.

[2] W. Sheng. Wave energy conversion and hydrodynamics modelling technologies: A review. Renewable and Sustainable Energy Reviews, 109:482–498, 2019.

[3] R. Ahamed, K. McKee, and I. Howard. Advancements of wave energy converters based on power take off (PTO) systems: A review. Ocean Engineering, 204:107248, 2020.

[4] H. Mikkelsen, Y. Shao, and J. H. Walter. CFD Verification and Validation of Added Resistance and Seakeeping Response in Regular Oblique Waves with varying wave length. The 9th Conference on Computational Methods in Marine Engineering (Marine 2021), 2021.

[5] DHI and WaveEnergyFyn. Crestwing wave energy converter - 3D wave tank model tests. Technical report, Danish Hydraulic Institute, 2011.