Pegalajar-Jurado, A.; Madsen, F.J.; Sarlak, H.;
Bredmose, H.; Lemmer, F.; Faerron-Guzman, R.;
Borisade, F.; Kretschmer, M.

D4.8 Validation of advanced models and methods for cascading into simpler models

The present deliverable of LIFES50+ focuses on the validation of advanced models developed in work package 4. The deliverable further gives examples of cascading (application) of results from the advanced models into models of lower fidelity. The model validation consists of:

- Validation of the inclusion of floater flexibility in dynamic response calculations in the HAWC2 aero-elastic model. The method's ability to predict response at the natural structural flexibility is demonstrated in a generic setup with a flexible monopile subjected to loads from steep waves.

- Validation of a second-order FAST model for the OO-Star Wind Floater Semi 10MW with full QTF quadratic wave forcing and damping calibration in the modal space. It is demonstrated that a good match can be obtained if a sea-state dependent damping calibration is applied. The second-order forcing of the Newman approximation is found to be generally smaller than the one obtained from full QTF analysis.

- Validation of an OpenFOAM hydrodynamic CFD setup for the OO-Star Wind Floater Semi 10MW. A good agreement is found for a heave decay test. A simplified mooring representation is developed and a further good match for surge motion in a regular wave case is shown.

- Validation of a second-order FAST model for the Nautilus-DTU10 floater with full QTF quadratic wave forcing. A damping approach based on calibrated Morison drag coefficients is utilized and a generally good match is found for pink noise tests. For larger sea states, the combined role of forcing and damping of the Morison drag term is found to prevent a good calibration for all degrees of freedom.

- Validation of an Ansys CFX hydrodynamic CFD setup for the Nautilus-DTU10 floater. Forced heave motion is utilized to compute added mass and damping coefficients. A good match with linear potential flow theory is found for the added mass. Free heave decay is compared to test results and the effect of viscous flow separation is discussed.

- Validation of an OMA (Operational Modal Analysis) based method for damping detection. The method is applied to the ocean basin tests of the Nautilus-DTU10 floater in combination with a QTF-driven second-order hydrodynamic model. The damping levels found by OMA agree well with those based on modal calibration for pink noise tests. Differences are found for the extreme sea states and are discussed in relation to the assumptions associated with OMA theory.

- Validation of a free vortex aerodynamic model against wind tunnel tests of POLIMI for a scaled model of the 10MW DTU reference wind turbine. Detailed comparison of aerodynamic damping from oscillatory tests are presented. It is found that the free vortex approach is generally more accurate than the BEM (Boundary Element Momentum) method.