Physical model tests for floating wind turbines - DTU Orbit (07/04/2019)

Physical model tests for floating wind turbines

Floating offshore wind turbines are relevant at sites where the depth is too large for the installation of a bottom fixed substructure. While 3200 bottom fixed offshore turbines has been installed in Europe (EWEA 2016), only a handful of floating wind turbines exist worldwide and it is still an open question which floater concept is the most economically feasible.

The design of the floaters for the floating turbines relies heavily on numerical modelling. While several coupled models exist, data sets for their validation are scarce. Validation, however, is important since the turbine behaviour is complex due to the combined actions of aero- and hydrodynamic loads, mooring loads and blade pitch control.

The present talk outlines two recent test campaigns with a floating wind turbine in waves and wind. Two floaters were tested, a compact TLP floater designed at DTU (Bredmose et al 2015, Pegalajar-Jurado et al 2016) and the recent Triple Spar design of Stuttgart University (Lemmer et al 2016). Both were built at a model scale of 1:60 along with a 1:60 scale version of the DTU 10MW reference wind turbine with a re-designed rotor, applicable to the low wind speeds of the lab. As a new development, the turbine was modified to enable active blade pitch control for the Triple Spar campaign.

The talk presents the scaling considerations and experimental design. The turbine was tested with rotor and floater ID tests and a range of wave conditions spanning from simple regular waves over focused wave groups to misaligned stochastic sea states. The floater and turbine response to combined wind and wave forcing are shown, with focus on aerodynamic damping from the wind and the effect of the controller. The results and analysis of these experiments for a new floater and with enabled pitch control contributes to a better understanding of the dynamics of floating wind turbines and improved validation of the numerical models.

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