Cross-wind fatigue analysis of a full scale offshore wind turbine in the case of wind–wave misalignment. - DTU Orbit (08/11/2017)

Cross-wind fatigue analysis of a full scale offshore wind turbine in the case of wind–wave misalignment.

Wind–wave misalignment is often necessary to consider during the design of offshore wind turbines due to excitation of side–side vibration and the low aerodynamic damping in that direction. The measurements from a fully instrumented 3.6 MW pitch regulated-variable speed offshore wind turbine were used for the estimation of the side–side fatigue loads at the tower bottom. The joint wind–wave distribution and the distribution of the wind–wave misalignment angles were considered. The side–side fatigue at the tower bottom and the damping from site measurements are presented as function of the misalignment angles. A model of the same wind turbine was set-up and simulations with the aero-hydro-servo-elastic code HAWC2 were performed to investigate the effect of damping on the side–side fatigue. Turbulent wind field, irregular waves and flexible soil are used in the simulations based on site-measurements. The aim of the current study is to examine the sensitivity of the side–side fatigue to the wind–wave misalignment and different values of additional offshore damping in the system. It was found that the additional offshore damping of the physical system may be higher than what is typically used in offshore wind turbine sub-structure design, due to the low sensitivity of the measured side–side fatigue loads to the misalignment angle. Choice of an accurate damping value implemented in the model during the design of the wind turbine sub-structure can lead to material and cost savings.

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