Coupled dynamics of offshore wind turbines

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Description:

Offshore wind turbines are subjected to a number of simultaneous dynamic processes, often mutually influencing. Of these, the damping of the structural response to wave loads by the operating turbine, so called aerodynamic damping, is widely recognized.
This damping will also have a positive effect on sea level loading due to floating ice. Moreover, as the ice failure mode is known to depend on the relative floating velocity, wind induced vibrations can also be thought to affect the ice loading itself.
Complexity of these processes is even enhanced if the combined excitation of fore-aft and side-to-side modes is regarded. Whereas the natural frequencies related to equivalent orthogonal modes of vibration are practically equal, the amount of aerodynamic damping due to an operating turbines differs importantly. Any coupling between the modes may result in severe side-to-side motion due to fore-aft loading.

Goal:

The project aims at providing the offshore wind industry with a model with which the effect of coupled dynamics on the preliminary support structure design can be estimated. The model enables the simultaneous time-dependent loading at sea level and tower top, taking the coupling of the modes of vibration into account. The model also allows for sea level loading due to floating ice, considering the dependency of the load on the relative velocity of the ice.
To reach this end, the mode coupling must be analyzed in detail and proper modelling of the interaction between the wind loaded structure and floating ice must be found.

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