CSM
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Lecture in CSM:

DYNAMICS, LOADS AND CONTROL OF OFFSHORE WIND TURBINES

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ABSTRACT

Offshore wind offers higher wind speeds and lower turbulence intensity compared to onshore wind, resulting in superior energy conversion potential. Offshore wind turbines (OWTs) tend to be larger than their onshore counterparts. This trend towards increased size further enhances the energy capture capacity of OWTs; however, it also introduces more severe vibration-related issues. In the marine environment, the combined effect of wind, waves, gravity and rotor operation induces a coupled vibration of the structural components. For larger OWT systems, the structure tends to be more slender and flexible, with natural frequencies becoming increasingly closer to the energetic excitation frequencies of turbulent wind, wave and 1P loads. These characteristics contribute to more pronounced vibration and high-level fatigue loads, thereby increasing the risk of damage and failure of the system.

This lecture will first focus on a rigorous methodology and a developed in-house tool for integrated nonlinear dynamic modelling and load analysis of OWTs, including both bottom-fixed and floating OWTs. It will then present the analytical quantification of multi-mode aerodynamic damping and aeroelastic stability evaluation of OWTs, which is one of the key aspects of the OWT dynamics. Finally, it will highlight the developments in vibration control/mitigation techniques for the flexible blades, tower and floater of OWTs.