Uncertainty-aware control in floating wind turbines

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Research Overview

Floating offshore wind turbines face complex nonlinear dynamics and uncertainty, making vibration control and maintenance challenging. These issues increase costs and risk, slowing the deployment of reliable renewable energy. We have developed an integrated framework combining nonlinear modelling, uncertainty quantification, and digital twin technologies, enabling predictive control and real-time monitoring to improve reliability and reduce lifecycle costs.

Industry Relevance

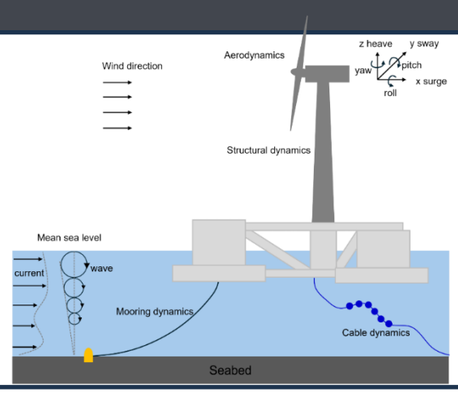
- Real-time digital twins for floating offshore wind turbines (FOWTs) to enable predictive maintenance and operational optimisation.
- Reduced maintenance and downtime through predictive maintenance and improved fatigue life.
- Addresses critical reliability and safety concerns for offshore wind in harsh environments.

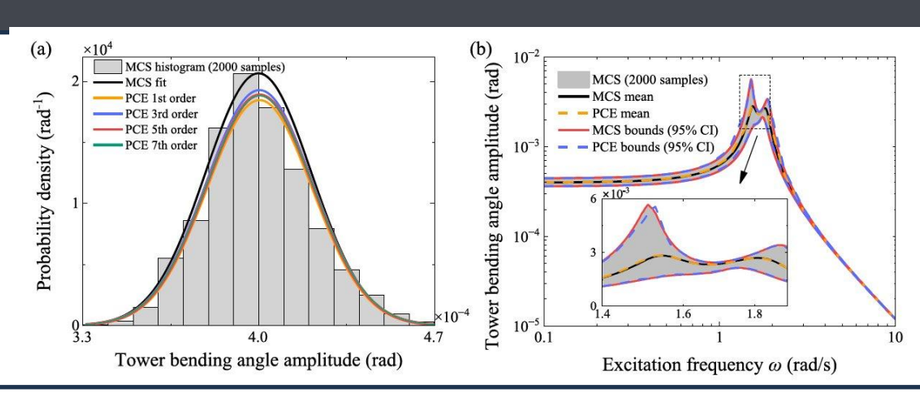
Methods & Technologies

Advanced nonlinear dynamic modelling, uncertainty quantification methods (e.g., polynomial chaos, stochastic collocation), and robust control strategies (H∞ and μ-synthesis) are used. Digital twin technology will integrate physics-based models with machine learning algorithms for real-time monitoring and predictive maintenance.

Innovations

A numerical framework which provides efficient and effective prediction and control on the dynamic response of FOWTs.





Opportunities

Seeking a wind turbine manufacturer to join as an external collaborator. The proposed project focuses on uncertainty quantification and vibration mitigation control for wind energy systems, aligning with EPSRC and Horizon Europe's goals of fostering innovation, sustainability, and industry-academia collaboration.

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