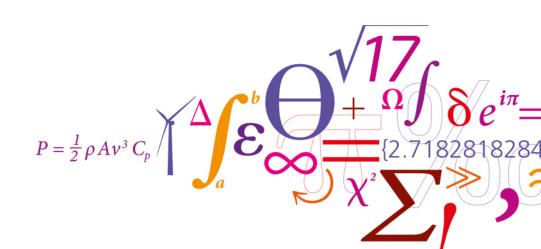


Integrated simulation challenges with the DeepWind floating vertical axis wind turbine concept

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DTU Wind Energy

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Outline

- Context
- Simulation tool
- Design Approach
- Integrated Simulation Challenges
- Future Design Cycles
- Conclusions



Context

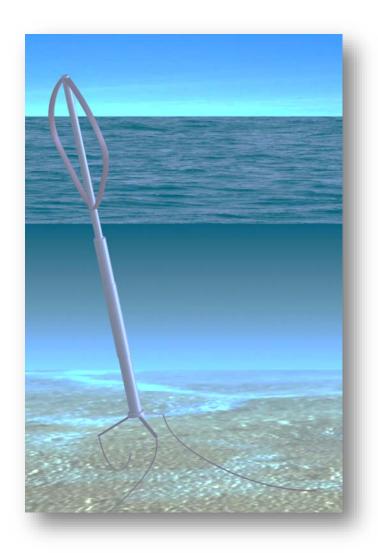
Need to lower the cost of offshore wind energy



Novel Designs

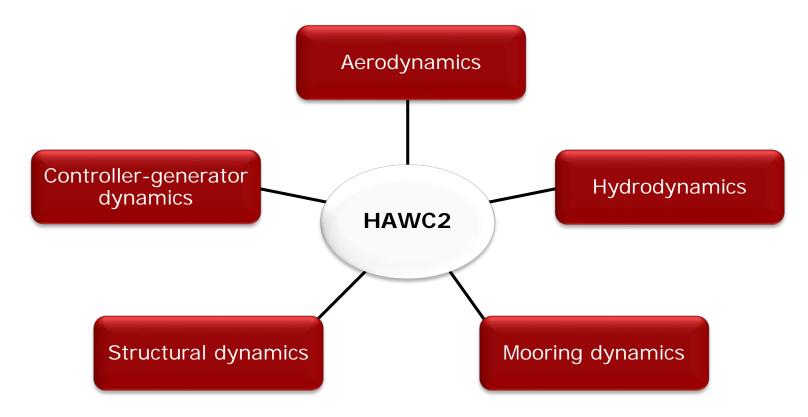


Challenges for current simulation tools



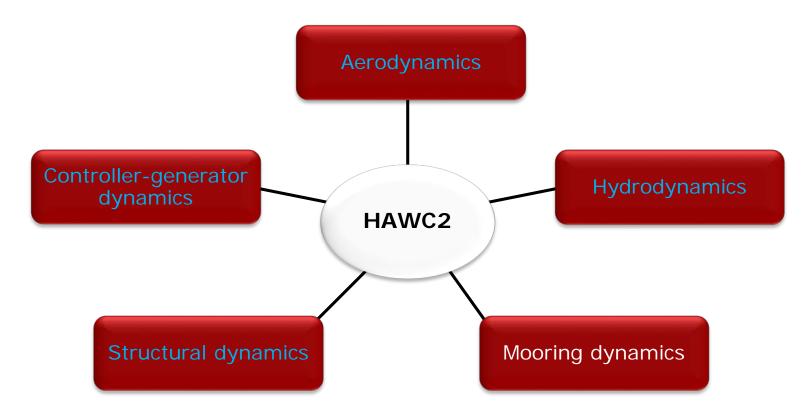


Simulation Tool





Simulation Tool





Design Approach

DeepWind floating vertical axis wind turbine concept

Rotor & tower

Floating support structure & mooring system

Generator & electrical system

Turbine controller



Overview

Simultaneous development of design & design tool

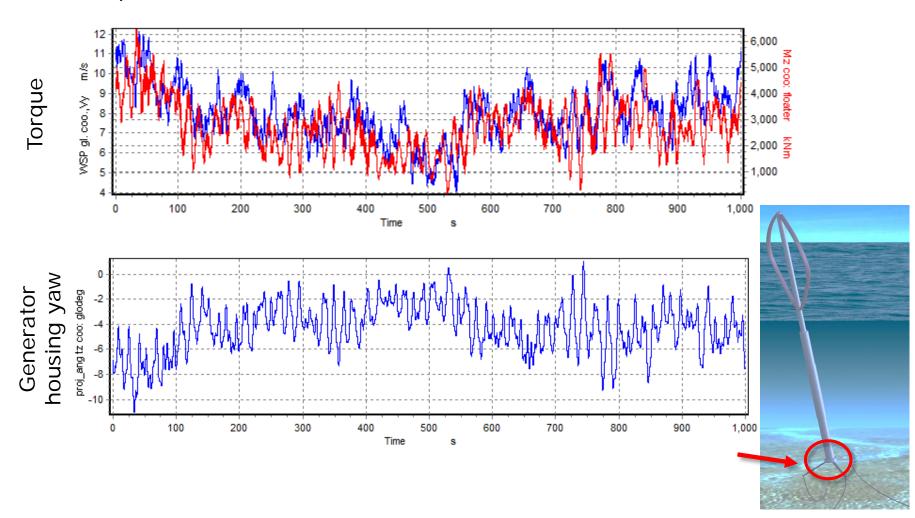
New tool capabilities, design changes, improved reference data

Challenging design environment

Issues with integrated simulation instabilities



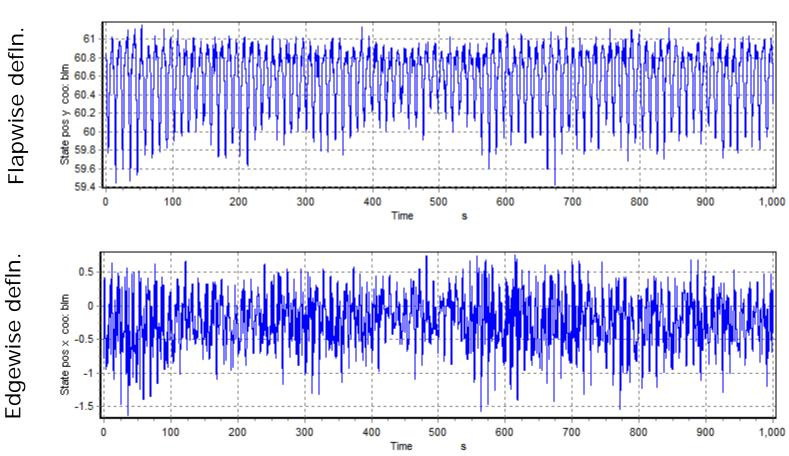
Stable operation -U=8m/s





Stable operation -U=8m/s

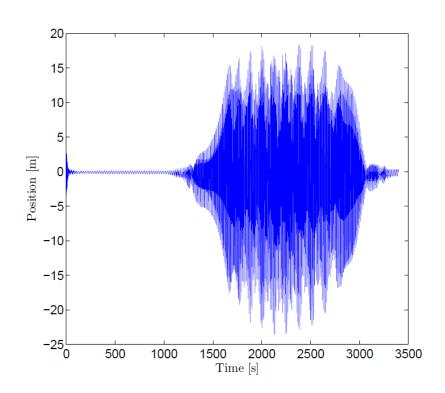


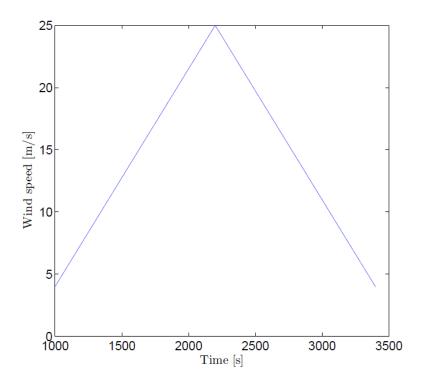




Blade Instabilities

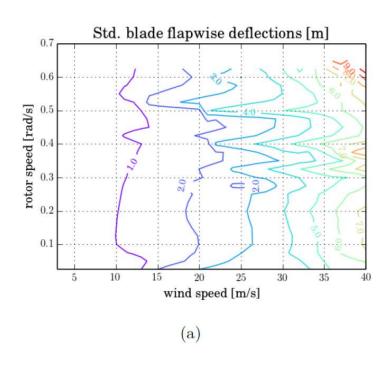
- Very large 2p load fluctuations.
- Stall controlled rotor → low, possibly negative blade edgewise damping

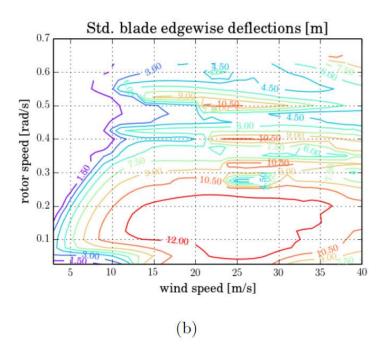






Blade Instabilities

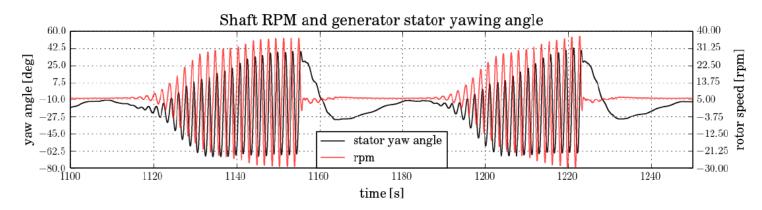


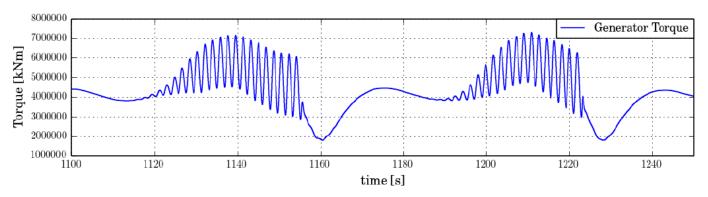




Controller/Drivetrain Instabilities

- Conventional PI controller with gain scheduler
- Simplified aerodynamic load model





Future Design Cycles



Need to increase design iterations within limited timescale

Multi-Discipinary Design, Analysis & Optimization (MDAO)

Integration of design and simulation tools e.g. OpenMDAO, FUSED-wind

Future Design Cycles



Create simplified subsystem models

Use complex model for further optimisation

Integrate simplified models into system model

Single Environment

Stability analysis: Linearize complex model around operating points

Use simplified system model in an optimization context

Translate simplified model into a complex model



Conclusions

- Design tool that integrates all phenomena taking place
- Independent subsystem design approach
- Simulation challenges when integrating subsystems
- Improve future design cycles

Need for efficient integrated simulation tools and MDAO



Acknowledgements

Thank You for Your Attention

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