DTU Wind Energy
Department of Wind Energy

DTU

Development of a FAST model for a floating 10MW wind turbine

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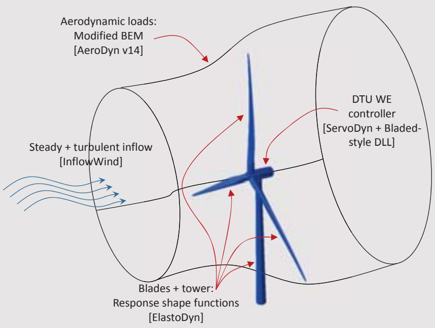
Motivation

The motivation for this work is the *LIFES50+* project [1] that focuses on the qualification of innovative floating substructures for the next generation of 10MW wind turbines. As part of this project there is a need to establish a reference 10MW turbine model for designing floating substructures. The DTU 10MW Reference Wind Turbine [2] was selected for this task by the consortium. A common numerical tool available to all partners, as well as the public, was desired for this reference model, and FAST v8.12 was selected [3].

Control	Variable speed Collective pitch
Cut in wind speed [m/s]	4
Cut out wind speed [m/s]	25
Rated wind speed [m/s]	11.4
Rated power [MW]	10.0
Rotor diameter [m]	178.3
Hub diameter [m]	5.6
Hub height [m]	119.0
Minimum rotor speed [rpm]	6.0
Maximum rotor speed [rpm]	9.6
Hub overhang [m]	7.1
Shaft tilt angle [deg]	5.0
Rotor precone angle [deg]	-2.5
Blade prebend [m]	3.332
Rotor mass [kg]	227,962
Nacelle mass [kg]	446,036
Tower mass [kg]	628,442

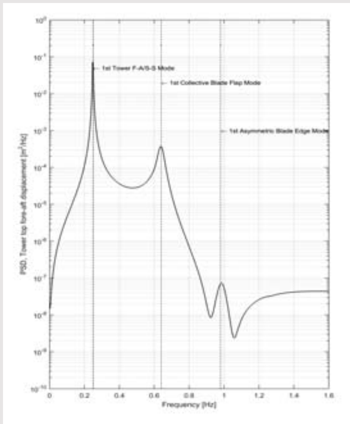
Model Development

Developed ***onshore*** aero-elastic model in FAST v8.12 [3]

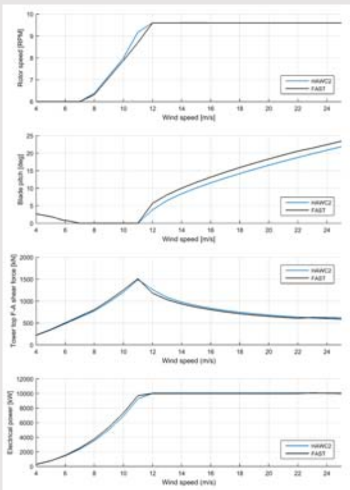


Structural Model

Natural frequencies comparison against HAWC2



Steady State Performance



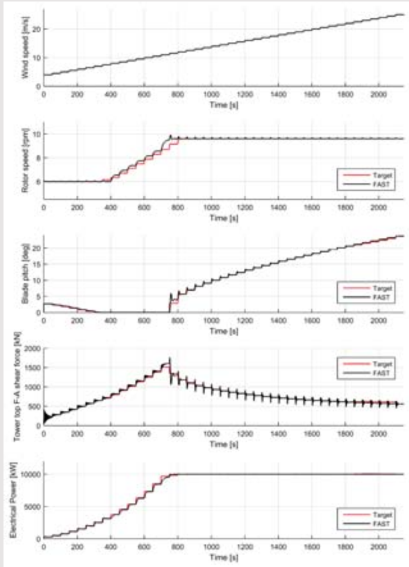
Challenges

Initially the BeamDyn FEM blade structural module within FAST was considered to capture the dynamic response of the large, flexible blades. However the BeamDyn module proved to be too computationally intensive for the purposes of floating substructure optimization, and hence the blade model was reverted back to the modal-based ElastoDyn module. As HAWC2 uses a multibody formulation and a different aerodynamic BEM implementation, there were expected differences in loads predicted by FAST and HAWC2 that were mitigated by the controller adjusting the blade pitch setting.

The FAST model implementation of the DTU 10MW Reference Wind Turbine is publicly available [4].

Scan this QR code for more information:

Controller Performance



Ongoing & Future Work

Developing framework for adapting controller to floating foundations in LIFES50+:

Develop & verify FAST implementation of *onshore* controller against HAWC2

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Establish methodology for adapting controller

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Develop & verify baseline floating wind turbine controller in FAST with generic floater against HAWC2

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Interact with LIFES50+ floating platform concept developers to develop controller tuned to each floating substructure concept

INNWIND.EU Triple Spar floating platform concept [5] as basis for generic controller tuning

References

[1] http://www.lifes50plus.eu
[2] C. Bak, F. Zahle, R. Bitsche, T. Kim, A. Yde, L.C. Henriksen, A. Natarajan, M.H. Hansen (2013). *Description of the DTU 10 MW Reference Wind Turbine,* DTU Wind Energy Report-I-0092, Roskilde, Denmark.
[3] B.J. Jonkman, J.M. Jonkman (2015). *Guide to changes in FAST v8: v8.12.00a-bjj.* National Renewable Energy Laboratory, Golden, Colorado
[4] M. Borg, M. Mirzaei, H. Bredmose (2015). *Wind turbine models for the design,* LIFES50+ Deliverable 1.2, DTU Wind Energy E-101, Lyngby, Denmark.
[5] F. Amann, F. Lemmer (2016). *Design solutions for 10MW floating offshore wind turbines,* INNWIND.EU Deliverable 4.37, University of Stuttgart.

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LIFES50+