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

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Motivation
The motivation for this work is the LIFESSO+ 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].

Model Development
Developed onshore aero-elastic model in FAST v8.12 [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] 178.1
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] 0
Rotor precone angle [deg] 2.5
Blade prebend [m] 3.332
Rotor mass [kg] 227,662
Nacelle mass [kg] 490,036
Tower mass [kg] 628,442

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.

Steady State Performance

Controller Performance

Ongoing & Future Work
Developing framework for adapting controller to floating foundations in LIFESSO+

Develop & verify FAST implementation of onshore controller against HAWC2

Establish methodology for adapting controller

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

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

References

Acknowledgements
The authors would like to acknowledge the assistance of Frank Lemmer (University of Stuttgart) and José Azcona Armendariz (CENER) in providing the design of the INNWIND Triple Spar floating platform, which was developed in the INNWIND.EU project.

The authors also acknowledge that this project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement no 640741.