NTNU Trondheim
Norwegian University of Science and Technology
Department of Marine Technology

MASTER THESIS IN MARINE CYBERNETICS

SPRING 2015

Name of the candidate:	Henrik Paust.
Field of study:	Marine control engineering.
Thesis title (English):	Finite element modeling and structural state estimation of a bottom fixed offshore wind turbine.
Thesis title (Norwegian):	Elementmodellering og strukturell tilstandsestimering av en bunnfast offshore vind turbin.

Background:
In the path to meet the world's growing energy demand, and fight the climate changes due to large emissions of greenhouse gases, new and greener energy alternatives are necessary. One of the proposed solutions to meet these goals is through increased use of wind turbines. Deploying wind farms offshore comes with opportunities of greater and more reliable energy capture, as the wind blows more steadily offshore, and are generally stronger in the afternoon when electricity demand is high. However, because of the remote nature of offshore wind farms, the corresponding cost of operations and maintenance are today high, and constitute about 25% of the total kWh costs over the entire life of a turbine. To decrease the costs for offshore wind turbines, prognosis and health-monitoring systems will become much more necessary. This will enable better maintenance monitoring and planning, as well a deeper understanding of the turbine behavior. Monitoring of structural response can also be of great aid in designing better offshore wind turbine structures, and eventually more sophisticated wind turbine control systems incorporating the structural response.

Work Description:
This thesis will design a low fidelity element model of the 10 MW DTU reference turbine on a monopile substructure. The model will be used for investigating possibilities for implementing real time estimation of the structural response.

Scope of work
- Investigate methods to design a finite element model for an offshore wind turbine.
- Generate a low fidelity finite element (FEM) model of the wind turbine structure in Matlab.
- Implement different realistic loading scenarios for the modeled structure.
- Design two structural state estimators on the modeled wind turbine model.
- Simulate the structural response and compare the performance of the state estimators when subjected to the modeled loading scenarios.
- Document each step in the process.

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The thesis shall be submitted with two printed and electronic copies, to 1) the main supervisor and 2) the external examiner, each copy signed by the candidate. The final revised version of this thesis description must be included. The report must appear in a bound volume or a binder according to the NTNU standard template. Computer code and a PDF version of the report shall be included electronically.

Start date: January 14, 2015 **Due date:** July 28, 2015

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