a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

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MECH 493 project: Modeling and analysis of a scaled floating offshore wind turbine

Background and research goal

Wind is a fastest growing renewable energy source, and has a great potential to generate electricity without impacting the environment and human beings. One of the recent trends in the wind energy industry is to place large wind turbines on floating platforms offshore, far from the coast, in order to receive strong and consistent wind without noise and visual impacts. Experimental validations of efficiency and behaviors of floating wind turbines using a scaled wind turbine will be important before constructing large scale ones.

Vestas wind turbine on a semi-submersible platform

The research goal of this project is to make models for a scaled wind turbine system which we have in UBC Control Engineering Laboratory, in order to simulate and analyze the wind turbine's behavior due to wind and wave, as well as to develop feedback control algorithms to maximize energy efficiency and minimize fatigue loading. We consider to attach a fictitious but realistic semi-submersible platform to this wind turbine. The models will be constructed in various levels of complexities; the most complex one with Solidworks and ANSYS, the medium complex mathematical model with PDEs, and the simple control-oriented mathematical model with ODEs. The developed models will be compared to the actual wind turbine system by experiments. The control-oriented model may be used for feedback controller design purposes.

Tasks to be performed by the student

1. Understand the mechanism of an experimental scaled wind turbine setup which UBC Control Engineering Laboratory has.
2. Augment the scaled wind turbine system with a semi-submersible platform.
3. Make a model (M1) of a scaled turbine with a platform with Solidworks, and simulate the turbine's behavior using ANSYS. Devise animation software to visualize the motion of the platform and the turbine.
4. Make a mathematical model using PDEs (M2) and ODEs (M3).
5. Validate the models (M1, M2, M3) by experiments using the scaled wind turbine (without a platform).
6. If time permits, design feedback controllers using the model M3, for yaw control, blade pitch control, and generator torque control.

Facilities and team:

Control Engineering Laboratory located at ICICS x015
Wind turbine system located in front of the wind tunnel in Rusty Hut
Work closely with Dr. Ryozo Nagamune and his graduate students