a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

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MECH 493 project: Position control of a utility-scale 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. Wind turbines on floating platforms have a capability of changing their locations dynamically, and we can potentially make use of this capability to maximize the total power generation of a wind farm, by adjusting the farm layout in real-time.

Vestas wind turbine on a semi-submersible platform

The research goal of this project is to test fundamental control algorithms for position control of a utility-scale floating offshore wind turbine in simulations. The computer-aided engineering tool FAST, developed at the National Renewable Energy Laboratory in US, is used to obtain a mathematical model of a 5MW wind turbine on a semi-submersible platform, and to simulate its power generation and motion under various wind and wave conditions. In order to achieve a desired positioning of the platform, without losing power capture and without increasing structural loading, yaw angle, generator torque and blade pitch angles are manipulated by PID and other basic controllers, based on various measured signals such as generator speed and platform motion. Animation software visualizing the motion of the platform and the turbine will also be developed.

Tasks to be performed by the student

1. Understand the mechanism of wind turbine control systems on floating platforms.
2. Understand the usage of the computer-aided engineering tool FAST.
3. Design and test PID controllers to maintain the position of the platform against disturbances such as wind gust, random wind and wave.
4. Design and test PID controllers to relocate the platform at specified/desired locations.
5. Design and test controllers other than PID controllers, such as linear quadratic regulators, for disturbance rejection and tracking purposes.
6. Devise animation software to visualize the motion of the platform and the turbine.

Facilities and team:

Control Engineering Laboratory located at ICICS x015
Work closely with Dr. Ryozo Nagamune and Mr. Jeffrey Homer (MASc student)