



## MECH 493 project: Modeling and control 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 the nature. One of the recent research trends in the wind energy field 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. Simulation and experimental validations of efficiency and behaviors of floating wind turbines using a scaled wind turbine will be important before constructing large scale ones.

The research goal of this project is to develop a model 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 devise 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 as a simple control-oriented mathematical model with ordinary differential equations. The developed models will be compared to the actual wind turbine system by experiments. This control-oriented model may be used for feedback controller design purposes, and the designed controllers are experimentally validated.



*Vestas wind turbine on a semi-submersible platform*

### Tasks to be performed by the student

1. Understand the control mechanism of wind turbines and the basic modeling technique.
2. Understand the mechanism of an experimental scaled wind turbine setup which UBC Control Engineering Laboratory has.
3. Augment the scaled wind turbine system with a semi-submersible platform.
4. Make a mathematical control-oriented model using ordinary differential equations.
5. Validate the control-oriented model by experiments using the scaled wind turbine (without a platform).
6. Design feedback controllers using the model, 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