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Control Systems for Load Mitigation and Stabilization of Floating Wind Turbines

The modern wind turbine usually relies on some form of automatic control to ensure safe and optimal operation. The generator torque is constantly adjusted to maintain a desired rotational rate and extract the right amount of power, whilst the blades may pitch to stabilize the turbine in high wind speeds. In some cases, unwanted vibrations are also damped through blade pitching.

To achieve this one relies on the application of control theory. The onboard computer acts in concert with various sensors and actuators to satisfy the control objectives set by the engineer. Central to this is the control algorithm that generates the right outputs for the actuators, based on a history of the inputs.

Floating wind turbines have presented the engineer with a special set of problems, due to their lack of a fixed base. The range of motion made possible by floating operation has proven to be very problematic for simple control algorithms and has underlined the need for more sophisticated approaches.

Most advanced control algorithms are based on a mathematical model of the system to be controlled. This is referred to as model-based control. The aim of this research may be stated in two objectives. (1): To produce an efficient low-order dynamic model of the turbine, capturing all relevant effects with adequate fidelity. (2): Application of the model towards generating better model-based control algorithms.

Control engineering is a vital aspect of present wind-turbine design. Improved control algorithms have the potential to increase the performance and reliability of wind turbines in a very cost effective manner.