Master thesis: *„Wind turbine de-rating strategies for active power control of waked wind farms”*

Background

Future wind farms have to significantly contribute to stabilization of the grid frequency. The wind farm control is challenging due to aerodynamic interactions among the wind turbines through wakes. The main characteristics of a wake are reduced wind speed and increased turbulence; the former diminishes the total power production of the farm, and the latter leads to a high dynamic loading [1].

A model predictive control (MPC) has been developed for power maximisation and active power control (APC) of wind farms, taking the wake effects into account [1]. In this framework, the MPC optimization was formulated with respect to the axial induction factors of individual wind turbines for regulating their powers and loads. However, in practice, wind turbines are regulated using the torque and pitch controllers. De-rating strategies have been studied at the wind turbine level [2] and they are needed to be properly integrated with the wind farm controller for regulating wind farm performance.

Task

The main task of this master thesis is to design and implement of an efficient de-rating strategy at the wind turbine level considering operations in wind farm flows and wakes. In wake conditions, wind turbines traditionally operate in the below-rated region with the classical generator torque to keep the operation around greedy control. The main research question is what would be the best closed-loop control solution using the torque and pitch controller for de-rating at the below-rated region. The controller should be integrated with the existing wind farm controller framework [1] and evaluated using wind farm flow and wake conditions.

Work steps

- Literature review
- Familiarization with simulation environment, i.e., FAST v8
- Proper de-rating strategy for wind farm control
- Closed-loop control design
- Simulation tests

Requirements

- Interest in wind energy control systems, aeroelastic simulation study, and load analysis
- Experience with MATLAB/ Simulink
- Basic knowledge of linear control systems is desirable

Literature

1. Vali, M. Model predictive control framework for power maximisation and active power control with load equalisation of wind farms, PhD thesis, University of Oldenburg, 2019.

2. J. Aho, et al.: A tutorial of wind turbine control for supporting grid frequency through active power control, American Control Conference (ACC), 2012.

Place	University of Oldenburg
Begin	as soon as possible
Duration	6 months
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