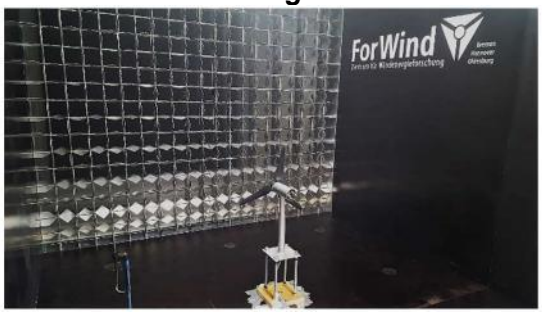
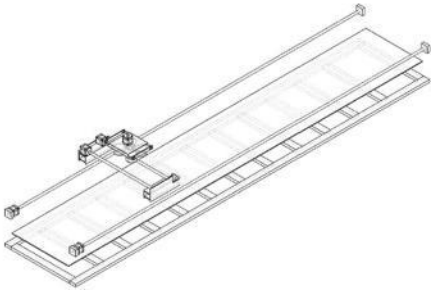
CARL VON OSSIETZKY universität OLDENBURG Wind Energy Systems

ForWind Center for Wind Energy Research Bremen Hannover Oldenburg

MA Thesis Simulating the wind direction in a single row wind farm within a wind tunnel

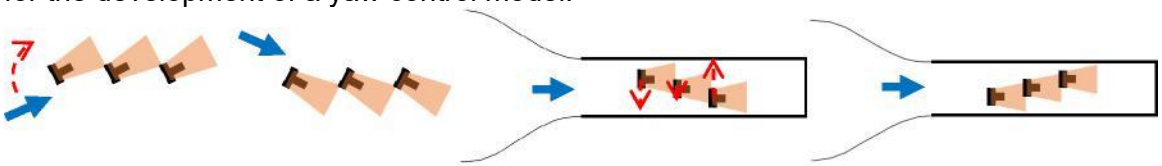




Background

Wind turbines operating in the wake of the upstream turbine experience power losses and an increase in the fatigue loads. Currently, one method to mitigate these effects is to intentionally misalign the upstream turbine and redirect the wake away from the downstream turbine. Windtunnel experiments can aid the process to develop a yaw control algorithm.

MoWiTO 0.6D is an experimental wind turbine model in the ForWind WindLab. The model is used for various experiments to analyse the behaviour of the wake at different inflow conditions and operational conditions. The wind tunnel at ForWind – University of Oldenburg has a 3m (H) x 3m (W) cross-section which can be mounted with an active grid and can be set up with a test section length of up to 30m. Multiple wind turbine models can be used to analyse the power output of a single row wind farm. However, dynamic effects such as the variability of the inflow and control strategies cannot be examined in the current setup. Evaluating control strategies in a controlled environment is crucial for the development of a yaw control model.



Example sketch to simulate the changing wind direction of single row wind farm with three turbines. A change in the wind direction will result in a change of the turbine position in the wind tunnel.

Task

The student will design, develop and construct a setup to mimic the variability of the wind direction in a single row wind farm and to yaw each individual wind turbine. The various wind directions will be simulated by moving each individual turbine over a predetermined domain. Additionally, the student needs to write an accompanying model to operate the movement of the turbine. During this project the student will develop one setup for one turbine. Furthermore, the project includes conducting a wind tunnel campaign to test the setup, assure the stability of the structure and to analyse qualitatively the vibration behaviour of the measurement setup. In addition, the results obtained from the wind tunnel campaign needs to be evaluated and compared with literature.

Work Steps

- Literature of existing methods
- Survey of user expectations
- Design of the measurement setup
- Design model to operate the movement of the turbine
- Conduct a wind tunnel campaign
- Evaluate measurement data - Documentation

Requirements

- Experimental work
- Proficient knowledge in LabVIEW, Matlab and CATIA
- Knowledge in designing and constructing

Place	University of Oldenburg
Begin	Aug 2020
Duration	27 ECTS
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