Leibniz Universität Hannover

ISD INSTITUT FÜR STATIK UND DYNAMIK

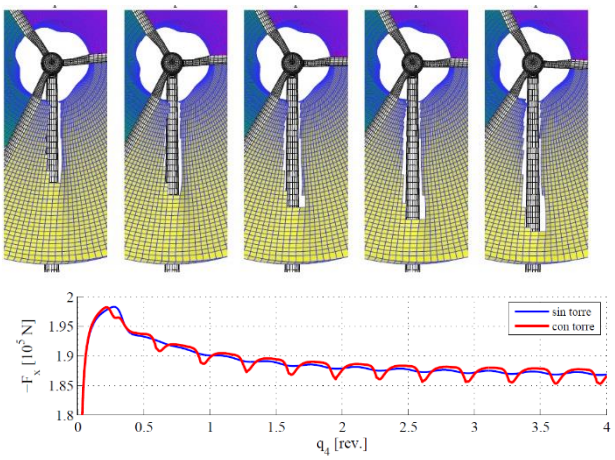
Project work / Master thesis

Extension of a mid-fidelity aeroelastic simulation tool for wind turbines based on UVLM to include the tower influence

Background

Offshore wind energy is a central component of the decarbonisation of our energy system. To utilize the potential of offshore wind turbines, they have been and are still growing in size, soon reaching rated powers in the range of 20 MW and rotor diameters of approx. 400 m. Designing such turbines is only possible using new simulation tools which find a middle ground between the computational efficiency of state-of-the-art simulation tools and the accuracy of complex CFD methods. To this end, at ISD we are developing the in-house simulation tool DeSiO for the coupled aero-hydro-servo-elastic simulation of the nonlinear dynamic behaviour of such large wind turbines.

To compute the aerodynamic forces, DeSiO used a boundary element method, namely the Unsteady Vortex Lattice Method (UVLM) coupled with a FEM model for geometrically exact beams for the structural behaviour.
UVLM is based on potential flow theory and the assumption that only at the trailing edge of the blade vortices are created and shed into the wake.



Influence of tower shadow and splitting of wake in UVLM (Gebhardt, 2012)

One phenomenon occurring in the aeroelastic computation of wind turbines, which is so far not implemented in DeSiO is the tower shadow: when the blades pass the tower during their rotation, the forces on the blades change briefly (see figure). The goal of this work is to include this effect in DeSiO. To do so it is necessary to modify the implantation of the UVLM to allow the wake to split (see figure). Finally, this implementation is to be verified against results from literature.

Tasks

- Familiarize with UVLM
- Familiarize with DeSiO
- Literature research on splitting the wake in UVLM
- Implementation of tower shadow in DeSiO
- Verification of implementation

Your profile

- Interest in modelling and programming
- Knowledge in fluid mechanics advantageous
- Experience in programming advantageous, especially in Fortran, but not required
- Experience with simulation tools advantageous but not required

Contact

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