POST-DOCTORAL POSITION – WIND2SIM Project

Turbulent boundary condition for floating offshore wind turbine simulation: coupling wind tunnel data to aeroelastic codes

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One-year contract:	gross monthly salary starting at 2450€ starting date: September 1st 2020
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Context

Accurately accounting for the upcoming wind coming is of crucial importance when estimating wind turbine performance and fatigue using aeroelastic simulation codes. It has indeed been shown that it is necessary to take into account not only the mean characteristics of the atmospheric boundary layer but also the its turbulent character. In particular, taking into account the presence of coherent structures and their spatio-temporal organization is crucial for predicting unsteady wind loading. While methods for generating turbulent inflow conditions exist in the case of a single wind turbine immersed in the atmospheric boundary layer, there is a clear lack for more complex configurations such as floating turbines operating within a wind farm where a given wind turbine is influenced not only by the atmospheric turbulence but also by that of wake of the upstream wind turbines. The project WIND2SIM, funded by WEAMEC, aims at filling this gap with an innovative approach.

Objectives

The project WIND2SIM aims at developing a new methodology to generate inflow conditions for aerodynamics and aeroelastic codes for floating offshore wind turbines operating in the wake of an upstream wind turbine. Accounting for the correct characteristics of the upcoming wind is crucial for the accuracy of aeroelastic simulations (such as FAST, NREL, USA). Even if current methods have been shown able to generate unsteady inflow conditions representative of the atmospheric boundary layer, there is a clear lack when the upcoming wind is perturbed by one or several wind turbines. Taking into account the flow modification by the presence of the wake is however crucial when studying wind turbine performance operating in farms. To tackle this challenge, the goal of the project WIND2SIM is to interface an aeroelastic code with wind tunnel measurements performed in a cross-section of the wake of a wind turbine scale model (1/500) immersed in an offshore atmospheric boundary layer. Besides measurements, such interfacing strategy will require modeling the temporal dynamics of the flow. Extrapolating - upscaling the generated data onto the simulation grid will also be performed to properly feed the aeroelastic code with the inflow data. All these steps will be data driven, therefore avoiding the need for any specific wake or boundary layer model. By varying the degree of representativity on the generated inflow conditions, the aeroelastic simulations will allow for the identification of the physical processes responsible for excessive load and fatigue of the wind turbine operating in the wake of another. WIND2SIM will be based on the properly scaled offshore boundary layer developed in the DAUC/LHEEA wind tunnel at Centrale Nantes within the FLOATEOLE project. In addition, the experimental setup developed during FLOATEOLE to reproduce and test floating offshore wind turbines at the scale of 1/500 will be used to generate the (fixed or moving) wind turbine wake flow representative of a realistic configuration encountered in wind farms and create the WIND2SIM experimental database.

Work plan

Based on an experimental database acquired in the atmospheric wind tunnel, the applicant will be in charge of

- developing a methodology to model of the temporal dynamics of the flow developing downstream of a floating wind turbine modelling,
- testing spatial extrapolating/interpolating methods to adapt the experimental data onto the mesh of the targeted numerical simulation,
- comparing the performance of the derived method with more classical approaches (such as those available in TurbSim / FAST),
- performing preliminary aeroelastic simulations with FAST using the derived methodology.

Applicant profile, prerequisites.

Phd in Fluid Mechanics, skills in experimental data processing, low-order modelling, data-driven modelling. Knowledge of the wind energy context and challenges are appreciated.