Parameter Tuning of an engineering wake model using real wind farm data

In various applications within the field of wind energy, a computationally efficient method for predicting the time-averaged wind speed in the wake of a wind turbine is of high importance. For this reason, we at LWE are working on the development of analytical wake models (https://doi.org/10.5194/wes-5-237-2020). These models are derived based on conservation equations, but they do depend on tuning parameters as well. The reason for this is that, in addition to how the turbine is operated, ambient wind conditions have a significant influence too.
The aim of this work is to define the tuning parameters of this model as a function of the ambient conditions. For this purpose, a measurement dataset from an existing wind farm will be used. As a first step, a phenomenological understanding of the influence of different ambient conditions on the characteristics of the wake velocity field must be developed. Based on this understanding, algorithms will then be developed that enable parameter tuning. It can be expected that not all ambient conditions can be satisfactorily covered by the existing model. Once these cases have been identified, physic based extensions of the existing model should be developed.
The scope of this work can be adjusted depending on whether it is carried out as part of a semester or masters thesis.

Tasks

1. Literature research on wake models and the influence of atmospheric conditions on the wake shape
2. Get familiar with the database and build routines to work with it
3. Development of tuning algorithms to specify the tuning parameter of the model
4. Identify the limitations of the current formulation and develop model extensions to capture the influence of specific atmospheric conditions

Your profile:

- Interest in wind energy, wind turbine aerodynamics and optimization
- Independent working style
- Good coding skills in Python, preferably experience in handling large datasets

Practicalities:

- Contact: jan.krause@tum.de
- Preferred start date: now