MsC thesis assignment

Triple A models for VAWT aerodynamics

Calculations to determine the load spectrum for vertical axis wind turbines (VAWTs) are very time consuming which is the reason why often so-called engineering models are used for the aerodynamic part in design codes. These engineering models are efficient but they lack physics on e.g. unsteady effects. On the other hand Computational Fluid Dynamic (CFD) tools and free vortex wake methods are used which include much more physics but which cannot be used for the above mentioned purpose in view of the excessive calculation times.

The aim of the TKI project S4VAWT (Semi-Submersible Support Structure for floating Vertical Axis Wind Turbine) is to design a semi-submersible floater for a large vertical axis turbine. For this purpose it is important to take the aerodynamic loading and performance accurately into account.

The proposed thesis project aims to improve the prediction of aerodynamic loads for vertical axis wind turbines using streamtube models. For horizontal axis turbines, streamtube theory can be applied relatively straightforward resulting in the Blade Element Momentum(BEM) method. For VAWTs the upstream cycle will influence the downstream cycle, which is a challenging feature to implement in a streamtube model. Several streamtube models exist to estimate aerodynamic forces, but their capability to predict unsteady loading is limited.

Calculations from lifting line and lifting surface free vortex wake methods and possibly CFD are carried out and the results are analyzed. On basis of these analyses together with physical insights, several approaches will be defined and tested to improve the momentum prediction.

The thesis project is supervised by ECN (Dr. Koen Boorsma).

Requirements:

Knowledge of wind turbine aerodynamic modelling and numerical programming is an advantage.
Moreover a good physical insight is an advantage.
The project needs to be carried out at ECN in Petten. Students which are employed at ECN receive a fee.

Starting date

As soon as possible

Contacts

Marco Caboni: caboni@ecn.nl