Calibration and Validation of the Dynamic Wake Meandering Model for Implementation in an Aeroelastic Code - DTU Orbit (08/11/2019)

Calibration and Validation of the Dynamic Wake Meandering Model for Implementation in an Aeroelastic Code

As the major part of new wind turbines are installed in clusters or wind farms, there is a strong need for reliable and accurate tools for predicting the increased loadings due to wake operation and the associated reduced power production. The dynamic wake meandering (DWM) model has been developed on this background, and the basic physical mechanisms in the wake—i.e., the velocity deficit, the meandering of the deficit, and the added turbulence—are modeled as simply as possible in order to make fast computations. In the present paper, the DWM model is presented in a version suitable for full integration in an aeroelastic model. Calibration and validation of the different parts of the model is carried out by comparisons with actuator disk and actuator line (ACL) computations as well as with inflow measurements on a full-scale 2 MW turbine. It is shown that the load generating part of the increased turbulence in the wake is due almost exclusively to meandering of the velocity deficit, which causes "apparent" turbulence when measuring the flow in a fixed point in the wake. Added turbulence, originating mainly from breakdown of tip vortices and from the shear of the velocity deficit, has only a minor contribution to the total turbulence and with a small length scale in the range of 10–25% of the ambient turbulence length scale. Comparisons of the calibrated DWM model with ACL results for different downstream positions and ambient turbulence levels show good correlation for both wake deficits and turbulence levels. Finally, added turbulence characteristics are compared with correlation results from literature. ©2010 American Society of Mechanical Engineers