Uncertainty quantification in wind farm flow models

This thesis formulates a framework to perform uncertainty quantification within wind energy. This framework has been applied to some of the most common models used to estimate the annual energy production in the planning stages of a wind energy project. Efficient methods to propagate input uncertainties through a model chain are presented and applied to several wind energy related problems such as: annual energy production estimation, wind turbine power curve estimation, wake model calibration and validation, and estimation of lifetime equivalent fatigue loads on a wind turbine. Statistical methods to describe the joint distribution of multiple variables are applied to the description of the wind resources at a given location. A new method to predict the performance of an aeroelastic wind turbine model, and its corresponding uncertainty, is presented. This approach helps understand the uncertainty in the lifetime performance of a wind turbine under realistic inflow conditions. Operational measurements of several large offshore wind farms are used to perform model calibration and validation of several stationary wake models. These results provide a guideline to identify the regions in which a model fails to make accurate predictions, and therefore help guide research and development to focus on areas with the biggest uncertainty to lower costs of energy effectively.

General information
Publication status: Published
Organisations: Department of Wind Energy
Contributors: Murcia Leon, J. P.
Number of pages: 207
Publication date: 2017

Publication information
Publisher: DTU Wind Energy
Original language: English
Electronic versions:
Thesis135.pdf