WindSTAR

Wind-Energy Science, Technology, and Research
Industry/University Cooperative Research Center

Data-driven Reduced Order Model Based on LiDAR Measurements for Predictions of Wind-Farm Annual Energy Production

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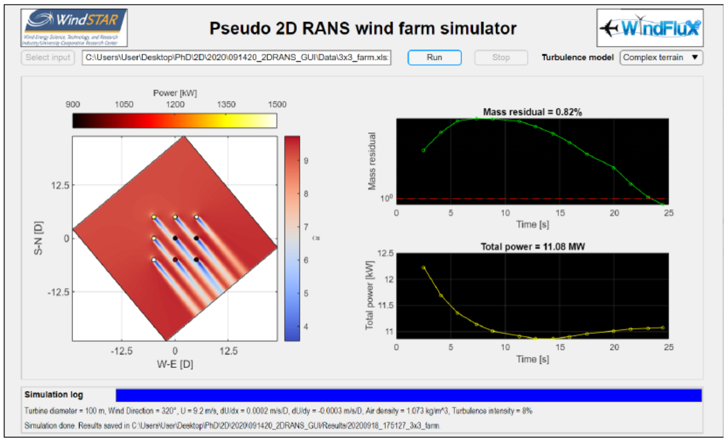
This project aims to develop a CFD tool for accurate predictions of wind turbine wakes and power capture at the turbine level by reproducing the typical variability during the daily cycle of the atmospheric stability and flow distortion due to the complex terrain. This CFD tool is based on the Reynolds-averaged Navier-Stokes (RANS) equations by leveraging rotor-heights averaging, which are solved parabolically to reduce the computational costs. The model has been validated against real wind farm data with a 10-minute time resolution. The latest upgrade of the CFD tool showed an accuracy of 10% with a confidence level of 95% for estimates of power capture from individual turbines. Among different features, the CFD tool provides a data-driven calibration of the turbulence closure to mimic variability in wake recovery due to different regimes of atmospheric stability. Furthermore, the thrust force over the turbine blades is experimentally estimated by coupling LiDAR data and RANS simulations. A GUI for simulations of wind farms with a generic layout and turbine power curve has been delivered to the IAB members.



Snippet of the Pseudo 2D RANS GUI at the end of a simulation of a farm operating during NW wind.

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