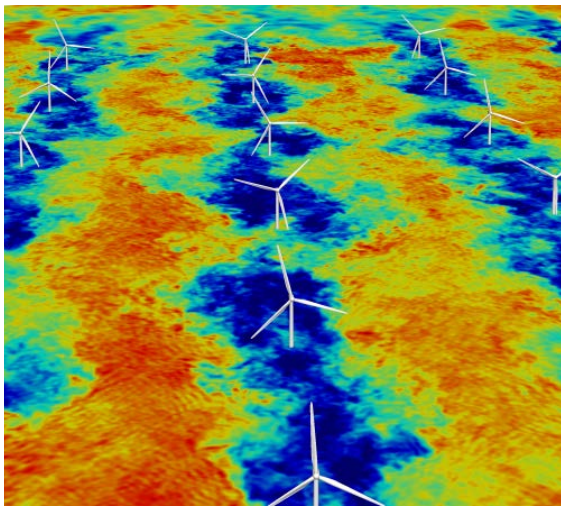
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

NREL Software Models Performance of Wind Plants

Highlights in Research and Development

Simulator fOr Wind Farm Applications helps optimize layouts and controls of wind plant arrays.

In 2014, researchers from the National Renewable Energy Laboratory (NREL) launched the Simulator fOr Wind Farm Applications (SOWFA), a coupled open-source software package and framework that allows users to investigate effects of weather patterns, turbulence, and complex terrain on the performance of wind turbines and plants. SOWFA simulates fluid dynamics on scales from regional weather to turbine wakes, and the impact of these dynamics on turbine structural and system response. SOWFA also features a Super Controller, developed in collaboration with the Delft University of Technology, which lets users simulate coordinated, multiturbine control of wind plants.



A SOWFA simulation of the Lillgrund Wind Farm in Denmark.
Graphic courtesy of Matt Churchfield

Much research has been dedicated to improving the performance of individual turbines, whereas SOWFA helps engineers and developers of both land-based and offshore wind energy technology to improve the performance of an entire wind plant. This software allows scientists to understand the causes of plant underperformance, increase power output, and decrease the effects of structural loads to minimize wear on turbine components. In addition, SOWFA enables turbine manufacturers to study designs before they are manufactured and installed in the field, and wind plant developers to study the performance of turbines on a proposed site before building, reducing the risks of development and deployment. Lowered risks will increase investor confidence, making it easier for developers to obtain lower cost financing.

Through the use of SOWFA in 2014, NREL researchers found that optimizing yaw control and the relative positioning of individual turbines improved the power performance of downstream wind turbines by mitigating the interference that wind turbines in an array have on each other.

Technical Contact: Pat Moriarty, *patrick.moriarty@nrel.gov*

References: Fleming, P., et al. (2013). "SOWFA Super-Controller: A High-Fidelity Tool for Evaluating Wind Plant Control Approaches." Preprint.". Presented at the European Wind Energy Association Conference, Feb. 4-7, 2013. NREL/CP-5000-57175. Golden, CO: National Renewable Energy Laboratory, 12 pp. *http://www.nrel.gov/docs/fy13osti/57175.pdf*

Fleming, P.A. et al. (2014). "Evaluating Techniques for Redirecting Turbine Wakes Using SOWFA." *Renewable Energy*. Vol. 70, pp.211-218. *http://dx.doi.org/10.1016/j.renene.2014.02.015*

Key Research Results

Achievement

NREL researchers have created software capable of modeling the dynamics and performance of entire wind plants.

Key Result

Innovative yaw control and turbine siting strategies were found to increase the performance of downstream wind turbines.

Potential Impact

These optimizations, if verified in the field, would result in increased wind plant efficiency and lower cost of wind energy.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

15013 Denver West Parkway
Golden, CO 80401
303-275-3000 | www.nrel.gov

NREL/FS-5000-63378 | January 2015

NREL prints on paper that contains recycled content.