



Control system to optimize wind turbine farm efficiencies

A method to optimize wind turbine farm efficiencies by minimizing performance loss caused by wind veer.

Technology No. 2021-164

IP Status: Provisional Patent Application Filed; **Application #:** 63/199,871

Applications

- Wind turbines

Key Benefits & Differentiators

- **Maximize efficiency** by choosing turbine rotation directions and yaw biases
- **Regular updates** performed at 5-10 min interval helps increase power generation
- **Scalable:** works with most commercial megawatt-scale horizontal-axis turbines
- **Cost effective retrofitting possible:** attractive payback on existing wind turbines and new installations .
- **Simple, robust and low cost** method to increase performance.

Overview

Wind direction variation with height (wind veer) plays a significant role in the inflow wind field, and therefore, the power performance of wind turbines. Wind veer may present appreciable differences between diurnal and nocturnal periods, leading to veering and backing winds, respectively. Studies suggest that the clockwise-rotating turbines tend to yield substantial power losses in veering winds and small power gains in backing winds. The counterclockwise-rotating turbines follow exactly opposite trends to the clockwise turbine. The findings provide insights into the turbine type selections targeting the maximum profits.

Prof. Jiarong Hong research group at the University of Minnesota has developed a method to minimize wind turbine performance reduction caused by wind veer. First, this method utilizes systems such as nacelle lidar and other sensors to detect the wind directions at different heights. This information is then used to choose the most beneficial rotational direction of the

turbine rotor. In addition, the method includes control updates to set small yaw biases in the turbine yaw controller to maximize efficiency based on wind veer conditions. The strategy can be readily adapted (retrofitted) to most commonly available megawatt-scale horizontal-axis wind turbines to increase the energy generation.

Phase of Development

TRL: 6-7

Researchers have demonstrated an increase in performance of a 2.5 MW turbine at the Eolos Wind Research Station.

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

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Researchers

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References

Gao, Linyue, Bochen Li, and Jiarong Hong, <https://doi.org/10.1063/5.0033826>

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