U.S. Department of Energy
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Wind Energy Program Technology Portfolio

Low Wind Speed Technology Phase II: LIDAR for Turbine Control

QinetiQ, Inc.

Examples of LIDAR scanning options, showing hub-mounted staring scheme and hub-mounted conical scan.

Project Description: Laser anemometry (LIDAR) offers an accurate, reliable method for wind speed measurement from remote locations. Although LIDAR was first demonstrated in the 1970s, widespread deployment of the technology was hampered by its expense and complexity. However, exploitation of recent telecommunications technologies promises large improvements in LIDAR cost, compactness, and reliability. These advances make it feasible to consider the deployment of LIDAR on large wind turbines for the advance detection of fluctuations in the incoming wind field. Potential advantages of this approach include greater energy capture and extended machine lifetime, resulting from mitigation of structural fatigue.

This study encompasses two main objectives. The first is to examine the requirements for a forward-looking LIDAR system, and the second is to characterize the performance of LIDAR when integrated with turbine control systems. In response to the first objective, different LIDAR options were characterized, including trade-offs like output power, transceiver configuration, signal processing, turbine mounting configuration, and scanning options. To address the second objective, the NREL FAST wind turbine aeroelastic model was augmented with a LIDAR simulation module and then run using turbulent inflow. Results indicate that fatigue loads can be significantly reduced under turbulent wind conditions by including LIDAR inflow measurements as a controller input.

Project Type: Conceptual Design Study
Total Project Budget: $112,430
Industry Cost Share: $0
DOE Cost Share: $112,430
Planned Project Duration: March, 2005–November, 2005

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Current Status: Project Completed

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