Researchers use lidar and feedforward algorithms to improve rotor speed regulation and reduce costs of maintenance and operation.

Controlling rotor speed in response to changes in wind conditions is imperative to capturing the maximum amount of energy with minimal structural loading for the least cost. Current technology uses a feedback controller on the turbine to sense wind conditions and make turbine adjustments accordingly. However, there may be a time delay between the controller sensing a wind gust and the mechanical adjustment to the rotor torque response. Researchers from the National Wind Technology Center (NWTC) at the National Renewable Energy Laboratory (NREL) have developed a feedforward controller that is able to regulate turbines by "looking ahead" at incoming wind conditions, which potentially eliminates this delayed control response.

NREL researchers achieved this technology by using lidars, which use lasers to measure wind speed and direction ahead of the wind turbine. These lidars transmit data to a turbine controller, which then controls the wind turbine. The test turbines were the NWTC’s two Controls Advanced Research Turbines (CARTs)—the two-bladed CART2 and the three-bladed CART3—which are the world’s only dedicated turbine controls testing platforms.

Researchers at NREL collaborated with the University of Stuttgart to use a lidar and associated algorithms to measure the velocity of winds before they reach the turbine, a technology called advanced feedforward control. Advanced feedforward control through the lidar’s previewed wind measurement allows the turbines to preemptively adjust their controls, instead of having to wait to react after the wind gust accelerates the rotor.

Field test results of the lidar coupled with advanced algorithms showed improved ability of the turbine controller to regular rotor speed, which will improve performance and allow for the feedback portion of the controller to be focused on load reduction. Loads cause damage that increases maintenance costs and can shorten the life of a turbine. The improvements offered by advanced feedforward control may extend turbine life and reduce energy cost.