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**Novel Diagnostics to Investigate Turbine-Turbine Interactions**[1]

B.J. BALAKUMAR, S. POL, Los Alamos National Laboratory — Strong aerodynamic interactions between upstream wind turbine wakes and downstream turbine blades cause fatigue loads and reduce turbine reliability. The wake structure also mediates the vertical flux of momentum and affects the power output of downstream turbines in turbine arrays. Despite their importance, our current understanding of wake-turbine interactions and wake structure is limited, especially under complex operating conditions such as yawed inflow and dynamic stall. Traditional diagnostics such as sonic anemometers, hotwires, and lidars suffer from interference and accuracy limitations and prove inadequate. At LANL, we have developed a Large Field-of-View Particle Image Velocimeter (LF-PIV) capable of measuring 3 m$\times$1 m (per camera) wake and inflow regions around a 5m-scale turbine. This scalable diagnostic operates in conjunction with a hub-mounted Rotating PIV (R-PIV) diagnostic to observe blade boundary layer and separation while the turbine is in operation. We discuss the diagnostic development challenges, solutions used to overcome these, and the interesting physics that these diagnostics promise to illuminate.

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