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Energetic Turbulence Structures in the Wake of Model Wind Turbines JIAN SHENG, FARAZ MEHDI, Texas Tech University, LEONARDO P. CHAMORRO, University of Illinois at Urbana-Champaign — Wind turbine wakes contain complex and energetic flow structures. Characterizing the near-wake field is critical to assess flow-structure interactions and evaluate asymmetric loadings that trigger premature structural failure. Although the turbulence flow structure in the far-wake region is important in the wind farm design, an integrated characterization of the entire wake flow would provide clearer mechanistic view on other phenomena such wake meandering and unsteady interactions with the blades of downwind turbines. High-speed Particle Image Velocimetry (PIV) is carried out over a model wind turbine in a neutrally stratified boundary layer flow. The measurements are made at consecutive locations ranging from three rotor diameters upstream to twelve rotor diameters downstream of the unit. Vortical structures within the wake including tip, root and hub vortices are identified and followed as they advect downstream. The evolution of these dominant near-wake flow structures are quantified and provide us a better understanding of interactions between turbine wake and boundary layer. The spatial distribution of the mean and fluctuating velocity, as well as energy spectrum and turbulent kinetic budget are also discussed.

Faraz Mehdi
Texas Tech University

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