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Experimental Study on the Effects of Winglets on the Wake of a Model Wind Turbine NICOLAS TOBIN, ALI M. HAMED, LEONARDO P. CHAMORRO, Univ of Illinois - Urbana — Wind tunnel particle image velocimetry was used to investigate the effects of winglets on the wake dynamics of a model wind turbine. The behavior of a turbine with downstream-facing winglets was compared with a turbine without winglets. The turbines were placed in a turbulent boundary layer that reached up to the hub height, allowing for investigation of behavior in both turbulent and uniform flow. The winglets did not significantly change the strength of the tip vortices in the region of uniform incoming flow. The tip vortices in the more turbulent region, however, decayed much faster, diminishing to near-zero within the first $\sim$1.5 rotor diameters, whereas the upper tip vortices persisted potentially up to $\sim$4 rotor diameters. The winglets also increased the power coefficient by 7.5%, while increasing the coefficient of thrust by 10.0%. The higher coefficient of thrust created a region of enhanced mean shear in the outer portion of the wake, leading to increased turbulence statistics in the far wake. The wingletted turbine had a similar wake deficit at 5 rotor diameters as the base turbine did at 1.5 rotor diameters, with potential implications for using wingletted turbines in wind farms.

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