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Effects of Freestream Turbulence on Wind Turbine Wakes[1] ALEXANDER PIQUE, Princeton University, MARK A. MILLER, The Pennsylvania State University, MARCUS HULTMARK, Princeton University — The wake of a model-scale, horizontal-axis wind turbine was investigated at $3\times10^6 < Re_D < 8\times10^6$ with uniform inflow and with varying degree of free stream turbulence. Data was collected in the High Reynolds Number Test Facility (HRTF) at Princeton University, which enables extremely high Reynolds numbers due to its ability to pressurize the working fluid, air, up to 3500psi. Streamwise velocity measurements were obtained using a nano-scale thermal anemometry probe (NSTAP), allowing for a temporal resolution of 200kHz, and spatial resolution of $60\mu m$. Mean and variance profiles were studied at several downstream distances of $0.35 < x/D < 5.1$. These spanwise profiles show the evolution of the turbine's tip vortices as they advect downstream. Freestream turbulence was injected upstream of the turbine using a turbulence generating grid, and the effects of the freestream turbulence on the turbine's wake and performance are investigated.

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