Abstract Submitted
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Horizontal Axis Wind Turbine Experiments at Full-Scale Reynolds Numbers[1] MARK MILLER, Princeton University, JANIK KIEFER, Danish Technical University, TARA NEALON, Princeton University, CARSTEN WESTERGAARD, Texas Technical University, MARCUS HULTMARK, Princeton University — Achieving high Reynolds numbers on a wind turbine model remains a major challenge for experimentalists. Since Reynolds number effects need to be captured accurately, matching this parameter is of great importance. The challenge stems from the large scale ratio between model and full-size, typically on the order of 1:100. Traditional wind tunnels are limited due to finite tunnel size, with velocity as the only free-parameter available for increasing the Reynolds number. Unfortunately, increasing the velocity 100 times is untenable because it violates Mach number matching with the full-scale and results in unfeasible rotation rates. Present work in Princeton Universitys high pressure wind tunnel makes it possible to evaluate the Reynolds number sensitivity with regard to wind turbine aerodynamics. This facility, which uses compressed air as the working fluid, allows for adjustment of the Reynolds number, via the fluid density, independent of the Tip Speed Ratio (TSR) and Mach number. Power and thrust coefficients will be shown as a function of Reynolds number and TSR for a model wind turbine. The Reynolds number range investigated exceeds 10×10^6 based on diameter and free-stream conditions or 3×10^6 based on the tip chord, matching those of the full-scale.

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