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Wind tunnel measurements of wake structure and wind farm power for actuator disk model wind turbines in yaw[1] MICHAEL HOWLAND, Johns Hopkins University, JULIAAN BOSSUYT, KU Leuven, JUSTIN KANG, Johns Hopkins University, JOHAN MEYERS, KU Leuven, CHARLES MENEVEAU, Johns Hopkins University — Reducing wake losses in wind farms by deflecting the wakes through turbine yawing has been shown to be a feasible wind farm control approach. In this work, the deflection and morphology of wakes behind a wind turbine operating in yawed conditions are studied using wind tunnel experiments of a wind turbine modeled as a porous disk in a uniform inflow. First, by measuring velocity distributions at various downstream positions and comparing with prior studies, we confirm that the non-rotating wind turbine model in yaw generates realistic wake deflections. Second, we characterize the wake shape and make observations of what is termed a "curled wake," displaying significant spanwise asymmetry. Through the use of a 100 porous disk micro-wind farm, total wind farm power output is studied for a variety of yaw configurations. Strain gages on the tower of the porous disk models are used to measure the thrust force as a substitute for turbine power. The frequency response of these measurements goes up to the natural frequency of the model and allows studying the spatiotemporal characteristics of the power output under the effects of yawing.

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