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On the wake similarity of a utility-scale wind turbine at different yaw angles[1] ZHAOBIN LI, XIAOLEI YANG, The State Key Laboratory of Nonlinear Mechanics, Institute of Mechanics, Chinese Academy of Sciences — This work is dedicated to systematically studying the influence of yaw angle on the wake characteristics of a 2.5 MW wind turbine under fully developed turbulent inflows. The turbine wake is simulated using large-eddy simulation with actuator surface models for turbine blades and nacelle. Four different yaw angles, i.e. $\gamma = 0^o, 10^o, 20^o, 30^o$, are considered. Two sets of scaling factors, which are functions of thrust coefficient and yaw angle, are derived using the one-dimensional momentum theory. The time-averaged velocity, wake width, and turbine-added turbulence kinetic energy from different yaw angles are found being collapsed with each other when normalized using the proposed scaling factors. The wake meandering characteristics are also examined. It is found that the probability distribution functions (PDF) of instantaneous wake center from different yaw angles are symmetric to the wake centerline, and the normalized wake meandering amplitudes are independent of the yaw angle. These findings suggest the feasibility of modeling wake dynamics at different yaw angles based on the wake data at one yaw angle.

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