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Data-driven RANS for prediction of wind turbine wakes GIACOMO VALERIO IUNGO, UT Dallas, FRANCESCO VIOLA, EPFL, UMBERTO CIRI, UT Dallas, SIMONE CAMARRI, University of Pisa, MARIO A. ROTEA, STEFANO LEONARDI, UT Dallas — Wind turbine wakes are highly turbulent flows resulting from the interaction between the atmospheric boundary layer and wake vorticity structures. Measurement technologies, such as wind LiDARs, are currently available to perform velocity measurements in a set of locations of wakes past utility-scale wind turbines; however, computational methods are still needed to predict wake downstream evolution. In this work, a low-computational cost and accurate algorithm is proposed for prediction of the spatial evolution of wind turbine wakes. Reynolds-averaged Navier Stokes equations (RANS) are formulated in cylindrical coordinates and simplified by using a boundary layer type approximation. Turbulence effects are taken into account with a mixing length model calibrated on the available observations. In this study, observations of wind turbine wakes consist in LES data of wakes produced by a wind turbine operating with different incoming wind and loading conditions. The mixing length calibrated on the LES data is constant in the near wake and only affected by the incoming turbulence, whereas further downstream it increases roughly linearly with the downstream position and with increased slope for increasing rotational speed of the turbine.

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