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Assessment of wake superposition models through wind tunnel tests and LiDAR measurements. STEFANO LETIZIA, LU ZHAN, University of Texas at Dallas, EMMANOUIL NANOS, CARLO BOTTASSO, Technical University of Munich, MARIO A. ROTEA, GIACOMO VALERIO IUNGO, University of Texas at Dallas, TUM TEAM, UTD TEAM — Wake superposition models have been developed for low-computational-cost estimates of the velocity field in the wake generated by a turbine affected by an upstream wake. For this work, data collected through two different experiments have been leveraged to assess accuracy of wake superposition models. The first set of measurements was collected at the BLAST wind tunnel of UT Dallas were two turbine models were tested for isolated operations and under occurrence of wake interactions. The second experiment consists in a LiDAR campaign performed for a wind farm in Colorado to collect velocity measurements in the wake of utility-scale wind turbines. Clustered LiDAR measurements have been analyzed to characterize single-wake evolution and wake velocity fields in presence of wake interactions. This study shows that accuracy of wake superposition models can be not sufficient for wind farm optimization and control studies. Therefore, for the mentioned-applications, more accurate models based on the solution of the Navier-Stokes equations, such as RANS models, are deemed necessary, yet entailing larger computational costs.

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