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COMPUTATIONAL SIMULATION OF WIND TURBINE ROTOR–TOWER–WAKE INTERACTION

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A three-dimensional, full-scale, complex-geometry, time-dependent modeling procedure has been proposed to obtain high-fidelity predictive simulation results for wind turbine aerodynamics under realistic wind conditions [1, 2]. The aerodynamics simulations are performed using the ALE–VMS formulation augmented with weakly enforced essential boundary conditions. The simulations are carried for a wide range of wind conditions and the computational results are in very good agreement with the experimental findings reported in Hand et al. [3]. The predicted time-averaged low-speed shaft torque at different wind speeds is compared with the experimental data. The full-wind-turbine simulation based on the sliding-interface method captures the blade–tower aerodynamic interaction effect, and the result indicated that the blade passing the tower produced an appreciable drop in the aerodynamic torque, creating additional cyclic loading on the rotor and tower, emphasizing the impact of fluid–structure interaction. The effect of the tower on the aerodynamic performance of the downstream wind turbines will also be investigated.

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