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Large Eddy Simulation of wind turbines using the actuator line model and immersed boundary method[1] CHRISTIAN SANTONI, KENNETH CARRASQUILLO-SOLÍS, STEFANO LEONARDI, Univ of Texas, Dallas — Despite the growth of the energy extracted from wind turbines, the flow physics is still not fully understood even under ideal operational conditions. Large Eddy Simulations of the turbulent flow past a wind turbine in a channel have been performed. The numerical setup reproduces the experiment performed in a wind tunnel at the Norwegian University of Science and Technology (NUST). The code is based on a finite difference scheme with a fractional step and Runge-Kutta, which couples the actuator line model (ALM) and the Immersed Boundary Method (IBM). Two simulations were performed, one neglecting the tower and nacelle resulting in the rotating blades only, the other modeling both the rotating blades as well as the tower and nacelle with IBM. Results relative to the simulation with tower and nacelle have a very good agreement with experiments. Profiles of turbulent kinetic energy shows that the effect of the tower and nacelle is not confined to the hub region but extend to the entire rotor. In addition we placed the wind turbine over an undulated topography to understand how it affects the performances and wake of a wind turbine. Comparison with the results obtained for the smooth wall show an interaction between the rough wall and the wake.

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