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Predictive simulation of wind turbine wake interaction with an adaptive lattice Boltzmann method for moving boundaries RALF DEITERDING, University of Southampton - Aerodynamics and Flight Mechanics Group, STEPHEN L. WOOD, University of Tennessee - Knoxville, The Bredesen Center — Operating horizontal axis wind turbines create large-scale turbulent wake structures that affect the power output of downwind turbines considerably. The computational prediction of this phenomenon is challenging as efficient low dissipation schemes are necessary that represent the vorticity production by the moving structures accurately and are able to transport wakes without significant artificial decay over distances of several rotor diameters. We have developed the first version of a parallel adaptive lattice Boltzmann method for large eddy simulation of turbulent weakly compressible flows with embedded moving structures that considers these requirements rather naturally and enables first principle simulations of wake-turbine interaction phenomena at reasonable computational costs. The presentation will describe the employed algorithms and present relevant verification and validation computations. For instance, power and thrust coefficients of a Vestas V27 turbine are predicted within 5% of the manufacturers specifications. Simulations of three Vestas V27-225kW turbines in triangular arrangement analyze the reduction in power production due to upstream wake generation for different inflow conditions.

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