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Improving the accuracy of wind farm LES using filtered actuator disk theory corrections[1] CARL SHAPIRO, DENNICE GAYME, CHARLES MENEVEAU, Johns Hopkins University — The utility of large eddy simulations (LES) of large wind farms that employ the actuator disk model (ADM) are limited by over-prediction of power that can exceed 10% at typical resolutions. Computational restrictions require spatial filtering of the actuator disk thrust force, which is distributed equally across the swept area of the rotor blades, resulting in an under-prediction of the shed vorticity. The filtered ADM, which models the wind turbine wake as concentric semi-infinite vortex cylinders, provides a basis for analytically correcting this error in simulation. When compared to simulations with various filter widths and grid sizes, the filtered ADM accurately predicts the power coefficient measured in simulations. An analytic correction factor is then derived from the filtered ADM that collapses the power coefficient measured in simulations onto the theoretical axial momentum theory predictions. This approach eliminates the need for highly refined numerical grids or empirical correction factors.

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