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An actuator line model simulation with optimal body force projection length scales[1] LUIS MARTINEZ-TOSSAS, Johns Hopkins Univ, MATTHEW J. CHURCHFIELD, National Renewable Energy Laboratory, CHARLES MENEVEAU, Johns Hopkins Univ — In recent work (Martínez-Tossas et al. "Optimal smoothing length scale for actuator line models of wind turbine blades", preprint), an optimal body force projection length-scale for an actuator line model has been obtained. This optimization is based on 2-D aerodynamics and is done by comparing an analytical solution of inviscid linearized flow over a Gaussian body force to the potential flow solution of flow over a Joukowski airfoil. The optimization provides a non-dimensional optimal scale ϵ/c for different Joukowski airfoils, where ϵ is the width of the Gaussian kernel and c is the chord. A Gaussian kernel with different widths in the chord and thickness directions can further reduce the error. The 2-D theory developed is extended by simulating a full scale rotor using the optimal body force projection length scales. Using these values, the tip losses are captured by the LES and thus, no additional explicit tip-loss correction is needed for the actuator line model. The simulation with the optimal values provides excellent agreement with Blade Element Momentum Theory.

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