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Optimal control of wind turbines in a turbulent boundary layer[1]

ALI EMRE YILMAZ, JOHAN MEYERS, KU Leuven, Mechanical Engineering, Celestijnenlaan 300A, B3001 Leuven, Belgium — In recent years, optimal control theory was combined with large-eddy simulations to study the optimal control of wind farms and their interaction with the atmospheric boundary layer [1,2]. The individual turbine's induction factors were dynamically controlled in time with the aim of increasing overall power extraction. In these studies, wind turbines were represented using an actuator disk method. In the current work, we focus on optimal control on a much finer mesh (and a smaller computational domain), representing turbines with an actuator line method. Similar to Refs. [1,2], optimization is performed using a gradient-based method, and gradients are obtained employing an adjoint formulation. Different cases are investigated, that include a single and a double turbine case both with uniform inflow, and with turbulent-boundary-layer inflow. [1] Goit Jay, Meyers Johan (2015). Optimal control of energy extraction in wind-farm boundary layers. Journal of Fluid Mechanics 768, 5-50. [2] Goit Jay, Munters Wim, Meyers Johan (2016). Optimal coordinated control of power extraction in LES of a wind farm with entrance effects. Energies 9 (1), art.nr. 29

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Johan Meyers
KU Leuven, Mechanical Engineering, Celestijnenlaan 300A, B3001 Leuven, Belgium

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