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Optimal coordinated control of energy extraction in LES of wind farms: effect of turbine arrangement patterns[1] JOHAN MEYERS, WIM MUNTERS, JAY GOIT, KU Leuven, Department of Mechanical Engineering —
We investigate optimal control of wind-farm boundary layers, considering the individual wind turbines as flow actuators. By controlling the thrust coefficients of the turbines as function of time, the energy extraction can be dynamically regulated with the aim to optimally influence the flow field and the vertical energy transport. To this end, we use Large-Eddy Simulations (LES) of wind-farm boundary layers in a receding-horizon optimal control framework. Recently, the approach was applied to fully developed wind-farm boundary layers in a 7D by 6D aligned wind-turbine arrangement [1]. For this case, energy extraction increased up to 16%, related to improved wake mixing by slightly anti-correlating the turbine thrust coefficient with the local wind speed at the turbine level. Here we discuss optimal control results for finite wind farms that are characterized by entrance effects and a developing internal boundary layer above the wind farm. Both aligned and staggered arrangement patterns are considered, and a range of different constraints on the controls is included.

[1] Goit JP, Meyers J. 2015 "Optimal control of energy extraction in wind-farm boundary layers," Journal of Fluid Mechanics 768, 5-50.

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