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High-fidelity simulations for wind farm control co-design: evaluation of individual blade pitch control for turbine arrays and utility-scale wind farms[1] FOTIS SOTIROPOULOS, XIAOLEI YANG, Stony Brook University, PETER SEILER, University of Minnesota — With the exponential growth of computer power, high-fidelity simulations are playing an increasingly important role enabling for the first time control co-design of wind farms, which can dramatically increase the annual energy production (AEP) and reduce the levelized cost of energy (LCOE). Individual blade pitch control (IBPC), which can effectively reduce the load fluctuations caused by the non-uniform incoming wind speed, has the potential to significantly reduce the LCOE of wind farms. IBPC, however, has been mostly evaluated for stand-alone individual wind turbines and its promise has yet to be demonstrated for turbine arrays especially at utility scale. We employ herein the VFS-Wind code to carry out large-eddy simulation (LES) with actuator-based parametrizations of turbine blades to explore the potential of IBPC in large wind farms. Two types of cases are investigated computationally: 1) a canonical turbine array with three different spanwise turbine spacings with the downwind turbine spacing fixed at seven rotor diameters; and 2) the XCEL Energy utility-scale wind farm in Pleasant Valley, Minnesota, United States, which consists of 100 wind turbines with generation capacity up to 200MW. Significant fatigue load reduction is observed for all the simulated cases.

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