Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Dynamic wake model with coordinated pitch and torque control of wind farms for power tracking[1] CARL SHAPIRO, Johns Hopkins University, JOHAN MEYERS, KU Leuven, CHARLES MENEVEAU, DENNICE GAYME, Johns Hopkins University — Control of wind farm power production, where wind turbines within a wind farm coordinate to follow a time-varying power set point, is vital for increasing renewable energy participation in the power grid. Previous work developed a one-dimensional convection-diffusion equation describing the advection of the velocity deficit behind each turbine (wake) as well the turbulent mixing of the wake with the surrounding fluid. Proof-of-concept simulations demonstrated that a receding horizon controller built around this time-dependent model can effectively provide power tracking services by modulating the thrust coefficients of individual wind turbines. In this work, we extend this model-based controller to include pitch angle and generator torque control and the first-order dynamics of the drive train. Including these dynamics allows us to investigate control strategies for providing kinetic energy reserves to the grid, i.e. storing kinetic energy from the wind in the rotating mass of the wind turbine rotor for later use.

[1]CS, CM, and DG are supported by NSF (ECCS-1230788, CMMI 1635430, and OISE-1243482, the WINDINSPIRE project). JM is supported by ERC (ActiveWindFarms, 306471). This research was conducted using computational resources at MARCC.

Carl Shapiro
Johns Hopkins University

Date submitted: 31 Jul 2017 Electronic form version 1.4