Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Wind tunnel measurements of the power output variability and unsteady loading in a micro wind farm model[1] JULIAAN BOSSUYT, KU Leuven, MICHAEL HOWLAND, CHARLES MENEVEAU, Johns Hopkins University, JOHAN MEYERS, KU Leuven — To optimize wind farm layouts for a maximum power output and wind turbine lifetime, mean power output measurements in wind tunnel studies are not sufficient. Instead, detailed temporal information about the power output and unsteady loading from every single wind turbine in the wind farm is needed. A very small porous disc model with a realistic thrust coefficient of 0.75 - 0.85, was designed. The model is instrumented with a strain gage, allowing measurements of the thrust force, incoming velocity and power output with a frequency response up to the natural frequency of the model. This is shown by reproducing the -5/3 spectrum from the incoming flow. Thanks to its small size and compact instrumentation, the model allows wind tunnel studies of large wind turbine arrays with detailed temporal information from every wind turbine. Translating to field conditions with a length-scale ratio of 1:3,000 the frequencies studied from the data reach from 10^{-4} Hz up to about 6.10^{-2} Hz. The model's capabilities are demonstrated with a large wind farm measurement consisting of close to 100 instrumented models. A high correlation is found between the power outputs of stream wise aligned wind turbines, which is in good agreement with results from prior LES simulations.

[1]Work supported by ERC (ActiveWindFarms, grant no. 306471) and by NSF (grants CBET-113380 and IIA-1243482, the WINDINSPIRE project).

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Date submitted: 29 Jul 2015 Electronic form version 1.4