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Measuring wind turbine wakes and unsteady loading in a micro wind farm model[1] JULIAAN BOSSUYT, KU Leuven and Johns Hopkins U., CHARLES MENEVEAU, Johns Hopkins University, Baltimore MD 21218, USA, JOHAN MEYERS, KU Leuven, Celestijnenlaan 300A, B3001 Leuven, Belgium —
Very large wind farms, approximating the "infinite" asymptotic limit, are often studied with LES using periodic boundary conditions. In order to create an experimental realization of such large wind-turbine arrays in a wind tunnel experiment including over 100 turbines, a very small-scale turbine model based on a 3cm diameter porous disk is designed. The porous disc matches a realistic thrust coefficient between 0.75-0.85, and the far wake flow characteristics of a rotating wind turbine. As a first step, we characterize the properties of a single model turbine. Hot-wire measurements are performed for uniform inflow conditions with different background turbulence intensity levels. Strain gage measurements are used to measure the mean value and power spectra of the thrust force, power output and wind velocity in front of the turbine. The dynamics of the wind turbine are modeled making it possible to measure force spectra at least up to the natural frequency of the model. This is shown by reproducing the -5/3 spectrum from the incoming flow and the vortex shedding signatures of an upstream obstruction. An array with a large number of these instrumented model turbines is placed in JHU's Corrsin wind tunnel, to study effects of farm layout on total power output and turbine loading.

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