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Power measurements in a scale model wind farm: Results from varying array size, arrangement, spacing, and setpoints DAN HOUCK, EDWIN COWEN, Cornell University — The current trend in wind energy research is to optimize wind farms as opposed to optimizing individual turbines. There is also an emerging idea to consider the wind turbines themselves as actuators that can be used to intentionally and beneficially manipulate the flow to improve the power output of the wind farm. To this end, we completed a series of experiments with an array of 18 model-scale wind turbines in a 2 m wide flume testing changes in the number, arrangement, and spacing of the turbines as well as the setpoint, or power production, of each turbine. Each treatment case is compared to a similar control case that was arranged and operated more conventionally with all turbines attempting maximum power production. A highly accurate torque transducer provides calibrations allowing non-intrusive mechanical power measurements of each turbine. Comparisons are made on the basis of overall power output, array efficiency (total power output of the N-turbine array divided by N of an upstream turbine operating at max power), and power density (power per area). Particle image velocimetry (PIV) further reveals the fluid dynamics at work to create any improvements in power.

Dan Houck
Cornell University

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