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Markovian properties of wind turbine wakes within a 3x3 array
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— Wind turbine arrays have proven to be significant sources of renewable energy. Accurate projections of energy production is difficult to achieve because the wake of a wind turbine is highly intermittent and turbulent. Seeking to further the understanding of the downstream propagation of wind turbine wakes, a stochastic analysis of experimentally obtained turbulent flow data behind a wind turbine was performed. A 3x3 wind turbine array was constructed in the test section of a recirculating wind tunnel where X-wire anemometers were used to collect point velocity statistics. In this work, mathematics of the theory of Markovian processes are applied to obtain a statistical description of longitudinal velocity increments inside the turbine wake using conditional probability density functions. Our results indicate an existence of Markovian properties at scales on the order of the Taylor microscale, λ, which has also been observed and documented in different turbulent flows. This leads to characterization of the multi-point description of the wind turbine wakes using the most recent states of the flow.

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