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Three-dimensional velocity measurements around a rotating vertical axis wind turbine FILIPPO COLETTI, KEVIN RYAN, Stanford University, JOHN DABIRI, California Institute of Technology, JOHN EATON, Stanford University — Vertical axis wind turbines (VAWT) can be more closely spaced than conventional horizontal axis wind turbines (HAWT), which points to a potentially greater power that can be extracted from a given wind farm footprint. In order to optimize the inter-turbine spacing and to investigate the potential for constructive aerodynamic interactions, the complex dynamics of VAWT wakes need to be analyzed. To date, only single-point or at best two-dimensional measurements of such wakes have been documented. We have measured the full three-component mean velocity field around and downstream the scaled-down model of a rotating VAWT by Magnetic Resonance Velocimetry (MRV). The high spatial resolution allows to quantitatively explore the structure of the wake, its interaction with the floor, and its development. The flow is shown to be highly three-dimensional and asymmetric for the whole investigated region (up to 7 diameters downstream of the turbine). These results can inform low-order models to predict the performance of turbine arrays.

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