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Stall behavior of a scaled three-dimensional wind turbine blade
KAREN MULLENERS, Leibniz Universität Hannover, MATTHEW MELIUS, RAUL BAYOAN CAL, Portland State University — The power generation of a wind turbine is influenced by many factors including the unsteady incoming flow characteristics, pitch regulation, and the geometry of the various turbine components. Within the framework of maximizing energy extraction, it is important to understand and tailor the aerodynamics of a wind turbine. In the interest of seeking further understanding into the complex flow over wind turbine blades, a three-dimensional scaled blade model has been designed and manufactured to be dynamically similar to a rotating full-scale NREL 5MW wind turbine blade. A wind tunnel experiment has been carried out in the 2.2m x 1.8m cross-section closed loop wind tunnel at DLR in Göttingen by means of time-resolved stereoscopic PIV. An extensive coherent structure analysis of the time-resolved velocity field over the suction side of the blade was performed to study stall characteristics under a geometrically induced pressure gradient. In particular, the radial extent and propagation of stalled flow regions were characterized for various static angles of attack.

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