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Dynamic stall on an airfoil pitching at very high amplitudes and Reynolds numbers[1] CLAUDIA E. BRUNNER, Princeton University, JANIK KIEFER, MARTIN O. L. HANSEN, Technical University of Denmark, MARCUS HULTMARK, Princeton University — The blades of a vertical axis wind turbine undergo large variations in angle of attack as it rotates around its axis. At low tip speed ratios, the angle of attack can exceed the stall angle of the blade and induce dynamic stall, an unsteady flow phenomenon that leads to significant hysteresis in the lift and drag forces. Accurate predictions of the forces acting on the blades are necessary to predict the performance of the turbine. At moderate Reynolds numbers, dynamic stall on vertical axis wind turbines has been widely studied, but due to the experimental challenges of investigating unsteady flows at high Reynolds numbers, dynamic stall in this regime is less well understood. In the current study, a NACA 0021 airfoil is sinusoidally oscillated at very high amplitudes, such that the stall angle is exceeded and the airfoil experiences dynamic stall with sufficient time to reattach during the downstroke. Reynolds numbers upwards of 10ˆ6 are achieved using a high-pressure wind tunnel, and a range of reduced frequencies are tested. The phase-averaged pressure distribution around the surface of the airfoil provides insight into the forces and moments acting on the airfoil, as well as the time-resolved separation and reattachment behavior.

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