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Dynamic Stall Experiments on a Sinusoidally Pitching Airfoil at High Reynolds Numbers[1] CLAUDIA BRUNNER, Princeton University, JANIK KIEFER, Technical University of Denmark, Princeton University, MARTIN O. L. HANSEN, Technical University of Denmark, MARCUS HULTMARK, Princeton University — The phenomenon of dynamic stall results in a lift overshoot experienced by an airfoil when its angle of attack is rapidly increased beyond the static stall angle. This overshoot is followed by a sudden drop in the lift force, and large hysteresis as the airfoil returns to its initial angle. Dynamic stall is observed in a variety of applications including helicopters and wind turbines, where it produces rapidly fluctuating loads on the blades. It is also seen in many biological systems, but they often use it advantageously. At low and moderate Reynolds numbers and reduced frequencies, this phenomenon has been extensively investigated, but due to the experimental challenges at high Reynolds numbers, only few studies have been conducted in this regime. In the current study, a NACA 0021 airfoil was oscillated sinusoidally around the static stall angle. A highly pressurized, low-velocity, wind tunnel was used to achieve Reynolds numbers up to $5 \cdot 10^6$, based on the chord length, and reduced frequencies up to 0.5. Forces and moments on the airfoil, as well as pressure distributions around its surface were recorded. Effects of Reynolds number, reduced frequency, mean angle of attack, and amplitude on the development of dynamic stall will be presented.

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Claudia Brunner
Princeton University

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