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Dynamic stall experiments on various pitching motion profiles of an airfoil at high Reynolds numbers JANIK KIEFER, Technical University of Denmark, CLAUDIA BRUNNER, MARCUS HULTMARK, Princeton University, MARTIN O. L. HANSEN, Technical University of Denmark — The combination of high Reynolds numbers and unsteady flow conditions depicts a challenge in experimental wind tunnel studies. Unsteady airfoil aerodynamics are commonly described by the reduced frequency k = omega c/2U, where a range of 0 <k <0.25 characterizes steady to highly unsteady flow conditions. The Reynolds number scales proportionally with the flow velocity U, whereas the reduced frequency scales inversely proportional. In regular wind tunnels, this leads to unrealistically high pitching frequencies in experimental attempts to achieve high Reynolds numbers simultaneously with high reduced frequencies. Instead, this study takes advantage of a high-pressure flow facility, in which the density of compressed air promotes high Reynolds numbers, while low velocities below 5 m/s allow for low pitching frequencies and large angle amplitudes. A NACA0021 airfoil was equipped with surface pressure sensors to investigate distributed pressures and integrated forces at Reynolds numbers between one and five million. The present study elucidates the differences of various motion profiles on airfoil performance in comparison to the commonly employed sinusoidal pitching motion in dynamic stall conditions.

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