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Comparison of driven and simulated "free" stall flutter in a wind tunnel[1] ETHAN CULLER, JOHN FARNSWORTH, Univ of Colorado - Boulder, CASEY FAGLEY, JURGEN SEIDEL, United States Air Force Academy — Stall flutter and dynamic stall have received a significant amount of attention over the years. To experimentally study this problem, the body undergoing stall flutter is typically driven at a characteristic, single frequency sinusoid with a prescribed pitching amplitude and mean angle of attack offset. This approach allows for testing with repeatable kinematics, however it effectively decouples the structural motion from the aerodynamic forcing. Recent results suggest that this driven approach could misrepresent the forcing observed in a "free" stall flutter scenario. Specifically, a dynamically pitched rigid NACA 0018 wing section was tested in the wind tunnel under two modes of operation: (1) Cyber-Physical where "free" stall flutter was physically simulated through a custom motor-control system modeling a torsional spring and (2) Direct Motor-Driven Dynamic Pitch at a single frequency sinusoid representative of the cyber-physical motion. The time-resolved pitch angle and moment were directly measured and compared for each case. It was found that small deviations in the pitch angle trajectory between these two operational cases generate significantly different aerodynamic pitching moments on the wing section, with the pitching moments nearly 180^{o} out of phase in some cases.

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