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Transitory Aerodynamic Control of Unsteady Separation[1]
GEORGE T.K. WOO, ARI GLEZER, Georgia Institute of Technology — The dynamics of the controlled three-dimensional attachment of transitory stall over an airfoil oscillating in pitch is investigated in wind tunnel experiments using a partial spanwise array of surface-integrated pulsed jet actuators. The actuation has a characteristic time scale that is an order of magnitude shorter than the convective time scale of the base flow. It is shown that the control authority of the single pulse is highly-dependent on the oscillation cycle phase due to the timed interactions between the actuation jets and the evolution of the dynamic stall vortex on the suction surface. The transitory effects of the actuation can be extended and exploited for significant suppression of the dynamic stall by using successive pulsed actuation strategically staged during the cycle. High-resolution phase-locked PIV measurements in the cross stream plane on the suction surface and in the near wake demonstrate that the pulsed actuation sequence can effectively regulate the accumulation (trapping) and shedding of vorticity. The time-modulation of the vorticity fluxes results in significant temporal changes in circulation, and consequently in the measured time-dependent aerodynamic forces and moments.

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