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Aerodynamic Control of a Pitching Airfoil by Distributed Bleed Actuation[1] JOHN KEARNEY, ARI GLEZER, Georgia Institute of Technology — The aerodynamic forces and moments on a dynamically pitching 2-D airfoil model are controlled in wind tunnel experiments using distributed active bleed. Bleed flow on the suction surface downstream of the leading edge is driven by pressure differences across the airfoil and is regulated by low-power louver actuators. The bleed interacts with cross flows to effect time-dependent variations of the vorticity flux and thereby alters the local flow attachment, resulting in significant changes in pre- and post-stall lift and pitching moment (over 50% increase in baseline post-stall lift). The flow field over the airfoil is measured using high-speed (2000 fps) PIV, resolving the dynamics and characteristic time-scales of production and advection of vorticity concentrations that are associated with transient variations in the aerodynamic forces and moments. In particular, it is shown that the actuation improves the lift hysteresis and pitch stability during the oscillatory pitching by altering the evolution of the dynamic stall vortex and the ensuing flow attachment during the downstroke.

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