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Aerodynamic Control of a Pitching Airfoil using Distributed Active Bleed[1] JOHN KEARNEY, ARI GLEZER, Georgia Institute of Technology — Aero-effected flight control using distributed active bleed driven by pressure differences across lifting surface and regulated by integrated louver actuators is investigated in wind tunnel experiments. The interaction between unsteady bleed and the cross flows alters the apparent aerodynamic shape of the lifting surface by regulating the accumulation and shedding of vorticity concentrations, and consequently the distributions of forces and moments. The present experiments are conducted using a 2-D dynamically-pitching VR-7 airfoil model from pre- to post-stall angles of attack. The effects of leading edge bleed at high angles of attack on the formation and evolution of the dynamic stall vorticity concentrations are investigated at high reduced frequencies ($k > 0.1$) using PIV phase-locked to the airfoil's motion. The time-dependent bleed enables broad-range variation in lift and pitching moment with significant extension of the stall margin. In particular, bleed actuation reduces the extent of "negative damping" or pitching moment instability with minimal lift penalty.

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