Abstract Submitted
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Aerodynamic Control using Distributed Active Bleed[1] JOHN KEARNEY, ARI GLEZER, Georgia Inst of Tech — The global aerodynamic loads on a stationary and pitching airfoil at angles of attack beyond the static and dynamic stall margins, respectively are controlled in wind tunnel experiments using regulated distributed bleed driven by surface pressure differences. High-speed PIV and proper orthogonal decomposition of the vorticity flux on the static airfoil show that the bleed engenders trains of discrete vortices that advect along the surface and are associated with a local instability that is manifested by a time-averaged bifurcation of the vorticity layer near the bleed outlets and alters the vorticity flux over the airfoil and thereby the aerodynamic loads. Active bleed is used on a dynamically pitching airfoil (at reduced frequencies up to k = 0.42) to modulate the evolution of vorticity concentrations during dynamic stall. Time-periodic bleed improved the pitch stability by reducing adverse pitching moment ("negative damping") that can precipitate structural instabilities. At the same time, the maintains the cycle-average loads to within 5% of the base flow levels by segmenting the vorticity layer during upstroke and promoting early flow attachment during downstroke segments of the pitch cycle.

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