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Airfoil Pitch Control Using Trapped Vorticity Concentrations[1]

DANIEL BRZOZOWSKI, JOHN CULP, ARI GLEZER, Georgia Institute of Technology — Closed-loop feedback control of the attitude of a free pitching airfoil is effected without moving control surfaces by alternate actuation of nominally-symmetric trapped vorticity concentrations on the suction and pressure surfaces near the trailing edge. The pitching moment is varied with minimal lift and drag penalties over a broad range of angles of attack when the baseline flow is fully attached. Accumulation (trapping) and regulation of vorticity is managed by integrated hybrid actuators (each comprised of a miniature [O(0.01c)] obstruction and a synthetic jet actuator). In the present work, the model is trimmed using a position feedback loop and a servo motor actuator. Once the model is trimmed, the position feedback loop is opened and the servo motor acts like an inner loop control to alter the model's dynamic characteristics. Position control of the model is achieved using a reference model-based outer loop controller.

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