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Transitory Control of the Aerodynamic Loads on an Airfoil in Dynamic Pitch and Plunge[1] YUEHAN TAN, THOMAS CRITTENDEN, ARI GLEZER, Georgia Inst of Tech — Transitory control and regulation of trapped vorticity concentrations are exploited in wind tunnel experiments for control of the aerodynamic loads on an airfoil moving in time-periodic 2-DOF (pitch and plunge) beyond the dynamic stall margin. Actuation is effected using a spanwise array of integrated miniature chemical (combustion based) high-impulse actuators that are triggered intermittently relative to the airfoil's motion. Each actuation pulse has sufficient control authority to alter the global aerodynamic performance throughout the motion cycle on a characteristic time scale that is an order of magnitude shorter than the airfoil's convective time scale. The effects of the actuation on the aerodynamic characteristics of the airfoil are assessed using time-dependent measurements of the lift force and pitching moment coupled with time-resolved particle image velocimetry that is acquired phased-locked to the motion of the airfoil. It is shown that the aerodynamic loads can be significantly altered using actuation programs based on multiple actuation pulses during the time-periodic pitch/plunge cycle. Superposition of such actuation programs leads to enhancement of cycle lift and pitch stability, and reduced cycle hysteresis and peak pitching moment.

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