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Transitory Control of a Separated Flow[1] GEORGE TAK KWONG WOO, ARI GLEZER, Georgia Institute of Technology — The dynamics of the flow transients associated with controlled attachment and separation over a stalled airfoil are investigated with the objective of enhancing the aerodynamic performance. Transitory response to pulsed actuation on time scales that are an order of magnitude shorter than the characteristic convective time scale is assessed. Actuation is effected by momentary [O(1 msec)] jets generated by an integrated spanwise array of combustion-based actuators. The flow field in the cross stream plane above the airfoil and in its near wake is computed from multiple high-resolution PIV images that are phase-locked to the actuation, and enable continuous tracking of vorticity concentrations. The brief actuation pulse leads to a remarkably strong transitory change in circulation about the entire airfoil that is manifested by severing of the separated vorticity layer and the subsequent shedding of the separated flow vortex. It is shown that the shedding of the severed vortex results in a momentary decrease in circulation which is followed by the formation of a new surface vorticity layer that leads to a longer increase in circulation that can last 5 to 10 convective time scales. The surface vorticity layer ultimately lifts off in a manner that is reminiscent of dynamic stall.

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