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Feedback Flow Control of a Periodically Pitching Airfoil ANDREW LOMBARDI, PATRICK BOWLES, THOMAS CORKE, ERIC MATLIS, University of Notre Dame — A method for detecting incipient flow separation using plasma actuators is presented. The detection scheme relies upon the receptivity of the flow to unsteady disturbances that are introduced by the flow actuator. The receptivity to the unsteady disturbances is heightened as the flow approaches the separation limit, and subsequently can be detected downstream. This is demonstrated on a dynamically pitching airfoil that progresses through a dynamic stall cycle. A plasma actuator is located at the leading edge and pulsed at a frequency that is optimal to re-attach the flow. A pressure sensor monitors the unsteady pressure disturbances on the suction-side of the airfoil. Short-time Fourier analysis is used to capture the time-frequency behavior of the pressure sensor time series. Simultaneous flow visualization using a high-speed camera aid in elucidating the fluid response to the actuator input. The method not only provides a precursor for flow separation, but also an indicator when conditions exist where active re-attachment control is no longer needed. A closed-loop, feedback control scheme based on this is demonstrated.

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