

Abstract Submitted
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Unsteady Aspects of Turbulent Boundary Layer Separation¹

DAVID M. SCHATZMAN, University of Notre Dame, FLINT O. THOMAS, University of Notre Dame — This experimental study is focused on the physics of unsteady turbulent boundary layer separation under conditions relevant to the dynamic stall process that occurs in helicopter rotors. A flat boundary layer development plate allows for the growth of a nominally zero pressure gradient turbulent boundary layer of thickness sufficient for high spatial resolution measurements. Downstream of the flat plate, a convex ramp section imposes a streamwise adverse pressure gradient that gives rise to boundary layer separation. In order to impose an unsteady pressure gradient, an airfoil equipped with leading edge plasma flow control is located above the ramp section. With the airfoil placed at a post-stall angle of attack, the boundary layer on the ramp remains attached but near a state of incipient separation. Plasma flow control is used to alternately attach and separate the airfoil flow which gives rise to unsteady turbulent boundary layer separation on the convex ramp. The resulting unsteady turbulent boundary layer separation is investigated via phase-locked two-component PIV, unsteady surface pressure measurements and high speed digital imaging.

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