Abstract Submitted
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Direct numerical simulation of turbulent boundary layer separation under unsteady pressure gradients[1] WILLIAM BROMBY, DONGHYUN YOU, Department of Mechanical Engineering, Carnegie Mellon University — Direct numerical simulations of attached, separated, and unsteady separated turbulent boundary layers are performed. Blowing-suction velocity distributions are imposed along the upper boundary to introduce adverse pressure gradients to the turbulent boundary layer. A time varying adverse pressure gradient induces unsteady separation of the turbulent boundary layer. Comparing unsteady and steady separated cases demonstrates significant differences in distributions of the average velocity, vorticity, and kinetic energy budget despite similar average wall pressure and skin friction distributions. The behavior of the unsteady separated turbulent boundary layer is described using instantaneous flow visualization, frequency of flow reversal, turbulent kinetic energy budget, vorticity distributions, Reynolds stress events, and auto-correlation of velocity fluctuation in time and space. Complex flow phenomena such as division of the recirculation zone during separation bubble collapse, motion of vortical structures into and over the bubble, and characteristics of detachment point and reattachment point variation in stream and span are revealed.

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William Bromby
Department of Mechanical Engineering, Carnegie Mellon University

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