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Direct numerical simulation of turbulent boundary layers under unsteady pressure gradients[1] WILLIAM BROMBY, DONGHYUN YOU, Carnegie Mellon University — Direct numerical simulations are performed to improve the understanding of unsteady separation processes of turbulent boundary layers characterizing the performance and efficiency of many aerodynamic applications such as helicopter rotor blades, wind turbine blades, pitching and flapping airfoils and wings, and rotating turbomachines. A time varying blowing-suction velocity distribution is imposed along the upper boundary to introduce unsteady adverse pressure gradients to the turbulent boundary layer. The distinct characteristics of turbulent boundary layers under unsteady adverse pressure gradients including unsteady boundary-layer detachment and reattachment, and production and dissipation of turbulent kinetic energy and vorticity, are revealed by a systematic comparison with steady attached/separated turbulent boundary layers.

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William Bromby
Carnegie Mellon University

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