THE WILLIAM E. BOEING DEPARTMENT OF

AERONAUTICS & ASTRONAUTICS

... welcomes ...

DR. RODNEY BOWERSOX

TEXAS A&M UNIVERSITY

Role of Mechanical Non-equilibrium on a Hypersonic Turbulent Boundary Layer

National interest in hypersonic flight provides the motivation for improved understanding of high-speed turbulent shear flows experiencing mechanical and thermochemical non-equilibrium effects. Crosshatch roughness, which occurs naturally in ablative materials, produces significant mechanical non-equilibrium. In this study, we examine the effects of the wave structure created by periodic crosshatch roughness (k+=160) on a Mach 4.9 boundary layer using particle image velocimetry. To help understand this problem, we also examine the role of streamline curvature driven favorable and adverse pressure gradients (FPG and APG) on modifying the turbulence. A smooth flat plate was examined for comparison, where the structure was consistent with the low-speed boundary layer hairpin vortex paradigm. For the FPG case, stabilizing (reduced turbulence) trends were observed, where the underlying structure was altered and the Reynolds shear stress changed sign in the outer half of the boundary layer. Increased transverse-normal and reduced principal strain rates were primary factors. For the APG case, opposite trends were observed. In the rough-wall boundary layer, the Reynolds stresses were higher than for the smooth-wall in the inner half of the boundary layer, and lower in the outer half, where the ejection and entrainment processes were strengthened and weakened in these two respective regions. This trend is traced to back to the turbulence response to the strain rates generated by the local pressure gradients associated with the roughness elements.

WILLIAM E. BOEING
DEPARTMENT OF AERONAUTICS & ASTRONAUTICS
UNIVERSITY of WASHINGTON

Monday, November 28, 2016 @ 4:00pm
Johnson 075, UW Seattle

Visitor RSVP: contact@aa.washington.edu

THE WILLIAM E. BOEING DEPARTMENT OF
AERONAUTICS & ASTRONAUTICS

... Distinguished Guest Speaker ...

DR. RODNEY BOWERSOX
TEXAS A&M UNIVERSITY

Chair & Professor, Aerospace Engineering
Director, TAMU National Aerothermochemistry Laboratory

Dr. Bowersox is the Ford I Professor and Department Head of Aerospace Engineering at Texas A&M University. He has been on the faculty for 12 years. He received his PhD in Aerospace Engineering from Virginia Polytechnic Institute & State University (Va Tech) in 1992. His research interests are in (1) turbulent and transitional flows with mechanical and thermochemical non-equilibrium, (2) advanced experiments methods including high-energy laser based optical diagnostics, and (3) innovative flow control. He founded and directs the Texas A&M University National Aerothermochemistry Laboratory. He is a fellow of the ASME, associate fellow of the AIAA, member of the ACS, APS, and OSA. He is also an Associate Editor for the AIAA Journal of Propulsion and Power.

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