Experimental and Numerical Studies of Roughness-Induced Instabilities in a Mach 3.5 Boundary Layer

ABSTRACT
In this talk, progress on a joint experimental and numerical study of laminar-to-turbulent transition induced by an isolated roughness element in a high-speed laminar boundary layer will be presented. The numerical analysis suggests that transition is driven by the instability of high- and low-speed streaks embedded in the wake of the isolated roughness element. In addition, spatial stability analysis revealed that the wake flow supports multiple modes (even and odd) of convective instabilities that experience strong enough growth to cause transition. The experimental measurements, which included hot-wire and pitot-probe surveys, confirmed the existence of embedded high- and low-speed streaks in the roughness wake. Furthermore, the measurements indicate the presence of both even and odd modes of instability, although their relative magnitude depends on the specifics of the roughness geometry and flow conditions.

BIO
Dr. Kegerise received a Ph.D. in Mechanical Engineering from Syracuse University in 1999. His doctoral research focused on the fluid dynamics and aeroacoustics of flow-induced cavity oscillations. Following the completion of his Ph.D., Dr. Kegerise joined the staff of the Penn State Gas Dynamics Lab as a postdoctoral scholar, and researched advanced sensing technologies for homeland security applications. In 2000, Dr. Kegerise joined the staff of the Flow Physics and Control Branch at NASA Langley Research Center. In that position, he has focused his research on high-speed boundary-layer transition, feedback flow control of complex turbulent flows, and experimental methods.