Applied Flow Diagnostics at Virginia Tech: Enabling Advanced Propulsion and Vehicle Aerodynamics Research

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Time: 9:00 – 10:00 AM
Location: 22 Deike Building
Coffee and donuts will be provided

Abstract: Innovative instruments are needed to address several pressing needs in propulsion and vehicle aerodynamics research. Useful techniques must meet stringent demands, such as exceptional spatiotemporal resolution and data throughput requirements, as well as tolerance to harsh experimental conditions. In the talk, examples of recent developments in applied flow diagnostics which meet these requirements will be presented. For instance, a robust approach to Doppler-based velocimetry capable of planar measurements up to Mach 4 (Fig. 1), with or without flow seeding, offers a new capability for wind tunnels, rigs, and even flight vehicles. New insights on the physics of turbofan engine inlet flows, gained from optical diagnostics measurements, will be highlighted in the talk (Fig. 2). To conclude, opportunities for impact in instrumentation research for propulsion and vehicle aerodynamics will be discussed.

Figure 1. High resolution validation measurements at Mach 4 in the NASA Langley Unitary Plan Wind Tunnel. Left: Probe laser beam between core stage and booster; Right: Processed velocity results for x- (top), y- (middle) and z-direction (bottom) velocity components.
Figure 2. Example visualization of turbofan inlet mean flow development with colors representing secondary flow magnitudes (red large, blue small) and streamlines depicting the direction of local secondary flow.

**Biography:** Prof. Todd Lowe leads a research team focused on the aerodynamics and aeroacoustics of propulsion inlets and exhausts with advanced capabilities in laser-based optical diagnostics. His fundamental contributions have provided insights for understanding turbulence transport and noise in turbulent shear flows, with much recent work focused on the impact of large-scale turbulence on supersonic jet noise. His instrumentation research has resulted in several notable impacts, including fluorescent particle velocimetry for very near wall flow measurement, 250 kHz planar Doppler velocimetry and new interpretations of the particle lag effects on supersonic turbulent boundary layer statistics. He is co-inventor of two US utility patents, with two additional patents pending, and has authored publications in the areas of advanced diagnostics for fluid dynamics, turbulent shear flow and jet noise physics, propulsion and power, and signal processing. He is the Co-Director of the Advanced Propulsion and Power Laboratory at Virginia Tech and currently leads a team of undergraduate and graduate student researchers, a research scientist and a laboratory engineer. Prior to returning to Virginia Tech as a faculty member in late 2010, he was V.P. for Research and Development at AUR, Inc., a small business focused on laser diagnostics research and development.