NASA SBIR 2016 Phase I Solicitation

A1.08 Aeronautics Ground Test and Measurements Technologies

Lead Center: LaRC

Participating Center(s): GRC

NASA's ground-based test facilities, which include low speed, transonic, supersonic, and hypersonic wind tunnels, hypersonic propulsion integration test facilities, air-breathing engine test facilities, and simulation and loads laboratories, play an integral role in the design, development, evaluation, and analysis of advanced aerospace technologies and vehicles. In addition to design databases, these facilities provide critical data and fundamental insight required to understand complex phenomena and support the advancement of computational tools for modeling and simulation. The primary objective of the Aeronautics Ground Test and Measurements Technologies subtopic is to develop innovative tools and technologies that can be applied in NASA's ground-based test facilities to enhance testing and measurement capability and improve utilization and efficiency. For this solicitation, NASA seeks proposals for innovative research and development in the following areas:

- *Force and Moment Balances* - Internal and external balances provide foundational data to evaluate aerodynamic performance and validate numerical solutions. To meet future testing and accuracy requirements, NASA is interested in new innovative balance designs for full- and semi-span test articles that incorporate new sensors, materials, manufacturing techniques, and calibration methods. Systems that are capable of transferring high pressure air and/or power across the balance and operating at high temperatures (up to 350F) are especially desired.
- *Wind Tunnel Calibration and Characterization* - Capabilities for wind tunnel calibration and characterization are critical for overall enhancement of facilities and will play a critical role in achieving the CFD 2030 Vision [1]. Non-intrusive measurement systems offering multi-component velocities, density, and pressure in the tunnel stream upstream and downstream of test articles are required to routinely quantify tunnel inflow and outflow conditions for the purposes of establishing boundary conditions for advanced numerical simulations. These systems should include provisions for combining these data into the regular stream of test data provided by a given facility.
- *Model Attitude and Position Monitoring* - Measurements of wind tunnel model attitude and position (e.g., roll, pitch, yaw angles and spatial coordinates X, Y, Z relative to a defined origin and coordinate system) are critical but are often difficult to make due to packaging constraints, model orientations where gravity based sensors are not applicable, and test configurations that require multiple angle of attack systems. To address some of these limitations, optical, non-intrusive techniques are needed to provide real-time or near real-time measurements of model attitude at high data rates (10 Hz – 8kHz) and with sufficient accuracy (0.005± 0.0025° in pitch 0.025±0.025° in roll and yaw). The setup and calibration time required for these systems should be 4 hours or less to minimize the impact on tunnel operations. Many NASA wind tunnel facilities conduct tests at elevated temperatures (above 700° F) or at extremely low temperatures (-250° F). Displacement measurement components in actuator systems for the setting of hydraulic cylinder positions and other hardware used in test article support and positioning systems must operate routinely in these environments. Innovative designs and hardware solutions are desired to provide accurate and reliable performance at these extreme conditions.

- *Improved Operational Efficiencies and Data Throughput.* - Technologies are needed to significantly increase the amount of data acquired per test point, including simultaneous measurement of multiple flow parameters at high acquisition rates to capture rapidly evolving or oscillatory flow phenomena. Methods that exploit wireless sensor capabilities to reduce instrumentation cabling are of interest, including wireless strain gauge systems and technologies that can be applied for strain measurement on high speed rotating fan/rotor blades. Virtual environments that provide data fusion for real-time comparisons between wind tunnel data and computational results are also desired as well as technologies that integrate knowledge capture, training, and best practices for improved operational efficiencies, especially for activities that occur on an infrequent basis like calibration and characterization.

References:

- [1] - Slotnick, J., et al., “CFD Vision 2030 Study: A Path to Revolutionary Computational Aerosciences”, NASA/CR–2014-218178, March 2014.