NASA SBIR 2017 Phase I Solicitation

A1.08 Aeronautics Ground Test and Measurements Technologies

Lead Center: LaRC

Participating Center(s): GRC

Technology Area: TA15 Aeronautics

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 revolutionize wind tunnel testing and measurement capabilities and improve utilization and efficiency. For this solicitation, NASA seeks proposals for innovative research and development in the following areas:

- *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]. Systems that can provide planar or volumetric measurements of flow quantities such as multi-component velocities, density, and pressure in the airflow upstream and downstream of test articles are required to quantify tunnel inflow and outflow conditions and specify boundary conditions for numerical simulations. NASA envisions using these systems in large test sections (6 feet wide by 6 feet high and larger) and desires the system design to 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 and model orientations where gravity based sensors are not applicable. To address some of these limitations, optical and non-optical techniques are needed to provide real-time or near real-time measurements of model attitude at high data rates of 10 Hz and with sufficient accuracy (0.005± 0.0025 degrees in pitch 0.025±0.025 degrees 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. With regard to position monitoring, many NASA wind tunnel facilities conduct tests at elevated temperatures (above 300°F) or at extremely low temperatures (-250°F). Displacement measurement components used in actuator systems for setting hydraulic cylinder positions and other hardware used in test article support and positioning systems must operate routinely in these extreme environments. Innovative designs for sensors, position measurement and monitoring, and hardware solutions are desired to provide accurate and reliable performance at these extreme conditions.
- *Technologies for Engine Simulators* - The need to assess aerodynamic performance at higher system levels with respect to fuel-burn and noise has created a great demand for propulsion-airframe integration (PAI) testing. Currently, PAI tests can be quite expensive due to issues related to the integration of the

system into the model, reliability, complexity of the calibration, and the high pressure air and/or power which must cross the force and moment balance. NASA seeks innovative propulsion simulation systems that are more compact and capable of accurately simulating the flow, speed, and volume of actual propulsion systems, including approach and landing conditions for the assessment of airframe noise. Hydraulic, pneumatic, electric, or hybrid approaches are solicited.

NASA also seeks innovative measurement systems and techniques for monitoring and evaluating the performance of these propulsion simulation systems. Example measurement systems and techniques include, but are not limited to, simulators that permit the measurement of loads on individual blades for studies involving boundary layer ingestion, force and moment balances capable of transferring high pressure air and/or power across the balance and operating at high temperatures (up to 350°F), and wireless sensor networks that are self-powered, intelligent (e.g., self-organizing, sensor fusion], and capable of performing preprocessing at or near the sensor to reduce bandwidth requirements.

Reference:

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