NASA SBIR 2015 Phase I Solicitation

A1.08 Ground Testing and Measurement Technologies

Lead Center: LaRC

Participating Center(s): GRC

This subtopic supports the experimental modeling and simulation requirements of NASA's Aeronautics Research Mission Directorate, as well as the testing requirements of other government and commercial entities. The subject facilities are managed by the Aeronautics Evaluation and Test Capability (AETC) Project within the NASA Advanced Air Vehicles Program. The primary objective of this subtopic is to develop innovative tools and technologies that enhance testing and measurement capabilities, improve ground test resource utilization and efficiency, and provide capability sustainment. Where possible, the tools and technologies should be applicable for the broad national scope of government, commercial, and university capabilities.

Wind tunnel vehicle design databases have traditionally included the foundational measurements of forces and discrete surface pressures and temperatures. However, designing and testing future vehicles with non-traditional aerodynamic geometries, possibly including highly integrated and distributed propulsion and flow control systems, will require enhanced, remotely sensed global surface measurements that cover a wide range of operational conditions. Enhanced optical systems are required to visualize the flow interactions both on and off the surface. Non-intrusive measurement systems offering multi-component velocities, density, and pressure in the tunnel stream are required to routinely quantify and baseline the test environment and to establish boundary conditions for advanced computational simulations. Non-intrusive measurements of off-body and near-body flow parameters both at a point and globally (i.e., planar or volumetric) are necessary to examine fluid-fluid and fluid-structure interactions for computational solution validation. The development of diagnostics for simultaneous volumetric measurements are particularly desired and will require a concentrated research effort in the development of enhanced laser and imaging techniques (including light field imaging), the development of new optical configurations, and the development of near real-time to real-time acquisition and processing architectures. In particular, development of techniques that significantly increase data capture per test point are needed, including the ability to simultaneously measure multiple flow parameters at high acquisition rates to capture rapidly evolving or oscillatory flow phenomena. Maturation of current particle-based, molecular, and/or surface diagnostics and unification of compatible instruments are desired. In all cases, significant measurement accuracy enhancements are required. Measurement systems must be robust and user-friendly for practical and routine application.

Proposals for clean seeding methods that do not contaminate wind tunnel walls or anti-turbulence screens are solicited. Seedless methods for velocity measurements near a model surface are particularly desired for adverse test environments where seeding contaminants are prohibited, may alter the model surface flow, or possibly damage gas reclamation systems. Two such environments occur at NASA Langley for -250Â°F cryogenic testing at the National Transonic Facility and heavy-gas testing using R134a at the Transonic Dynamics Tunnel.

Proposals are also solicited for shear stress sensors that are applicable to high-temperature/high-flow-rate environments such as those encountered in engine and high-speed testing where surface heating is important.

Small models and/or packaging constraints for large models can make model attitude measurements difficult. Testing in the non-gravity direction precludes use of traditional angle sensors. Many test configurations require multiple angle of attack systems, including redundant systems to guard against in-test failure. Maintaining calibration currency and accuracy of multiple systems significantly increases test costs and complexity. Proposals are solicited for accurate, real-time, optical, non-intrusive techniques for determining model attitude.

The impact of icing on vehicle performance for flight certification is increasingly important. Currently, the NASA Glenn Icing Research Tunnel cannot reproduce the full range of test conditions defined in the FAA Appendix O Supercooled Droplet Icing Conditions. Simulation of Appendix O conditions for freezing rain and drizzle scenarios requires a bimodal droplet distribution with much larger size droplets. These large droplets have an extended cooling period before entering the test section; and, they dont follow the flow, falling toward the test section floor. Innovative ideas and technology advancements are solicited to create and control Appendix O conditions in current facilities.

Many NASA wind tunnel facilities conduct tests at elevated temperatures (400Â°F to 700Â°F) or at extremely low temperatures (-250). Displacement measurement components in actuator systems for the setting of hydraulic cylinder positions and other hardware that is 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.

Additional information about the mission and facility capabilities may be obtained at (http://www.aeronautics.nasa.gov/atp/index.html).

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