NASA SBIR 2020 Phase I Solicitation

A1.08 Aeronautics Ground Test and Measurement Technologies

Lead Center: LaRC

Participating Center(s): ARC, GRC

Technology Area: TA15 Aeronautics

NASA’s aero sciences ground test facilities include wind tunnels, air-breathing engine test facilities and simulation and loads laboratories. They play an integral role in the design, development, evaluation and analysis of advanced aerospace technologies and vehicles. 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 for application in NASA’s aero sciences ground test facilities that can revolutionize testing and measurement capabilities and improve utilization and efficiency. Tools and technologies that can be applied in NASA’s portfolio of large-scale ground test facilities are of primary interest. For this solicitation, NASA seeks proposals for innovative research and development in the following areas:

Non-Intrusive Temperature Measurements of Super-Cooled Water Droplets and Ice Crystals

Non-intrusive ice and super-cooled water particle temperature measurement techniques are sought for NASA’s Icing Test Facilities, the Propulsion Systems Laboratory and the Icing Research Tunnel.

Accurate temperature measurements of individual ice particles and super-cooled water droplets within an icing cloud in NASA icing test facilities is a key capability to enable technologies for the advancement of engine and airframe icing simulation tools. For engine icing facilities, this is important for characterizing the particle cloud entering the engine being tested and understanding the temperature history of the liquid droplets when they transition to ice crystals. For airframe icing, this is important for understanding the thermodynamic state of super-cooled large water droplets at the test section location. Proper validation of experimental simulations and computational models of ice accretion processes requires that the test facility be able to continuously measure and monitor the icing cloud particle/water droplet temperature at multiple locations simultaneously and non-intrusively.

Cryogenic Shear Measurements

Shear stress measurements are needed to validate computational tools that ultimately will be used to support the certification of aerospace vehicles by analysis. Shear stress is an important parameter for characterizing the interaction between a fluid and a surface over which it is moving. Quantitative measurements of shear stress provide information about the surface conditions on a model and help determine the location where features such as flow separation occur. Currently, shear stress is measured at discrete locations using sensors and probes; however, global (2D) measurements are also needed to help determine measurement locations for these sensors a priori and to provide Computational Fluid Dynamics (CFD) code validation data. Robust systems are sought to enable measurements on simple and complex geometries and configurations at both room temperature and cryogenic conditions (down to 80 Kelvin).
Wind Tunnel Characterization

Wind tunnel tests required to enable the CFD2030 Vision and support Certification by Analysis will need to have boundary conditions in the wind tunnel properly measured and documented. NASA is seeking non-intrusive measurement systems that can be installed permanently within NASA’s larger facilities to document the test section inflow and/or outflow conditions. Specific flow parameters of interest include pressure, velocity, temperature, and density. Target facilities include the 11-Foot Wind Tunnel at NASA Ames Research Center, the 9x15 Low-Speed Wind Tunnel at NASA Glenn Research Center and the 14x22 Subsonic Tunnel at NASA Langley Research Center. These facilities feature large test sections with considerable optical access and are highly utilized. Another target facility is the Langley 8-foot High Temperature Tunnel (HTT), a combustion-heated, high-enthalpy supersonic wind tunnel having water vapor and water droplets in the free-stream flow. For this facility, desired measurements include gas temperature, velocity, water vapor concentration, as well as droplet size and the concentration and distributions thereof.

References

https://www.nasa.gov/aeroresearch/programs/aavp/aetc/ground-facilities

https://ntrs.nasa.gov/search.jsp?R=20140003093