A2.08 Experimental Capabilities and Flight Research

Lead Center: AFRC

Participating Center(s): LaRC

Advances to the state of the art in both Experimental Capabilities and Flight Research are needed to support almost every aspect of the Fundamental Aeronautics programs under development in NASA. These tools will be used to generate experimental data for the creation and validation of advanced prediction models, as well as evaluate advanced concepts, both in the laboratory and in suitable facilities (e.g. wind tunnels, flight tests, etc.). New measurement techniques capable of measuring transient phenomena are needed to support acoustic noise model validation and turbulence measurements. Developing sensors capable of measuring environments in harsh environments (e.g. inside engines) are needed to support intelligent engine design. Proposals are sought for new flight testing technologies and capabilities in order facilitate evaluation of concepts at true flight conditions. More specific examples of research in this area are listed below.

Experimental Capabilities
Innovative technologies are sought that will advance current experimental capabilities and develop new measurement techniques to support other areas of Fundamental Aeronautics. These techniques will not only support traditional aeronautical measurements in wind tunnels, but also development of advanced concepts in areas such as structures and materials and propulsion design. Current experimental techniques are highly effective at measuring parameters under highly controlled conditions found in traditional wind tunnels and test chambers. What is necessary to support advanced designs is the ability to make continuous field, time-resolved measurements under conditions which are difficult to control. It is also highly desirable to reduce the setup and calibration effort associated with experimental measurement techniques. Some examples of research interests in this area may include but are not limited to:

- New capabilities for the assessing the properties of advanced lightweight materials under relevant flight loads combining mechanical, thermal, and pressure loads;
- Development and applications of novel high temperature MEMS sensors based on silicon carbide technology;
- Advanced testing techniques to address such phenomena as icing and scaling effects in wind tunnels;
- Development of high temporal resolution optical diagnostics (such as Particle Imaging Velocimetry) capable of operating at frequencies up to 50 kHz;
- Development of advanced videogrammetric systems capable of characterizing the 3D shape of aerodynamic surfaces with high data acquisition rates and increased precision.

Flight Research
The Flight Research area solicits innovative flight research experiments that demonstrate breakthrough vehicle or system concepts, technologies, and operations in the real flight environment. This includes both test techniques and subsystems that will make flight research easier to achieve, as well as innovative vehicle system concepts at low maturity levels. The emphasis of this subtopic is the feasibility, development, and maturation of advanced flight
research experiments that demonstrate advanced or revolutionary methodologies, technologies, and concepts. It seeks advanced flight techniques, operations, and experiments that promise significant leaps in vehicle performance, operation, safety, cost, and capability; and may require a demonstration or validation in an actual flight environment to fully characterize or validate it. Some examples of research interests in this area may include but are not limited to:

- Inflatable aero-structures;
- Innovative control surface-effectors;
- Innovative engine designs for UAVs;
- Noise reduction for Conventional Take-off and Landing/Short Take-off and Landing (CTOL/STOL) aircraft and engines;
- Aerodynamic systems optimization for planetary aircraft;
- Flexible system stability derivative identification;
- Innovative approaches to thermal protection that minimize aerodynamic performance degradation;
- Innovative approaches to structures, stability, control, and aerodynamics integration schemes;
- Innovative approaches to incorporation of UAV operations into commercial airspace.

This subtopic is intended to advance and demonstrate revolutionary concepts and is not intended to support evolutionary steps required in normal product development. Proposals should emphasize the need of flight research on a concept or technology as a necessary means of verifying or proving its worth; emphasis should also be given to multidisciplinary integration of advanced flight systems. The benefit of this effort will ultimately be more efficient aerospace vehicles, increased flight safety (particularly during flight research), and an increased understanding of the complex interactions between the vehicle or technology concept and the flight environment.