NASA SBIR 2008 Phase I Solicitation

A1.07 On-Board Flight Envelope Estimation for Unimpaired and Impaired Aircraft

Lead Center: LaRC

Participating Center(s): ARC

A primary goal of the NASA Aviation Safety Program is to develop technology for safe aircraft operation under different types of anomalies. These may occur in a variety of forms, including failed actuators, failed sensors, damaged surfaces or abrupt changes in aerodynamics or large changes in aerodynamics during upsets. As part of the Aviation Safety Program research, the Integrated Resilient Aircraft Control (IRAC) Project is investigating advanced control system concepts to provide greater aircraft resiliency to adverse events. The goal of the IRAC project is to arrive at a set of validated multidisciplinary aircraft control design tools and techniques for enabling safe flight in the presence of adverse conditions.

Research on advanced technical approaches (such as direct and indirect adaptive control) has focused on accomplishing stability and safe operability in the presence of anomalies. To be able to effectively develop and apply such methods, it is highly desirable, if not essential, to characterize each anomaly and assess the limits of operation of the impaired vehicle, as control application without regard to the vehicle impairment or adverse condition could have significant detrimental consequences. In particular, it would be desirable to characterize and isolate the anomalous condition, and then estimate the level of controllability, limits of maneuverability, and achievable flight envelope of the vehicle. This SBIR subtopic will develop analytical tools and prototype software to assess the ability of the vehicle to accomplish safe operation under specified anomalous conditions. Specific technology areas where contributions are sought include the following:

- Adaptive mathematical framework for control-centric onboard aircraft models that can accommodate real-time changes to subsystem dynamics;
- Real-time system identification capability for updating an onboard vehicle model with an adaptive structure to satisfy sub-system constraints under adverse conditions;
- Real-time fault diagnostic and prognostics capability needed in adaptive flight, propulsion, structural control applications;
- Real-time control power map identification with inclusion of aircraft sub-system constraints under adverse conditions;

- Real-time dynamic flight envelope identification and prediction capability; and
- Metrics and assessment models for safety-of-flight diagnostics and prognostics.