NASA SBIR 2011 Phase I Solicitation

A1.12 Propulsion System Performance Prediction for Integrated Flight and Propulsion Control

Lead Center: GRC

Participating Center(s): LaRC

In current aircraft, the flight and propulsion controls are designed independently and pilots manually integrate them through manipulation of the cockpit controls. Although the pilot manages these individual systems well under normal conditions, an integrated design approach would be able to achieve maximum benefit from these systems under abnormal conditions, especially for energy management and coordinated control for upset prevention and recovery. NextGen operations might also benefit, especially relative to 4-D trajectory management. If properly integrated up front in the flight control design, the propulsion system could be an effective flight control actuator. However, in order to optimally integrate the two systems, the engine performance must be known. The propulsion performance is dependent on operating condition, and many safety constraints make it highly nonlinear. Thus it is necessary to have a system that can continuously predict the engine performance and constraints at the current operating condition and communicate this to the flight control system to facilitate optimal flight and propulsion integration. Ideally, the flight control system should be able to treat the propulsion system as a linear time-varying constrained system for real-time control purposes. Including the propulsion system in the flight control design provides another degree of freedom for the designer, and because the propulsion system is such a powerful actuator, it is one that potentially enhances upset prevention and recovery. Developing the ability to use the propulsion system to augment the flight control while still providing traditional pilot interaction with the cockpit controls can improve maneuverability and safety transparently.

Under this research subtopic, an approach to predicting, and communicating engine dynamic response that facilitates integrated flight and propulsion control would be developed. This is a prerequisite to utilizing the engines as flight control actuators to improve maneuverability and aid in upset prevention and recovery.

Potential NASA resources:

Commercial Modular Aero-Propulsion System Simulation40k (C-MAPSS40k) and Generic Transport Model (GTM).