



NASA SBIR 2009 Phase I Solicitation

A2.07 Flight and Propulsion Control and Dynamics

Lead Center: ARC

Participating Center(s): AFRC, GRC, LaRC

Enabling advanced aircraft configurations for subsonic, supersonic and hypersonic flight, and high performance engines will require advancement in the state-of-the art dynamic modeling and flight/propulsion control. Control methods need to be developed and validated for "optimal" and reliable performance of complex, unsteady, and nonlinear systems with significant modeling uncertainties while ensuring operational flexibility. New dynamic modeling and simulation techniques need to be developed to investigate dynamic performance issues and support development of control strategies for innovative aircraft configurations and propulsion systems. Technology needs specific to different flight regimes are summarized in the following:

Subsonic Fixed Wing Aircraft

Technologies of interest include: flying qualities design guidelines for civil transport aircraft and methods for evaluating the flying qualities of concept transport aircraft, including blended-wing-body and cruise efficient short takeoff and landing aircraft; active control techniques for subsystems within current and advanced engines that lead to improvements in propulsion system efficiency; definition of actuation requirements and characterization of transient behavior of flow control for active aerodynamic shaping; development of a modular, distributed control system architecture for unified propulsion/airframe control; toolset capable of assessing the controllability for a given control effector layout and determining the sizes of conventional control surfaces, horizontal tail and vertical tail necessary to meet control power requirements; novel control techniques for reducing system noise, emissions and fuel burn.

Supersonic Flight

Technologies of interest include: methods for developing integrated aeroservoelastic (ASE) models, including propulsion effects, suitable for simulation and control design; novel control design methods for integrated aero-propulsion-servo-elastic control leading to acceptable flying qualities over the operating flight envelope; novel, and feasible, takeoff and approach to landing procedures to accommodate the visibility challenges due to long forebodies; integrated inlet/engine control to ensure safe (no inlet unstart or compressor surge/stall) and efficient operation.

Hypersonic Flight

Technologies of interest include: system dynamic models pertaining to a dual-mode combustor based propulsion system (RAM/SCRAM) incorporating the essential coupled dynamic elements with varying fidelity for control design, analysis, and evaluation; methods for characterizing uncertainty in the dynamic models to enable control robustness evaluation; methods for dynamic modeling of hypersonic flow fields, both for external aerodynamics and internal flowpaths, and of heat release in scramjet flowpaths with appropriate fidelity for use in dynamic analysis and control design; hierarchical GNC (Guidance, Navigation and Control) architectures and energy management techniques to enable trajectory shaping and control over a wide operating envelope with integrated flight/propulsion control.

Proposals on other flight and propulsion control and dynamic technologies will also be considered as resources and priorities allow, but the primary emphasis of the solicitation will be on the technical areas identified above.