



## NASA SBIR 2008 Phase I Solicitation

### A2.07 Flight and Propulsion Control and Dynamics

Lead Center: GRC

Participating Center(s): AFRC, ARC, LaRC

Enabling advanced aircraft configurations for subsonic, supersonic and hypersonic flight, and high performance "Intelligent Engines" will require advancement in the state-of-the art dynamic modeling and flight/propulsion control. The need to minimize the carbon footprint will necessitate new trajectory planning and control concepts. 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, enabling unique concepts of operations with novel configurations, lower emissions and noise, and safe operation over a wide operating envelope. 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 with enhanced control effectors and propulsion systems. Control objectives include feasible and realistic boundary layer and laminar flow control, aeroelastic maneuver performance, and load control including smart actuation and active aerostructural concepts, active control of propulsion system components, and drag minimization for high efficiency and range performance. Technology needs specific to different flight regimes are summarized in the following:

#### **Subsonic Fixed Wing Aircraft**

Technologies of interest, with application to both flight and propulsion control, include: methods for development of dynamic models and simulations of the integrated component/control system being considered; defining actuation requirements for novel control approaches and developing prototype actuators for flight-like environments; developing and applying innovative control methods and validating them through laboratory test, vehicle simulations and sub-scale flight test as appropriate. Technologies related to the development and integration of modular, open-system control elements leading to the transition to distributed control architecture in the engine environment are of special interest.

#### **Supersonic Flight**

Technologies of interest include: methods for developing integrated dynamic models and simulation including propulsion and aeroelastic effects and suitable for 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 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; hierarchical GNC (Guidance, Navigation and Control) architectures and energy management techniques to enable trajectory shaping and control over a wide operating

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envelope with integrated flight/propulsion control; adaptive and robust control methods that can handle large modeling uncertainties; simulation test beds for evaluating hypersonic concept vehicle control under various types of uncertainty, system wide coupling and associated model misspecification.

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