NASA SBIR 2009 Phase I Solicitation

A2.09 Rotorcraft

Lead Center: ARC

Participating Center(s): GRC, LaRC

The challenge of the Subsonic Rotary Wing thrust of the NASA Fundamental Aeronautics Program is to develop validated physics-based multidisciplinary design-analysis-optimization tools for rotorcraft, integrated with technology development, enabling rotorcraft with advanced capabilities to fly as designed for any mission. Technologies of particular interest are as follows:

Propulsion-Variable Speed Drive Systems/Transmissions

Technologies, and predictive capability, related to enabling concepts and techniques for variable speed drive systems/transmissions suitable for large rotorcraft application are encouraged. Specifically this would include concepts for controlling and enabling variable speed drives as well as lightweight and reliable drive system components. Efficient drive-system speed-variability on the order of 30-50% should be the focus of the proposed technologies and analysis tools.

Experimental Capabilities: Instrumentation and Techniques for Rotor Blade Measurements

Instrumentation and measurement techniques are encouraged for assessing scale rotor blade boundary layer state (e.g., laminar, transition, turbulent flow) in simulated hover and forward flight conditions, measurement systems for large-field rotor wake assessment, fast-response pressure sensitive paints applicable to blade surfaces, and methods to measure the rotor tip path plane angle of attack, lateral and longitude flapping, and shaft angle in flight and in the wind tunnel. Very low airspeed measurement systems for flight vehicles.

Acoustics: Interior and Exterior Rotorcraft Noise Generation, Propagation and Control

Topics of interest include, but are not limited to, external noise prediction methods for manned and unmanned rotorcraft, improved acoustic propagation models, psychoacoustics analysis of rotorcraft noise, interior noise prediction methods and active/passive noise control applications for rotorcraft including engine and transmission noise reduction, advanced acoustic measurement systems for flight and wind tunnel applications, acoustic data acquisition/reduction/analysis, rotor noise reduction techniques, noise abatement flight operations. Methods, devices, concepts for rotorcraft, or specifically wing, airflow control for steep noise abatement approach operations and hover (low speed) download relief. Rotor noise including broadband, harmonic, blade-vortex interaction, and

high-speed impulsive noise, as well as rotor/tail rotor and rotor/rotor interactional noise, are of interest. Frequency range includes not only audible range, but very low frequency rotational noise (blade-passage frequency below 20 Hz) as well. Optimized active/passive concepts and noise tailoring, including rotorcraft designs that are inherently designed for lower noise as a constraint.

Rotorcraft Diagnostics

Health management of rotorcraft power trains is critical. Predictive, condition-based maintenance improves safety, decreases maintenance costs, and increases system availability. Topics of interest include algorithm development and tools to detect and predict the health and usage of rotorcraft dynamic mechanical systems in the engine and drive system. Automatic rotor imbalance detection and rotor smoothing is also of interest. Additionally, rotorcraft health management technologies can include, but are not limited, tools to: increase fault detection coverage and decrease false alarm rates; detect onset of failure, isolate damage, and assess damage severity; predict remaining useful life and maintenance actions required; integration of health monitoring information with maintenance processes and procedures; data management and automated techniques to acquire/process diagnostic information; system models, material failure models and correlation of failure under bench fatigue, seeded fault test and fielded data; data collection/management for analysis of operational data; in-flight pilot cueing and warning of impending catastrophic events.

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