



NASA SBIR 2009 Phase I Solicitation

A1.12 Prognosis of Aircraft Anomalies

Lead Center: ARC

Participating Center(s): AFRC, GRC, LaRC

The ability to accurately and precisely predict the remaining useful life (RUL) of aircraft components and subsystems enables decision making and action taking that can avert or mitigate failures, thereby enhancing aircraft safety. Furthermore, it can improve operational efficiency by facilitating condition-based maintenance and reducing unscheduled maintenance. This effort here addresses the development of innovative methods, technologies, and tools for the prognosis of aircraft faults and failures. The assessment of the RUL could be used by other aircraft systems to place additional restrictions, such as a new operating envelope, on the flight control systems or it could be used by flight or maintenance personnel to take preventative actions. Areas of interest include developing methods for making predictions of RUL which take into account operational and environmental uncertainties (pure data-driven approaches are discouraged); physics-based models of degradation; generation of aging and degradation datasets on relevant components or subsystems; and development of validation and verification methodologies for prognostics.

Research should be conducted to demonstrate technical feasibility during Phase 1 and to show a path toward a Phase 2 technology demonstration. Proposals are solicited that address aspects of the following areas:

- RUL prediction techniques that address a set of fault modes for a device or component, for example by modeling the physics of the most critical fault modes and using (typically less accurate) data-driven methods for the remainder.
- Physics-based damage propagation models for one or more relevant aircraft subsystems such as composite or metallic airframe structures, engine turbomachinery and hot structures, avionics, electrical power systems, electromechanical systems, and electronics. Proposals that focus on technologies envisioned for next generation aircraft are strongly encouraged.
- Uncertainty representation and management (reduction of prediction uncertainty bounds) methods. Proposers are encouraged to consider uncertainties due to measurement noise, imperfect models and algorithms, as well as uncertainties stemming from future anticipated loads and environmental conditions. Methods can also consider the fusion of different techniques but must show how this helps to improve the uncertainty using appropriate metrics.

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- Aircraft relevant testbeds that can generate aging and degradation datasets for the development and testing of prognostic techniques.
 - Verification and validation methods for prognostic algorithms.