NASA SBIR 2011 Phase I Solicitation

A1.18 Prognostics and Decision Making

Lead Center: ARC

Participating Center(s): AFRC, GRC, LaRC

The benefit of prognostics will be realized by converting remaining life estimates and dynamically changing context information into actionable decisions. These decisions can then be enacted at the appropriate level, depending on the prognostic time horizon and safety criticality of the affected area. In particular, information about RUL could be used either reflexively, through resource re-allocation, through mission replanning, or through appropriate maintenance action.

To maximize the impact, it is necessary to provide an accurate and precise prognostic output, carefully manage uncertainty, and provide an appropriate contingency. This effort addresses the development of innovative methods, technologies, and tools for the prognosis of aircraft faults and failures in aircraft systems and how to decide on remedial actions.

Areas of interest include the development of methods for estimation of RUL, which take into account future operational and environmental conditions; for dealing with inherent uncertainties; for building physics-based models of degradation; for generation of example aging and degradation datasets on relevant components or subsystems; and for development of validation and verification methodologies for prognostics.

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

- Novel RUL prediction techniques that improve accuracy, precision, and robustness of RUL output, for example through the fusion of different methods.
- 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.

- Contingency management methods that act on predictive information. Particular interest is for methods that address the medium-and long term prognostic horizons.
- Verification and validation methods for prognostic algorithms.
- Aircraft relevant test beds that can generate aging and degradation datasets for the development and testing of prognostic techniques.

All methods should be demonstrated on a set of fault modes for a device or component such as composite airframe structures, engine turbomachinery and hot structures, avionics, electrical power systems, or electronics. Prognostic performance needs to be measured on benchmark data sets using prognostic metrics for accuracy, precision, and robustness. Metrics should include prognostic horizon (PH), alpha-lambda, relative accuracy (RA), convergence, and R_delta.