NASA SBIR 2011 Phase I Solicitation

A1.04 Airframe Design and Sustainment

Lead Center: LaRC

Participating Center(s): AFRC, GRC

Conventional aircraft airframe structures have achieved a high level of reliability through decades of experience, incremental technology changes, and an empirically based building block design methodology. Emerging and next generation aircraft will employ new lightweight materials and structural concepts that have very different characteristics than our current experience base. One element in NASA's effort to ensure the integrity of future vehicles is research to improve the reliability of airframe structures through enhanced computational methods to predict structural integrity and life, and validating correlation between computational models and the as-manufactured and as-maintained aircraft structure.

NASA seeks tools and methods for improved understanding and prediction of structural response, and experimental methods for measuring and evaluating the performance of new airframe structural designs. Specific areas of interest include the following:

- Improved structural analysis methods for complex metallic and composite airframe components using novel multi-scale as well as global-local computational codes. The methods used for these solutions need to detail the initiation and progression of damage to determine accurate estimates of residual life and or strength of complex airframe structures. Robust numerical algorithms are required to simulate the nonlinear behavior of damage progression coupled with geometric and material nonlinearity.
- Correlation between computational models and airframe structures:
    - Experimental methods for detailed characterization of as-manufactured structures relative to the as-designed configuration, to identify deviations in geometry, material application, and possibly identify manufacturing anomalies.
    - Advanced experimental methods for full-field assessment of strain during structural or flight tests for the purpose of validating computational models, and identifying hot-spots in the structure that are not represented in the models. Ease of application on built-up structures will be a significant factor.
    - Technologies to measure residual stresses in structures resulting from manufacturing processes

and fit-up during structural assembly, as these residual stresses may severely compromise design margins.

- Repair technology for metallic or composite structures:
    - Novel approaches to arrest damage and return structural integrity (other than replacement, grind out, scarf, or bonded or bolted doublers).
    - Validation of structural repair: technology to interrogate an applied repair to validate the design of the repair, and correct application of the repair. The intent will be to determine whether the repair performs as expected to return structural integrity.

Technology innovations may take the form of tools, models, algorithms, and devices.

All proposals should discuss means for verification and validation of proposed methods and tools in operationally valid, or end-user, contexts.