RQ16-34

AFRL CALL FOR RESEARCH

1. **Research Title:** Design and Life Prediction Tools for Aircraft Structural Components with Engineered Residual Stresses

2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Mechanical, Aerospace, or Civil Engineering / Solid Mechanics or Structural Mechanics or Computational Mechanics (MS or Ph.D. level)

4. **Objectives:** The objective of this research area is to develop validated computational models for designing optimized engineered residual stress solutions that achieve a specified fatigue response for a given airframe component. The emphasis is on developing robust methodologies that account for initial conditions and probabilistic considerations.

5. **Description:** The introduction of engineered residual stresses, through processes such as glass shot peening, laser shock processing, and low plasticity burnishing, can potentially increase the fatigue life of aircraft components, with attendant benefits of enhanced safety, reduced operational costs, and improved performance. However, for full exploitation of these technologies, there is a need for validated predictive models that can be used to determine optimal surface regions in a given component and to prescribe optimal processing parameters. Such models, when used in conjunction with or linked to structural design and life prediction software, can help maximize the life benefit to total cost ratio on a component specific basis. A validated methodology can also reduce the costly experimental iteration processes currently required to field each new application. Further, it allows for optimized designs rather than those that simply meet the requirement.

   To attain this goal, research opportunities exist in the general area of design and life prediction for aircraft structural components with engineered residual stresses. Specific topics include: (1) development of validated models and design tools for optimizing the benefits of introducing engineered residual stresses, including but not limited to laser shock processing and low plasticity burnishing, into aircraft structural components. A successful methodology will be capable of accounting for stress concentrations as well as allowing for the prediction of fatigue behavior in components containing both applied stresses and residual stresses, and (2) development of an incorporated methodology for predicting lower bound fatigue behavior due to the material damage and residual stress states surrounding cracks. A successful methodology will account for component initial conditions, including pre-existing residual stresses and prior fatigue exposure, and will allow for a probabilistic consideration of fatigue life.

6. **Research Classification/Restrictions:** This research is unclassified and for public distribution.

7. **Eligible Research Institutions:** Indicate to what organizations this topic should be provided.

   ☒ **DAGSI** (Wright State University, AFIT, Ohio State University, University of Dayton, Miami University, Ohio University, University of Cincinnati)

   ☐ **AFIT** (only)

   ☐ **USAFA** (only)

   If you are submitting a topic for the USAFA, indicate if you are also interested in sponsoring a USAF Cadet in summer 2015 (Average cost for USAF Cadet for 33 days is $5000)

   ☐ Yes ☐ No