STATEMENT OF OBJECTIVES (SOO)

BAA: Collaborations for Innovative Research on Aerospace Structure (CIRAS)

Qualifying Additively Manufactured Airframe Structure

I. Background

Additive manufacturing (AM) offers many opportunities for reducing part count and making complex shapes. AM of metal structure is hampered by the expense of qualifying each new part. Among the issues that need to be addressed in the part qualification process are:

- The size, shape, orientation, frequency, and location of discontinuities in the part,
- Anisotropy of strength and fatigue properties, and
- Residual stresses.

These issues are a function of the part design, the build strategy, and even the specific machine, by serial number, that the part is built with. Thus, every new AM part requires an extensive effort to [1]:

1. Establish that the fabrication process is stable and repeatable,
2. Demonstrate that the process can be scaled up to produce parts in quantity,
3. Develop mechanical properties and design allowables,
4. Verify that the performance of the final part is predictable, and
5. Demonstrate that the part is sustainable (i.e., inspectable, maintainable, repairable, etc.)

As the Air Force and its industrial partners consider AM parts for primary structures in the future, the Air Force Research Laboratory need to provide the Air Force Lifecycle Management Center guidance on design practices that move away from a part by part qualification strategy to one that provides guidance based on features including but not limited to roughness, wall thickness, radii, overhang, material, etc.

II. Description of Effort

The Air Force Research Laboratory, Aerospace Systems Directorate is soliciting white papers and potentially technical and cost proposals under this announcement to foster innovative research in technology and methods to understand design considerations for AM parts for primary structures to cost effectively address two of these five requirements: (3) developing mechanical properties and design allowables, and (4) verifying that the performance of the final parts is predictable. The initial focus would be for limited life (attritable) aircraft with only hundreds of hours of life or less. Following those results, the focus would shift to typical Air Force operations with thousands of hours of life or more.

III. Resources

AFRL will provide up to $150,000/yr for two years to support this research. AFRL anticipates providing two years of support for this effort.

IV. OPSEC

Operations Security (OPSEC) must be an integral part of our daily activities. As we maintain security on our future technologies that are vital to national interest, we must recognize and prepare for the threat poised against our technology. Department of Defense policies mandate a high degree of security throughout the acquisition process. However, heightened security awareness and threat-based countermeasures are particularly essential during the research and development phase when our technology is most vulnerable to espionage, sabotage, or exploitation. It is the obligation of each employee or persons involved on this agreement be constantly aware of and strictly adhere to security requirements designed to protect sensitive unclassified and other information and resources produced by acquisition, research and development, and technological security efforts outlined in this SOO. The recipient shall ensure employees receive training and follow appropriate Operations Security (OPSEC) measures during the performance of the agreement.

V. References

1. Structures Bulletin EZ-SB-19-01, "Durability and Damage Tolerance Certification for Additive Manufacturing of Aircraft Structural Metallic Parts", 10 June 2019, https://daytonaero.com/usaf-structures-bulletins-library/