RQIS-37

1. Research Title: *Aircraft Computational and Experimental Research*

2. Individual Sponsor:

Jon Zumberge

AFRL/RQQI

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TBD

3. Academic Area and Education Level: Mechanical, Aerospace, Electrical, Computer Engineering; Applied Mathematics or Statistics. MS or Ph.D. Level

4. Objectives: Develop advanced experimental and/or analytical approaches for the accurate assessment of on-demand aircraft systems. The research can be directed towards improved bench experimentation, innovative component design/modeling, or fundamental science issues.

5. Description: On-demand systems require attention to issues of system integration and energy management for optimal performance and capability. Integrated system modeling and simulation spans a broad range of technical expertise such as thermal management, power generation, power distribution and load management in a highly dynamic environment. Energy conversion is critical in the efficient design of on-demand systems. For aircraft applications, the majority of energy conversion takes place in the gas turbine. Therefore, consideration of auxiliary systems and how they interface with the hot gas engine sections is needed. Gear boxes and starter/generators are key components of power generation, leading to power distribution, which is then connected to load management. Methods of storing and dissipating energy such as high-energy density batteries, super-capacitors and heat exchangers are also vital for on-demand system optimization. Consideration for bi-directional energy transfer needs made in light of regenerative energy from actuators. From an experimental view, the verification and validation (V&V) process for complex on-demand systems-of-systems needs development. Validation is critical in understanding the risks associated with technology assessment predictions. In particular, areas of importance include statistical validation of dynamical models, design of experiments to optimize the amount of testing without losing information, and validation of control laws for use with the on-demand systems. In addition, hardware in the loop (HIL) system integration optimization for energy management will continue to be pursed. One area, remote HIL system integration, is vital to advancements in aircraft system integration. Another area is the simulation of switching models in real-time to be used with an emulator for HIL. Finally, research into integrated system health management will continue to be utilized to optimize the complete system.

6. Research Classification/Restrictions: U.S. Citizens only.

7. **Interest in Summer USAFA Cadet: Yes**

8. **Eligible Research Institutions:**

[**X**] Universities (DAGSI) [X] AFIT [ ] USAFA

Public Release Pending