

1. **Research Title:** Multiscale, Multiphysics and Multifidelity Modeling of Aircraft Power and Thermal Systems
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level**  
Aerospace/Mechanical/Electrical/Computer/Materials/Chemical Engineering (MS or Ph.D.)
4. **Objectives:** Develop computational methods, tools and models for design and performance-analysis of aircraft power and thermal management systems.
5. **Description:** Cross-domain, advanced physics based modeling and simulation tools have been identified by the Air Force as game changers that can significantly reduce development and deployment cycle time for acquisition. Our research focusses on development of computational methods, tools and models for design and performance-analysis of aircraft power and thermal (P&T) management systems. The performance analysis of these systems is applied towards exploring the multi-dimensional P&T trade space and developing technology impact forecast. Aircraft P&T systems demand both static and dynamic response and include technologies that represent physical phenomena across a wide range of spatial and/or temporal scales involving multi-physics coupled interactions. Our M&S effort therefore includes multiscale, multiphysics and multifidelity modeling and includes development of computational methods, numerical formulations and software with an integrated and unifying modeling framework. To support this, we are also developing an integrated P&T modeling workspace. Research opportunities include but are not limited to: System of systems studies, P&T modeling toolset development; Dynamic modeling of P&T systems; High fidelity thermodynamic analysis of aircraft P&T systems; Molecular and multiscale modeling of heat transfer and thermal energy storage; Molecular and stochastic simulation methods of nanoscale transport phenomenon; Reduced order modeling of P&T systems; Co-simulation of dynamic systems; Model verification and error estimation methods. Access to several commercial and in-house developed codes and computing resources at the AFRL DoD. Super Computing Resource Center is available.
6. **Research Classification/Restrictions:** This research will be unrestricted and the results will be in the public domain. However to facilitate close collaboration between AFRL and the student, frequent visits to WPAFB will be required. The student and the faculty member are therefore required to be US citizens or permanent residents.
7. **Eligible Research Institutions:** All DAGSI.

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