

## Characterization and Modeling of Turbines in Highly Unsteady Flows

1. **Research Title:** Characterization and Modeling of Turbines in Highly Unsteady Flows
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level**

Mechanical or Aerospace Engineering (MS and/or PhD level – PhD preferred)

4. **Objectives:** The objectives of this proposed 3-year DAGSI project is to conduct research related to the development of physical understanding of and modeling and design capabilities for turbines driven by highly unsteady flows. The study will include the development and use of computational tools for turbine aerodynamic design and flow prediction and experimental validation of turbine component flow behavior and performance under highly unsteady flow conditions. Experiments will be conducted using the Air Force Research Laboratory Propulsion Directorate turbine facilities.
5. **Description:** The rapid maturation in the understanding of detonation based combustion (i.e. pulse detonation combustion and continuous detonation combustion) has led to significant interest in the integration of pressure gain combustors into gas turbine engines. The theoretical benefits of such integration are significant, allowing increases in engine overall pressure ratio and improved thermal efficiency while reducing the number of compressor stages. However the output of detonation based combustion devices is highly unsteady, with shocks up to Mach 5, pressure variations orders of magnitude higher than is experienced in traditional turbomachinery, and wide variations in flow conditions including temperature and flow angle. This unsteadiness has a significant and poorly understood impact on the performance of the turbine, which is required to extract mechanical work from the flow exiting the combustor. Improved modeling capabilities anchored by detailed component and subcomponent experiments offer the opportunity to improve the understanding of turbine flows under highly unsteady conditions and improve the design of future systems incorporating detonation driven combustors.
6. **Research Classification/Restrictions:** The bulk of this research will fall under the 6.1 basic research classification. Some aspects, in particular those dealing with specific engine configurations and performance parameters, will be FOUO and may have ITAR restrictions.
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) NOTE: Topics submitted to DAGSI must be approved for public release. PA Approval # 88ABW-2012-5423



**USAFA** If you are submitting a topic for the USAFA, indicate if you are also interested in sponsoring a USAF Cadet in summer 2017 (Average cost for USAF Cadet for 33 days is \$5000)



Yes



No