1. **Research Title:** Advanced Analytical Tools for Turbine Engine Bearing Compartments
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level**
Mechanical Engineering; Aerospace Engineering; Applied Mathematics / Tribology, Solid Mechanics, Fluid Mechanics, Fluid Structure Interaction, Multi-Phase Flow, Numerical Methods (MS and/or PhD level)
4. **Objectives:** Develop methodologies and software tools to model complex multidisciplinary phenomena associated with turbine engine bearings. Validate methodologies through experiment or literature as appropriate. Software tools should be developed in either Python or Matlab such that integration with RQTM analytical tools is prioritized. Phenomena of interest include but are not limited to: optimized and stable solvers for elastohydrodynamic contacts, heat generation and heat transfer in elastohydrodynamic contacts, bulk flow within rolling element bearings, multi-phase flow within rolling element bearings, windage losses, lubricant supply/scavenge efficiency, hydrodynamic flow with compliant boundaries, stiffness and damping of bump foils and their contact surfaces, compartment seal leakage, stiffness and damping of compartment seals, and flexible six degree of freedom rolling element bearing dynamics.
5. **Description:** In State-of-the-Art turbine aero-engines, engine mechanical systems such as main-shaft bearings and power transmission systems are being pushed to operate under extreme conditions at extreme performance levels never before experienced. This puts developmental engines with product relevant mechanical systems under unacceptably high risk with mitigation available only through prohibitively costly component rig testing. Alternatively, development programs can reduce this initial risk and cost by utilizing lower risk, product irrelevant mechanical systems. However, this approach puts the engine lifecycle costs at high risk due to increased likelihood or late program redesigns. Effective modeling and simulation of engine mechanical systems has been elusive in the past due to the extreme complexity of interacting physics and the lack of methodologies or computational efficiencies. New methodologies and/or advancements to current methodologies will allow for practical modeling tools for mechanical systems, significantly reducing the risk to future aero-engine development. Activities will be performed in the Mechanical Systems Research Laboratory (MSRL) or using RQTM computing facilities with access to Matlab, Python, SolidWorks, SolidWorks Simulation, and SolidWorks Flow Simulation. The MSRL provides extensive opportunities for empirical validation of tools and methodologies developed. Among the MSRL research capabilities are the Versatile Bearing Test Facility used to test full scale engine bearings at relevant engine conditions and the Bearing Life Assessment Facility used to provide rolling contact fatigue life data and perform spall propagation testing. Modifications to current capabilities would be considered for model validation purposes. Other capabilities include, but are not limited to,

ball-on-disk tribometer/lubricant traction rig, multi-configuration tribometer, FZG-Ryder gear scuffing rig, and a scanning electron microscope equipped with energy dispersive x-ray spectrometry.

6. **Research Classification/Restrictions:** Open to U.S. citizens only. Some aspects of this research may include ITAR restrictions.
7. **Eligible Research Institutions:**

DAGSI (All DAGSI Universities).

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