RQ20-17

1. **Research Title:** *Development of Active Control Systems for Scramjet Engines*

2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Aerospace Engineering, Electrical Engineering, and Mechanical Engineering (MS or Ph.D. level)

4. **Objectives:** Utilize provided 3-D time-accurate computational fluid dynamics (CFD) simulations of a scramjet combustor to develop active control strategies for scramjet engines. There may also be some limited experimental data to aid in control system development. Link the developed active control algorithms to time accurate CFD simulations via Python or other appropriate programming language to assess control system performance.

5. **Description:** With time-accurate CFD solutions of scramjet engine transients becoming available and significant interest in developing control systems for these types of engines, there is a research opportunity in linking the two areas. Coupling of control system elements (algorithms, sensor placement, and simple actuators) to CFD computations of engine transients is possible using a variety of programming languages and several CFD software packages. Transients of interest include initial starting of the engine, fuel-flow rate changes, fuel-phase transition, fuel staging, ram/scram transition, and vehicle maneuvers. Some of these transients occur very quickly (on the order of milliseconds), while others are very slow (on the order of seconds). Both of these extremes present unique challenges for connecting control strategies and time-accurate CFD solutions. With current computer resources, it is believed that such a coupling is possible and could be compared to some experimental data for validation. Initial areas of interest would include the short duration transients such as ignition, unstart, and rapid changes in fuel flow rate, and fuel staging.

6. **Research Classification/Restrictions:** U.S. Citizens only, potential for ITAR.

7. **Eligible Research Institutions:**

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