RQ19-20

1. **Research Title:** *Coupling Computational Fluid Dynamics (CFD) Analysis and Optimization Techniques for Scramjet Engine Design Applications*
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level**
   Aerospace Engineering, Mechanical Engineering or Mathematics (MS or Ph.D. level)
4. **Objectives:** The objective of the proposed thesis topic is to develop an approach for integrating CFD analysis, grid generation and an optimization routine for use as a design tool. The tool will be demonstrated on an idealized scramjet or scramjet component. Examples include optimizing the pressure rise capability in an inlet/isolator and optimizing the fuel distribution for an array of fuel injectors.
5. **Description:** As computing resources increase, CFD promises to play an expanding role in engine design. Rather than solely being used to evaluate designs generated with lower order tools, CFD can be fully integrated into the design process by combining CFD analysis, rapid or automatic grid generation and an appropriate optimization algorithm: e.g. genetic or gradient based algorithms. The optimization technique must be appropriate for the relatively expensive evaluation of the objective function via CFD. Tools available within RQH include CFD++ and VULCAN for CFD analysis, MIME and Pointwise for grid generation and Dakota or NEWUOA for optimization, but the research activity is not constrained by these choices.
6. **Research Classification/Restrictions:** U.S. Citizens only. Most aspects of this research fall under the 6.1 basic research classification. However, some aspects, in particular those dealing with specific engine configurations and performance parameters, are FOUO with ITAR restrictions.
7. **Eligible Research Institutions:** Indicate to what organizations this topic should be provided

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