Numerical Simulation of High Mach Number Viscous Flow

1. **Research Title:** Numerical Simulation of High Mach Number Viscous Flow
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Aerospace Engineering, Mechanical Engineering, Applied Mathematics, Engineering Physics (MS or PhD level)
4. **Objectives:** Apply advanced numerical methods to the study of viscous flow effects at high Mach number
5. **Description:** Flight at hypersonic speeds requires an air vehicle to endure an extremely harsh environment, with intense heating and fluctuating loads. Prediction of this environment remains a difficult scientific and engineering challenge, in large part because of the inability of computer models to predict viscous effects in these flows. This topic aims to address numerical prediction of some of the key physical phenomena, including transition from laminar to turbulent flow, turbulence, separation, shock-wave / boundary-layer interaction, and large-scale unsteadiness. Particular emphasis will be placed on employing high-fidelity numerical simulation to predict aerodynamic heating rates and fluctuating pressure loads in the flight environment.

   Some areas of interest for projects include:

   - Application of existing computer codes to problems of USAF interest, with detailed analysis of the flow physics
   - Enhancement of in-house codes, for example, implementation of new numerical methods
   - Development of tools for the analysis of very large data sets generated by large-eddy simulation and direct numerical simulation
   - Enhancement of the parallel performance of in-house codes on large numbers of processors

   A prospective student will need to have good programming skills and a strong background in fluid mechanics.

6. **Research Classification/Restrictions:** US citizen or US permanent resident. Candidate will require access to DoD computer systems and export-controlled software.
7. **Eligible Research Institutions:**

   ☒ **DAGSI** (Wright State University, AFIT, Ohio State University, University of Dayton, Miami University, Ohio University, University of Cincinnati