1. **Research Title:** Leveraging Both Experimental and Computational Data to Study Hypersonic Flight

2. **Individual Sponsor:**

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

4. **Objectives:** To study hypersonic aerodynamic phenomena such as aero-heating, boundary-layer transition, and shock/boundary-layer interactions and to develop the diagnostic techniques and tools required to enhance our understanding of these flows

5. **Description:** A vehicle flying at hypersonic Mach numbers encounters some of the same aerodynamic phenomena as at lower speeds. However, the effects can be significantly compounded. For example, both boundary-layer transition and shock/boundary-layer interactions can substantially increase heat flux, reduce the effectiveness of control surfaces, and alter the aerodynamic characteristics of the vehicle. A unique challenge in the study of hypersonic aerodynamics is the inability of either wind-tunnel facilities or computational studies to simultaneously match/model all relevant flight conditions: Mach number, Reynolds number, enthalpy, and disturbance levels. Because no experiment or computation fully models hypersonic flight, each dataset offers only a limited view of the full in-flight physical processes. This topic aims to utilize combined experiments and computations to increase our understanding of and ability to predict aerodynamic effects at hypersonic Mach numbers. Data collection may be primarily focused on either experiments or computations, however, the prospective student(s) must work with, understand, and interpret both experimentally-generated and computationally-generated data and leverage the perspectives given by each.

   Some possible topics of interest include:

   - Investigation of the effects of surface roughness, mixed instability modes, entropy layers, or sharp geometrical changes (e.g. fins, flaps, excrescences, cavities) on boundary-layer transition.
   - The control of boundary-layer transition by active and/or passive means.
   - The study of laminar, transitional, and turbulent shock/boundary-layer interactions.
   - Development of new diagnostic tools and techniques-particularly non-intrusive methods.
   - Development of computational techniques to better model experimental diagnostic tools and/or experimental flow conditions.

6. **Research Classification/Restrictions:** U.S. Citizens only. Most aspects of this research fall under the 6.1 basic research classification. However, there is potential for some aspects to be subject to ITAR restrictions.

7. **Eligible Research Institutions:** DAGSI, AFIT

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