

RQ15-7

1. **Research Title:** *Guidance and Control of Hypersonic Vehicles*

2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Aerospace Engineering; Electrical Engineering; Flight Vehicle Dynamics, Guidance, and Control (Ph.D. level)
4. **Objectives:** Research and develop robust guidance and control laws for air-breathing hypersonic vehicles and hypersonic gliders. Develop a theoretical framework for control law design for linear and nonlinear systems that must obey input, state, output, and/or path constraints while providing the following: guaranteed and verifiable stability margins, tracking performance under plant uncertainty, fault tolerance, and operation across a wide range of operating points. Formulate techniques that ensure robust guidance/energy management for the flight vehicle.
5. **Description:** Hypersonic vehicles pose unique guidance and control challenges compared to current USAF systems. In particular, parametric uncertainties in the aerodynamics are expected to be significant due to an increased reliance on computational methods to predict stability and control for this class of vehicles. Maneuvering flight presents a special challenge due to restrictive angle-of-attack and sideslip constraints that are dictated either by the propulsion system operability or inherent limits on vehicle stability and controllability. The proposed project seeks to advance the state of the art in guidance and control of flight vehicles so that input and state constraints are enforced for uncertain systems while being robust to modeling errors, control surface failures, and measurement noise.
6. **Research Classification/Restrictions:** Unclassified
7. **Interest in Summer USAFA Cadet:**
None
8. **Eligible Research Institutions:** Place an X in all that apply.

Universities (DAGSI)

AFIT only)

USAF