RQ20-32

1. **Research Title:** Low-Speed, Unsteady Aerodynamics: Physics, Modeling, and Control
2. **Individual Sponsor:**

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

4. **Objectives:** The distillation, modeling and control of unsteady transient phenomena experienced in vortical laden flows for the purpose of exploitation or mitigation of such phenomena for aerodynamic efficiency of low-speed agile airfoils.

5. **Description:** A thorough understanding of unsteady aerodynamics is critical when analyzing and designing aircraft operating in unsteady flight environments or undergoing maneuvers, wind energy devices, rotorcraft, and aircraft during takeoff and landing. Accurate knowledge of the underlying flow physics that occur during unsteady conditions would allow for the determination of aircraft performance and design requirements when operating near the boundaries of the flight envelope, but further research is required to determine the dynamic response of aircraft to unsteady incoming flow fields and vortex-dominated wakes. Analytical methods, numerical simulations, and experimental studies are all useful in their contributions to improve the overall body of knowledge. The current focus is on incompressible studies involving dynamically pitching, plunging, and/or surging wings with or without the incorporation of flow control. The ultimate goal of this body of research is a robust low-order model of the complete vehicle state which could then be used for flight performance determination, closed-loop control, and vehicle design.
   Areas of interest include, but are not limited to: (1) Gust mitigation/rejection with or without flow control, (2) maintaining control surface effectiveness during extreme maneuvers, (3) reduced-order modeling of vortex-wing interactions, (4) dynamic stall characterization and prevention, (5) load response of wings interacting with unsteady flow fields, (6) mitigation of separated flows using flow control, (7) development of closed-loop control algorithms, and (8) development of flow control devices.

6. **Research Classification/Restrictions:** This research is unclassified, with intent to publish in the open literature.

7. **Eligible Research Institutions:** All DAGSI Universities

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