RQ20-4

1. **Research Title:** Multi-Fidelity Analysis Methods for Multidisciplinary Design Optimization

2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Aerospace or Mechanical Engineering / Computational Physics and Numerical Analysis (BA/BS, MS or Ph.D. level).

4. **Objectives:** Develop new computational procedures to predict the behavior of a coupled system in a collaborative manner using aerodynamic simulation methods at different fidelity levels.

5. **Description:** A significant challenge in applying Multidisciplinary Design Optimization (MDO) to future aircraft systems is the high cost of performing accurate aerodynamic analysis, particularly in settings where there are important couplings with others disciplines (e.g., structure and control). Strategies to lower analysis cost include various forms of physics-based reduced order modeling and more general forms of surrogate modeling, statistical analysis, etc. Another way to lower the cost of analysis is to introduce different modeling fidelities within a single computation; i.e., treat sub-domains at different analysis fidelity levels. A well-known example of this strategy is coupling an inviscid analysis method with a boundary layer analysis method to predict viscous flowfields. What is desired in this topic is a more rigorous and general multi-fidelity approach across a wide range of fidelities (potential flow to Navier-Stokes). Potential directions include: goal-oriented adaptation (adjusting sub-domain fidelity requirements to minimize analysis cost while meeting accuracy targets for certain goals, such as drag); account of multidisciplinary couplings (e.g., new requirements levied by structural deformations, both static and dynamic), and more complex physics (e.g,. boundary layer transition, acoustics (near/far field), and thermal effects).

6. **Research Classification/Restrictions:** Unclassified

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