RQ 20-43

1. **Research Title:** Chimera Hole Cutting for High-Order Discontinuous Galerkin Fluid Solver
2. **Individual Sponsor:** List the AFRL research topic sponsor's contact information
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3. **Academic Area/Field and Education Level:** Aerospace Engineering (MS level)
4. **Objectives:** The objective of this research is to support development of a high-order discontinuous Galerkin finite element framework for Computational Fluid Dynamics (CFD) with Chimera overset grid capability. Specifically, this research will develop automated hole-cutting routines to enable efficient overset implementation on high-order curvilinear grids.
5. **Description:** AFRL/RQ has undertaken the development of a high-order, finite element based fluid-structure interaction (FSI) simulation capability. This approach leverages the computational efficiencies afforded by high-order methods to achieve significant reductions in computational time (approx. 2 orders of magnitude over traditional approaches) and enable coupled physics simulations on full scale geometry. The current fluid solver capabilities are provided by ChiDG, a highly efficient, Chimera based, discontinuous Galerkin framework. It is capable of simulating flows governed by the Euler, Navier-Stokes, and Reynolds Averaged Navier-Stokes (RANS) equations. It also possesses multi-fidelity and moving grid capabilities, and is written in modern FORTRAN.

   A key feature of the code is the ability to evaluate full configuration aerodynamics via overset grid capability. To have an efficient overset capability, portions of the overlapping grids must be removed from the solution process (effectively blanked-out). Identification and elimination of these overlapping portions is commonly referred to as hole-cutting. This effort will develop and implement efficient, automated, three-dimensional hole cutting routines in ChiDG to enable efficient overset solution on high-order curvilinear grids. Implementation of the hole-cutting procedure is a key remaining component to enable realistic simulation of aerothermoelastic phenomena on three-dimensional, full-scale, Air Force configurations within the developing framework.

6. **Research Classification/Restrictions:** Unclassified.
7. **Eligible Research Institutions:** All DAGSI Universities.

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