Enabling Technology Tools for HFS & MDO

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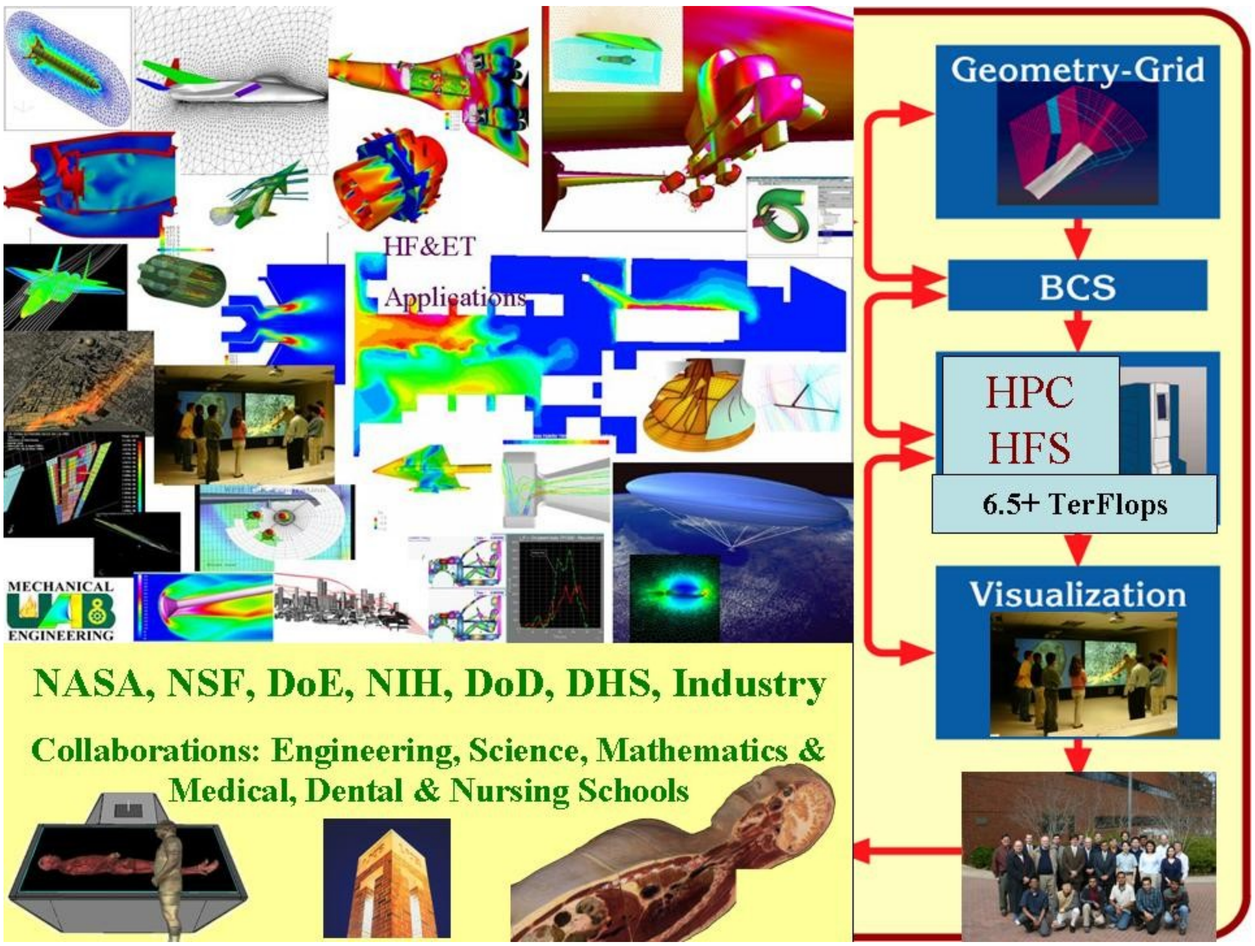
ABSTRACT

With the advent and rapid development of high performance computing and communication (HPCC) technology computational fluid dynamics (CFD) and computational structural dynamics (CSD) have emerged as essential tools for engineering analysis and design. Last three decades have seen considerable progress in the development of tools and technologies for addressing CFD and CSD applications. However, **accuracy, confidence, thru-put and cost effectiveness in performing CFD and CSD simulations** remain the critical barriers associated with complex applications. In response to the perceived need for the development of computational enabling technology tools to address these challenges, a broad-based research and education program utilizing state-of-the-art information technology has been initiated at the High Fidelity Simulations and Enabling Technology Laboratory (HFS&ETL), University of Alabama at Birmingham (UAB). The overview of the HFS & ETL will be presented with emphasis on associated research and development thrusts: (i) Automated and Parametric Geometry-Mesh generation and Adaptation; (ii) Domain specific simulation algorithms and applications; and (iii) Technology tools needed to address multidisciplinary simulations and design optimization.

The development of these tools with applications will be presented. Along with CFD and CSD systems, the emphasis will be placed on the enabling technology software libraries: GGTK (Geometry-Grid Tool Kit), FSITK (Fluid Structure Interaction ToolKit), and CaseMan (Simulation case management infrastructure) with their application to engineering design applications. The GGTK with associated MiniCAD system facilitates automatic and parametric generation of geometry and quality meshes timely enough for design study. The FSI toolkit provides a loosely-coupled reusable environment for efficient and accurate load and motion transfer between unmatched meshes utilized in different disciplines. An integrated aerodynamics shape optimization (ASO) framework developed using object-oriented toolkit, DAKOTA as basis will be described with applications.

Computational examples will be presented to demonstrate the success of the developed enabling and simulation methodologies. The perspectives, vision, strategic plan, and road map associated with the research in multidisciplinary design optimization will be included.


HF&ET
Applications
NASA, NSF, DoE, NIH, DoD, DHS, Industry
Collaborations: Engineering, Science, Mathematics &
Medical, Dental & Nursing Schools
MECHANICAL
ENGINEERING
Geometry-Grid
BCS
HPC
HFS
6.5+ TerFlops
Visualization