High Fidelity Simulations & Enabling Technologies - Future Directions in Mechanical Engineering

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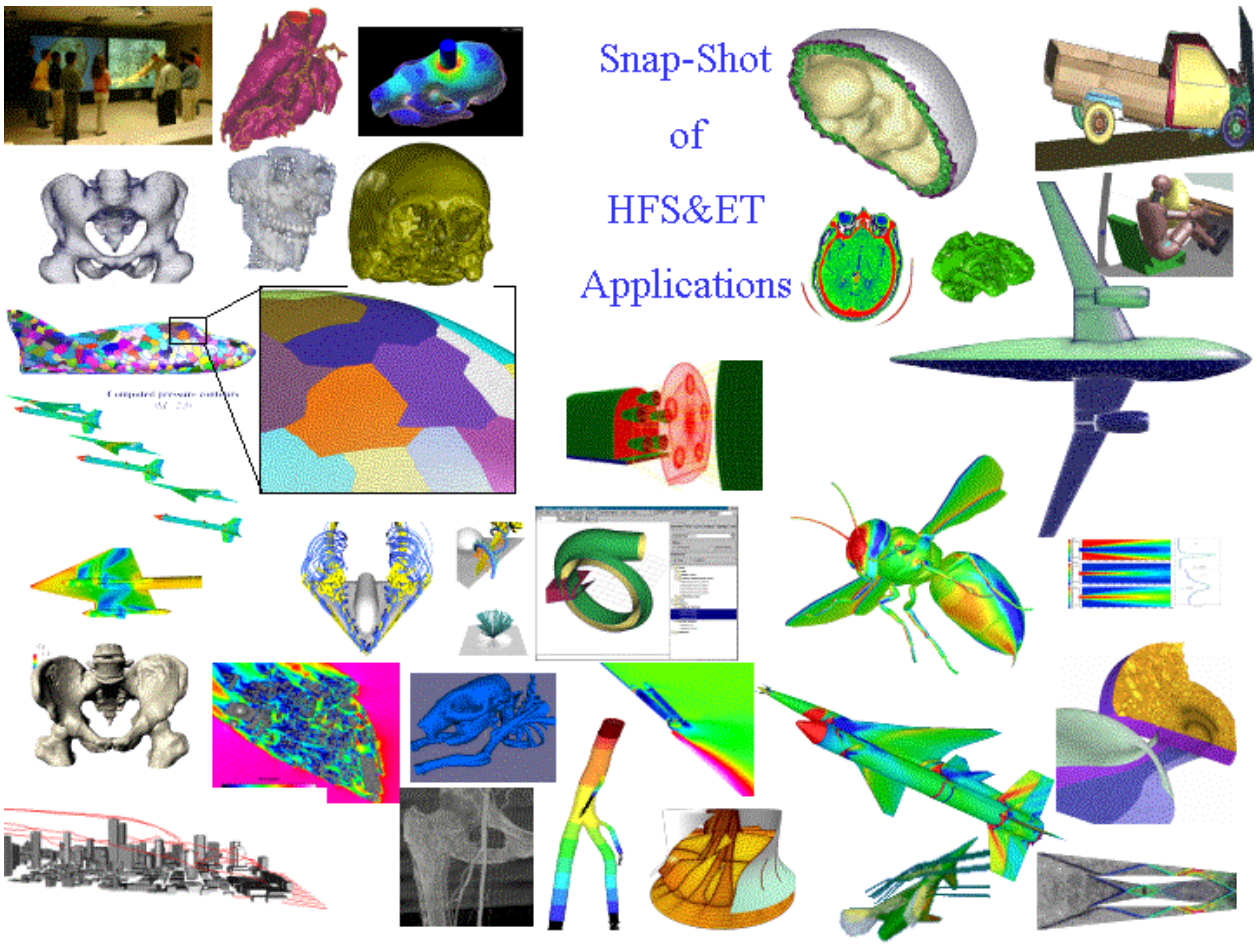
Abstract:

With the advent and rapid development of high performance computing and communication (HPCC) and robust and efficient mathematical/numerical algorithms, computational field simulation (CFS) has rapidly emerged as an essential tool for scientific, engineering, and biomedical analysis and design environment. This has fundamentally changed the way underlying principles of science and engineering are applied to research, design, and development. For example, computational fluid dynamics (CFD) and computational mechanics techniques, traditionally used in fluid mechanics and structural mechanics problems involving aerodynamics, hydrodynamics, automotive, and heat and mass transfer applications, are now being applied to electromagnetic, bio-engineering, bio-medical, semi-conductor, atmospheric science, environmental and civil transport, and other physical field problems. In response to this paradigm change, integration of experiments, simulations and theory encompassing micro/nano technology, Biotechnology, information technology, and ecology/energy have became the education and R&D emphasis of this century. In this respect, an interdisciplinary group of engineering, computer and information science, physics, biology, chemistry, public health and medicine faculty from University of Alabama at Birmingham (UAB) has formed a collaborative team to address emerging multidisciplinary applications.

The progress realized in the development of high fidelity simulation (HFS) algorithms and associated enabling technologies (ET) for this endeavor will be presented. Emphasis will be placed on providing the current state-of-the-art (SOA) and the state-of-the-practice (SOP) associated with all aspects of computational field simulations involving pre-processing (geometry-mesh generation, boundary conditions and problem set-up), processing (numerical solution of pertinent set of non-linear partial differential equations representative of the science of the field to be simulated), and post-processing (visualization and feature detection). The tools and technology developed by the presenter and his group will be discussed with computational examples of practical interest. In particular, the concentration will be placed on the current and future directions in research and development and education of Mechanical Engineering.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