Kestrel Software on the HPCMP Portal

The CREATE-AV Kestrel application is the first multi-physics application suite ported to the HPCMP Portal. It is a high fidelity, full vehicle, multi-physics analysis tool for fixed-wing aircraft. Kestrel is a new, integrated product that allows crossover between simulation of aerodynamics, dynamic stability and control structures, propulsion, and stores separation. Kestrel is designed to simulate multi-disciplinary physical phenomena such as fluid-structure interactions, inclusion of propulsion effects, moving control surfaces, and coupled flight control systems. Kestrel addresses the needs of fixed-wing aircraft in flight regimes ranging from subsonic through supersonic flight, including maneuvers, multi-aircraft configurations, and operational conditions.

The Kestrel software product is written in modular form using a Python infrastructure that supports growth of additional capabilities. Computational efficiency will also be improved by targeting the next generation peta-FLOP HPC architectures. Recent Kestrel releases included the ability to model three different behaviors independently:
1) Fluid dynamics simulation for a single mesh, steady or unsteady, in viscid, viscous, laminar, or turbulent flow;
2) Coupled fluid dynamics (CFD) and dynamics solution of a single mesh in rigid body motion, specified by either a user defined motion file or built up from user inputs describing sinusoidal or constant rate and hold pitch, yaw, or roll motions or combinations of these motions that include a pre-flight capability to check out mesh motion to ensure that motion is properly set up; and
3) Coupled fluid dynamics/structural mechanics simulation of a static position single mesh aeroelastic wing with second order temporal accuracy using a modal structural solver that includes a pre-flight capability to check out mesh quality during a forced elastic variation that may be encountered during a fluid structure interaction simulation9. KESTREL 1.0 incorporates a rewritten version of AVUS (kAVUS) for the fluid dynamics. This package was able to compute solutions as accurately as typical fluid dynamics codes in common use (FLUENT, COBALT, FUN3D and USM3D).

Kestrel, a fixed-wing air vehicle simulation suite, consists of three major pieces. The first major piece is its thick client Kestrel User Interface (KUI), serving as the traditional interface" to the user. The second is the set of components that operate together to generate simulation products of the desired air vehicle behavior. The third major piece is the Kestrel Infrastructure Executive (KIE) that orchestrates a specific instance of components for a simulation. The KUI piece is more than a graphical user interface; KUI is a graphical user interface (GUI) engine that is also the basis for other CREATE-AV applications. The KUI caters to a class of CFD codes and related multi-physics tools. With the KUI, software can dynamically configure the GUI for a specific set of components and related tools. A configuration is provided composed of input definition XML files, boundary condition scripts, and input validation templates. Kestrel's flexible design is well suited for HPCMP Portal. The KUI has been ported to the HPCMP Portal browser while preserving its flexible configuration. This new piece of Kestrel is called the Kestrel Web UI (KUIWeb), which today lets users setup, modify, visualize, and submit jobs. Kestrel jobs are spawned, managed, and monitored through a generic job management application built atop the foundational portal infrastructure.

For additional information, contact info@mhpcc.hpc.mil