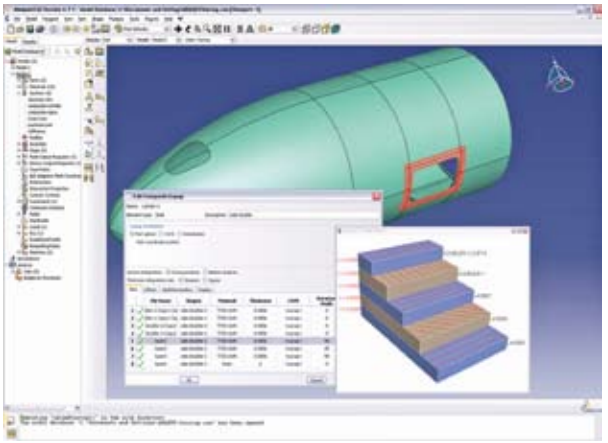
Computers in engineering

Simulia shaping future of simulation

With recent announcements about the release of Abaqus Version 6.7, a new multiphysics platform, and a strategic initiative to deliver solutions for simulation life-cycle management (SLM), the last several months has been a busy time for **Dassault Systèmes' Simulia** brand.

Abaqus, acquired by Dassault in October 2005, is the flagship product of Simulia. In the latest version, released in May, a new architecture for high-performance linear dynamics is introduced, as well as advanced capabilities for composites simulation and nonlinear materials modeling, an intuitive and customizable user interface for accelerated model building and results visualization, and two new interfaces for CAD associativity.



Composite materials are often applied to payload fairings to protect spacecraft from aerodynamic forces and debris. This aeroshell model was created using the new composites layup interface in Abaqus/CAE. Abaqus FEA software is then used to analyze the strength of the composite shell and identify potential areas of weakness in critical areas such as windows and access doors.

Typically used with nonlinear sophisticated products—**Airbus** recently selected Abaqus as its preferred solution for static nonlinear FEA of aircraft structures—there has been a shift within recent years to also focus on linear dynamics.

"Linear dynamics became very interesting to us a couple of years ago and we've been working on building a new framework upon which the rest of our linear dynamics strategy can hang," said Greg Brown, Product Management, Simulia. "In Version 6.6, we had some procedures and features available, and we've been expanding that in 6.7 to include a lot more procedures and some quite sophisticated things like coupling structural and acoustic analyses together using this new framework to achieve essentially much higher performance than was previously available."

The new linear dynamics architecture is fully integrated with existing nonlinear capabilities to allow engineers to share model data and results across workgroups. In an effort to make the program more accessible to users of various skill levels, Simulia engineers are striving to create more robust contact models for nonlinear situations.

"What we want to do is have default behaviors work, rather than make experts go in and twiddle all the knobs because we can always get that to work," Brown said. "But the defaults are the much more sensitive things to help a wider community of people start using Abaqus successfully."

An extended functionality release of Abaqus 6.7 is slated for later this year that will include new Eulerian-Lagrangian technology for fluid-structure interaction (FSI). Referred to as "completely new" within the Abaqus software suite, this technology does not rely on coupling with other software, so FSI studies can be conducted directly within a single solution.

Applications for this type of technology include studying the tread design of a tire.

"You have a tire that's a solid structure moving through a pool of water and you want to investigate the effectiveness of your tread design for avoiding hydroplaning-type phenomenon," said Mark Schrank, Director of Crashworthiness and Occupant Safety, Simulia. "It's this type of technology that's needed to be able to simulate this kind of phenomenon."

To add greater functionality to Abaqus, Simulia recently made available a direct coupling interface that allows third-party physics codes developed by partners or customers to communicate directly with Abaqus for high-performance multiphysics simulation. The direct coupling interface complements existing Abaqus multiphysics capabilities as well as third-party protocols, including the mesh-based parallel code coupling interface from the **Fraunhofer Institute for Algorithms and Scientific Computing**.

An ongoing project for Simulia is its SLM initiative, developing a new product portfolio to help companies better manage the vast amount of data produced through simulation tools and the associated methods and processes.

"Someone can develop a very good methodology and keep it to himself or herself and it doesn't get shared as it should throughout the organization, throughout the enterprise," Schrank said. "SLM is intended to do that as well as to connect users."

The new SLM products will utilize a standard Web interface as well as Dassault's new 3D Live technology to allow users to query, manage, and collaborate on simulation information regardless of the location, source, or format.

"The intent is to develop an open platform to manage and deploy various applications, recognizing that not all of the applications are going to be Simulia-authored to begin with," Schrank said. "There will be third-party applications and we will provide connector architecture to enable third-party applications to be connected through SLM."

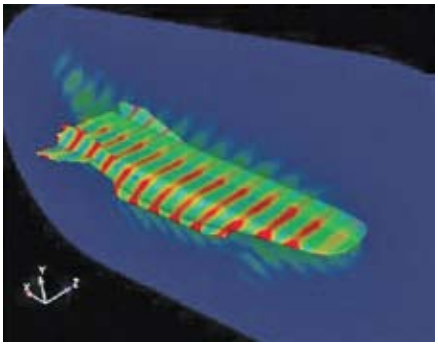
The SLM initiative is scheduled to be phased in over a three-year period, with data management currently under way, process management slated for 2008, and decision support for 2009.

Matt Monaghan

DOD takes steps to increase computing capability

With security concerns at a consistently high level, U.S. **Department of Defense** (DOD) engineers and scientists are tasked with developing next-generation warfare systems at a rapid pace. A new **SGI** Altix 4700 system deployed at the Aeronautical Systems Center Major Shared Resource Center (ASC MSRC) at Wright-Patterson Air Force Base will provide a boost to the DOD's computational capability, helping researchers achieve results faster and pursue innovations that were previously impossible.

The 4700 system, acquired as part of the TI-07 program, comprises 9216 **Intel** Itanium 2 processor cores in a single supercomputer equipped with 20 terabytes (TB) of shared memory and 440 TB of usable disk space, making it one of the largest computers in the DOD, according to SGI.



The SGI Altix 4700 system will be used to help U.S. Department of Defense (DOD) researchers solve complex problems such as electromagnetic scattering from an X-43 hypersonic vehicle.

"Combined with our three existing 2048-processor systems, the ASC MSRC will increase its total computing performance to 85 teraFLOPS, which will provide our researchers with the resources to solve complex and challenging problems," said Steve Wourms, Director, ASC MSRC.

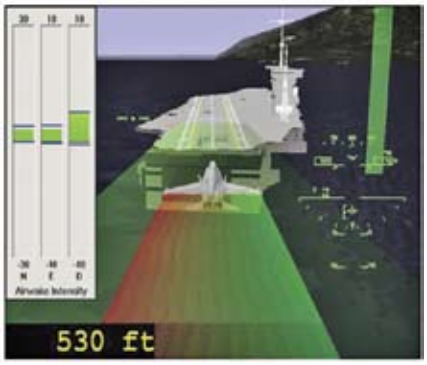
The system will help researchers design weapons systems faster, reduce risk by improving the quality of modeling and simulation, and support the effort to develop innovative computational science and engineering applications.

An array of projects will benefit as a result of the new system.

"More than a thousand researchers will rely on the ASC MSRC's powerful SGI installation to simulate entire battles, aircraft, and weapons systems with unprecedented fidelity," said Eng Lim Goh, Senior Vice President and Chief Technology Officer for SGI.

One area where significant advantages will be realized is in CFD studies designed to reduce the risks posed by turbulence on aircraft carrier decks. Airwake, a potentially dangerous aerodynamic effect caused by the superstructure of an aircraft carrier, can extend up to 1 mi from the ship. With the increased power offered by the Altix system, researchers will be able to more quickly and accurately modify carrier designs that minimize the ship's airwake and in turn minimize the danger to pilots.

The Altix platform's shared-memory NUMAflex architecture will allow the DOD's high-performance computing applications to take advantage of all of the Altix system's globally addressable memory and SGI's InfiniteStorage 4500 disk storage. Altix systems enable customers to independently expand memory, I/O, and processors, while the compact blade packaging of the Altix 4700 rack provides performance density.



With the increased computing power of the system, DOD engineers can more quickly and accurately modify carrier designs that minimize the ship's airwake.

"With technology needs growing exponentially, there is a real need to increase the power of our supercomputers while providing a powerhouse system with industry-leading capability, scalability, production quality, ease of use, and the ability to handle massive amounts of data while supporting globally addressable memory across multiple nodes," Wourms said.

SGI computing systems have also aided in another military program. In October 2006, **Sikorsky Aircraft** purchased a 48-core, 48-GB Altix XE cluster to help its propulsion engineering group run larger, more complex airflow simulations as it refines design concepts for the CH-53K, a next-generation cargo and personnel aircraft being built for the **U.S. Marine Corps**.

Previously, the engineering group relied on **Linux** systems assigned to other Sikorsky departments, scheduling its CFD studies when server time was available. By adding a dedicated resource for the CH-53K project, models that once required up to four days to complete are now able to be finished in a matter of hours.

"Previously, we had models that were 3 million cells in size, but today some models have more than 12 million cells," said Mike Kazlauskas, Propulsion Engineer for the CH-53K program at Sikorsky. "We're running larger, full-vehicle simulations that include complex interactions, like rotor downwash effects and heat-transfer models. We simply needed total access to more memory and more processors, and that's what the Altix XE cluster provides."

The CFD studies are part of a $3.08 billion design and demonstration contract for the CH-53K, which will replace the Marine Corps' "Super Stallion" heavy-lift helicopter currently in use throughout the world.

The CH-53K poses engineers with some unique challenges. It must be able to carry a cargo load of 27,000 lb for up to 110 nmi at an altitude of 3000 ft in temperatures surpassing 90°F. These conditions can quickly erode a helicopter's ability to carry cargo for long distances, making the aerodynamics of the aircraft crucial.

Matt Monaghan