Computers in engineering

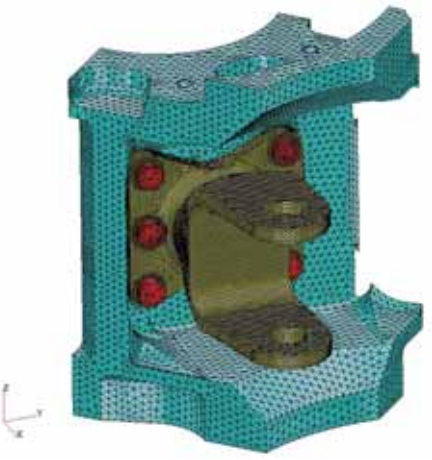
Contact analysis for all

Different types of solvers require different modeling techniques. Occasional use of advanced FEA software results in excessive refresh training time or a bottleneck waiting for an experienced analyst. Commercially available translators can help, but still require significant amounts of cleanup.

MSC.Software has come up with a solution. By integrating another solver in MSC.Nastran 2004 Solution 600, the same model in the familiar MSC.Nastran format can be used for both linear and nonlinear (with MSC.Marc) analysis. **Sikorsky Aircraft** is one of the first to test Solution 600 nonlinear analysis on its applications.

"We use nonlinear simulation primarily for contact analysis," said Michael Urban of Sikorsky's Structures Research Department. "In the past, when engineers had a contact problem and needed a better understanding of the issues involved, they created a second model in Mentat for analysis in MSC.Marc or another nonlinear program. If the engineers had not been trained to use nonlinear analysis programs, they sent the model to an analyst, thus creating a bottleneck in the design process."

Previously, MSC.Nastran users who wanted to perform analyses studying complex materials, large strain, or 3-D surface-to-surface contact had to learn how to use MSC.Marc and its Mentat interface.



The Sikorsky S92 blade droop-stop assembly must support the main rotor blades once the rpm of the rotor drops below a prescribed level. Non-linear FEA from MSC.Software gives the engineers confidence in their calculations.

With MSC.Nastran 2004, two specific internal translators were developed between MSC.Nastran and MSC.Marc, and included in Solution 600. One of them translates Nastran input data for Marc to analyze, and the second converts the Marc results into Nastran format for post-processing. Transparent to the user, the MSC.Marc solver does the "number crunching" for advanced nonlinear analysis using an existing MSC.Nastran model, and provides results in the MSC.Nastran format.

The use of nonlinear analysis is important for describing the real world. If a linear analysis gives stress and/or strain levels that go past the material yield point, or a deformation causes contact, a nonlinear analysis is needed. In Solution 600, the engineer only has to change the solution card from linear static to Solution 600, add some data to describe the contact, and then run the nonlinear analysis. The contact problems can include self contact, which results from severe buckling when the material comes into contact with itself. Engineers identify elements where contact will occur against other elements.

"The main value is that people who are trained in Nastran and Patran can now do contact analysis with virtually zero training in Marc," said Urban. "When they use Solution 600, they only have to remember the few steps they need to modify the model settings to run the contact analysis, so many more engineers can now run contact analysis."

The goal is to make it as easy as possible for the average engineer to perform nonlinear analysis. MSC has carefully set up defaults to help inexperienced users get good results.

Among the new applications Solution 600 brings to MSC.Nastran users are studies of deformation of laminated composite materials, enforced displacement, analysis of spring-back, viscoplasticity studies for creep analysis, and more accurate buckling analysis.

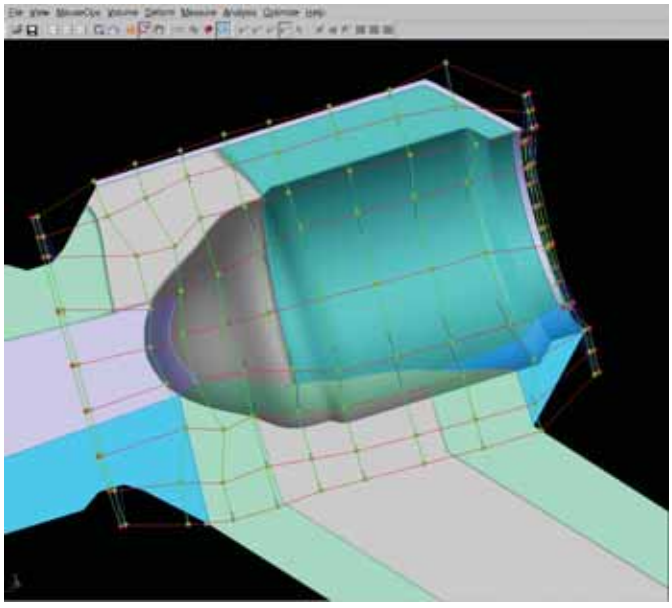
David Alexander

Shaping up

Optimal Solutions has developed an interactive CFD design software program called Sculptor that can perform real-time shape deformation and optimization. By using this unique tool, numerous iterations inherent in the process when the designer has to manually modify the design are eliminated. The ASD (arbitrary shape deformation) technology used by Sculptor automatically alters shapes that are typically very complex and hard to manipulate into designs that improve performance, without having to remesh.

Automated engineering design with CFD has centered on shape optimization, which has been hindered by two major problems: inadequate shape change parameterization algorithms and inadequate algorithms for CFD grid modification. Optimal's ASD method of controlling and manipulating the shape of any type of geometry, either CAD/CAM data or a computational grid, has made a major advancement in solving these two problems.

NASA recently awarded Optimal a second phase of its Small Business Innovation Research (SBIR) project. The



Optimal Solutions enhanced its CFD arbitrary shape deformation technology for a NASA SBIR.

first phase of the project began in January 2004. The SBIR Program was established by Congress in 1982 to provide increased opportunities for small businesses to participate in research and development, and to create new, or embellish existing, commercial applications of a technology.

The SBIR project that Optimal won allows the company to add new features to Sculptor. The new capability will enable NASA engineers who are responsible for designing complex valves and pipe fittings on pipes that transport dangerous fluids, such as liquid hydrogen and liquid oxygen, to achieve designs that meet strict standards.

There are many benefits that Sculptor will have as a result of this NASA SBIR project. The ability to optimize complex component designs such as control valves, manifolds, mixers, and pipe fittings will be added. Some of these components require the deformation of several different grids while guaranteeing the same shape change in each grid. The high-level volume creation and manipulation tools will greatly simplify this process and enable the optimization of complex problems. Also, the optimization process will be sped up by taking advantage of advanced parallel computers. The successful addition of evolutionary optimization algorithms to Sculptor will provide the ability to create a broad range of optimal designs that can be produced based on different and often competing objective functions.

The SBIR also means that NASA Stennis Space Center will be able to leverage its CFD analysis capabilities to quickly troubleshoot engineering problems and produce timely solutions, and the Sculptor CFD design tool will become available for all of NASA as well as other government agencies and the commercial marketplace.

NASA SBIR projects are not new to the Optimal Solutions team. In 1998, Optimal captured a **DOD/Air Force** SBIR for "Efficient CFD-Based Aerodynamic Shape Optimization," an application of the technology to the optimization of aircraft shapes. An initial shape was provided, along with certain criteria for design optimization such as maximizing the lift-to-drag ratio through all angles of attack. Improvements in these aircraft shapes delivered more maneuverability during flight to perform evasive actions.

David Alexander

Briefs

Raytheon Space and Airborne Systems has added to its design and digital simulation solutions with new seats of NX Nastran, NX TMG Thermal Analysis, and Femap from **UGS**. The agreement calls for deployment of NX digital product-development solutions across multiple Raytheon programs. UGS with its partner, **Maya Heat Transfer Technologies**, will develop customized advanced thermal analysis software to simulate high-energy laser systems.

NASA is working with **SGI** and **Intel** to dramatically increase the agency's supercomputing capacity. NASA will integrate a cluster of 20 interconnected SGI Altix 512-processor systems to create the Space Exploration Simulator. Based at NASA **Ames Research Center**, the new machine, part of "Project Columbia," will provide an estimated ten-fold increase in supercomputing capacity. The primary purpose of Project Columbia is to upgrade NASA's supercomputing capability through deployment of an integrated computing, visualization, and data storage environment.

Alenia Aeronautica has purchased a high-performance iHawk multiprocessor graphics system from **Concurrent Computer** for its next-generation unmanned combat air vehicle simulation platform. Alenia will use Concurrent's Linux-based NightStar toolkit, a standards-based set of real-time software development tools designed to allow integrators to identify and correct problems early in the project life cycle.

Lockheed Martin will use multicomputers from **Mercury Computer Systems** in the guidance electronics unit of the Joint Common Missile (JCM) system. The tactical version of Mercury's RACE++ Series commercial off-the-shelf hardware will be used. The JCM system is the next-generation air-to-ground missile that will be carried by both fixed- and rotary-wing platforms across the U.S. armed forces.