ALGOR Software Offers a Cost-Effective, Quality and Feature-Rich Solution

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The combination of modern design and finite element analysis (FEA) software is making it possible for more engineers to speed up time to market and make better, safer products at a lower cost. While CAD and FEA are not new to the engineering field, what sets today's tools apart from those of the past is the capability to directly exchange data between 3-D solid modelers and FEA software within a modern, intuitive user interface.

Among the FEA and CAD software available, I use ALGOR software in conjunction with Autodesk Inventor. ALGOR is a complete FEA solution that offers a good combination of cost-effectiveness, quality and features within ALGOR FEMPRO, an easy-to-use interface. ALGOR provides all the necessary features for directly capturing 3-D solid geometry from Autodesk Inventor, generating a high-quality solid FEA mesh, easily setting up loads and constraints, performing analyses quickly, evaluating results and presenting a final design.

From CAD to an FEA Mesh

Today's 3-D solid modelers are extremely powerful and better than the CAD tools of the past. Although there is a learning curve involved in adopting a 3-D solid modeler, the advantage is that it makes initial geometry creation easier and modifications to that geometry much easier. The benefits of 3-D CAD extend to FEA model creation because today's FEA tools work so seamlessly with these applications. Utilizing 3-D solid and surface modelers as the primary design tool allows creating the 3-D-product geometry once and when complete, using it for all subsequent downstream activities. Typically these can include all of the following: 2-D and 3-D FEA, creation of 2-D detailed drawings, 3-D assembly exploded drawings, 3-D CNC manufacturing, and graphics illustrations for training materials, sales & marketing materials, and product documentation.

ALGOR's InCAD technology provides direct CAD/CAE data exchange with leading CAD solid modelers including Autodesk Inventor, CADKEY, Mechanical Desktop,

Pro/ENGINEER, Solid Edge and SolidWorks. I find that InCAD technology works well to accurately capture the geometry I create in Autodesk Inventor whether for a single part or a complete assembly. This technology eliminates the need to recreate geometry specifically for FEA purposes or to translate CAD geometry to a universal file format. Plus, full associativity is available to facilitate the typical process of performing multiple, iterative analyses on an evolving design.

The real power of InCAD technology is in the meshing tools it offers. The capability to create surface and solid meshes with control over mesh size parameters and do that quickly is a technology that has made the integration of CAD and FEA practically effortless compared to manually building the mesh. InCAD's meshing tools automatically create high-quality meshes, but still provide full control over the mesh size when needed.
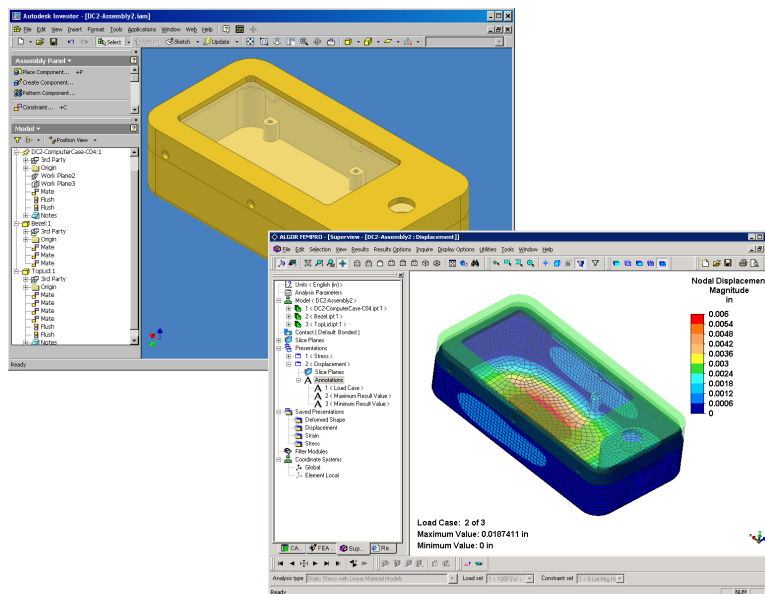
ALGOR's InCAD technology provided direct CAD/CAE data exchange of this oceanographic instrumentation housing from Autodesk Inventor (top) for a linear static stress analysis (bottom).

For the oceanographic instrumentation model shown here, I simply entered my desired mesh size or it can be selected with the sliding control bar. The software automatically created a surface mesh and then I created a solid mesh using the automatic mesh engine. I prefer to generate the surface and solid meshes separately in order to access meshing options at each step. However, the meshing tools also offer an automatic, one-

step meshing option and include mesh refinement tools such as point-and-click definition of areas where a finer mesh is desired and automatic, intelligent, feature-based refinement.

Setting up and Performing Analyses

After creating a mesh, the next step is to set up and perform an analysis. ALGOR FEMPRO is a modern interface that lets me work visually in 3-D. It includes Windows-style features such as right-click functionality for loads, constraints and FEA properties, tree views that visually guide me to provide all of the necessary information, multiple view windows, docking toolbars and context-sensitive menus that are tailored to particular steps in the analysis process.

I find that working directly and visually on surfaces and parts of a model is fast and efficient. It lets me take advantage of ease-of-use features such as the capabilities to select multiple surfaces with the control key or copy and paste loads and constraints from one surface to another. Modern FEA interfaces, like modern CAD interfaces, let you do what you need to visually rather than having to use the keyboard or by entering command-line directives. Such an interface can be navigated by common sense because there simply isn't as much that you have to learn.
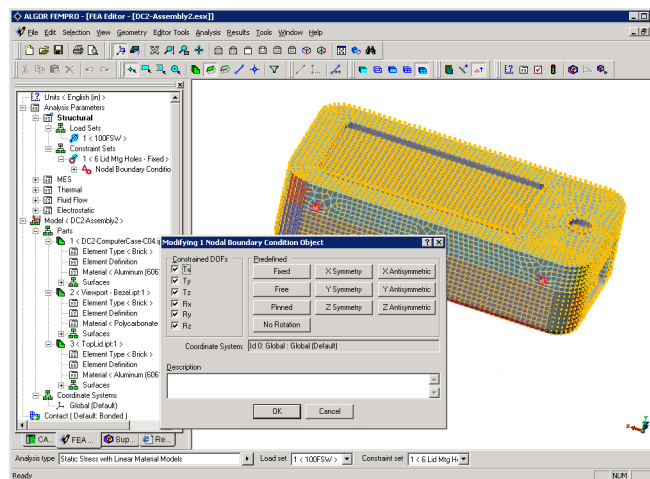

Working directly and visually on surfaces and parts of a model enables users to take advantage of ease-of-use features such as the capability to copy and paste loads and constraints from one surface to another.

In the case of the model shown here, I applied a pressure load on the outer surfaces and constraints at the screw holes. I then performed a linear static stress analysis. Although I only needed linear static stress analysis for this model, ALGOR offers a wide range of add-on capabilities including static stress and Mechanical Event Simulation (MES) with linear and nonlinear material models, linear dynamics, steady-state and transient heat transfer, steady and unsteady fluid flow, electrostatics, full multiphysics and piping.

Evaluating and Presenting Results

Once the analysis is complete, the results can be viewed in ALGOR FEMPRO's Superview IV Results environment. This environment provides extensive results evaluation and presentation capabilities and features transparent display options, multiple-window displays, fast dynamic viewing controls and customization options including user-defined color palettes and annotations. All analysis results can be displayed graphically as contours or plots; output in a variety of image formats; animated with AVI creation and display tools; and presented in text or HTML reports.
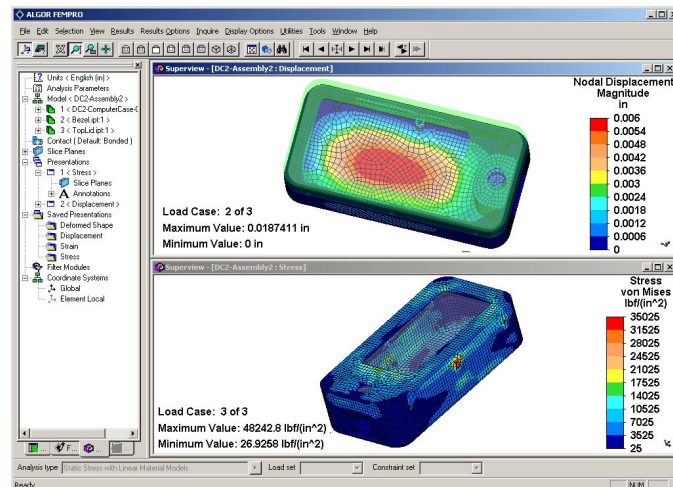

ALGOR FEMPRO's Superview IV Results environment enables engineers to view different types of results in multiple view windows. In the lower frame, the viewport is displayed transparently to reveal the stresses inside the housing.

For the model shown here, I viewed von Mises stress and displacement results. In addition, I used the capability to make parts, such as the housing's viewport, transparent. Capabilities like transparency that enable me to dissect models help to view

and present results on complex assemblies. This feature is representative of the wide array of results visualization tools available in ALGOR FEMPRO.

Extensive visualization capabilities enable me to perform the most important step in the FEA process – verifying that the model and analysis set-up lead to proper results. At a minimum, I compare the results to simple hand calculations to see if the magnitudes are reasonable. In addition, it is important to look at where high stresses are occurring on the model. An engineer should always be able to explain why the high stresses are occurring where they do, what the weaknesses of a design are and how critical they are.

In addition to providing results evaluation capabilities, ALGOR FEMPRO includes a report wizard that collects information from any analysis and automatically generates an organized, professional report in standard HyperText Markup Language (HTML). These reports can then be shared with my clients by publishing them to a web site, or via email.
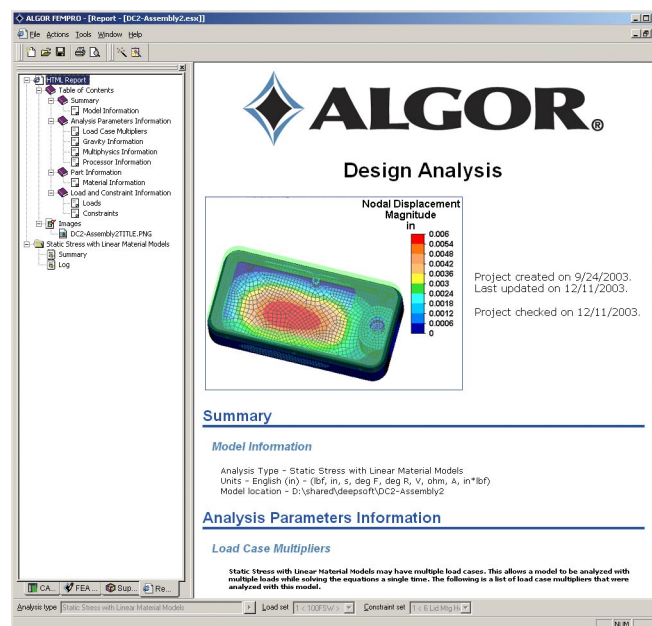
ALGOR's report wizard collects information related to any analysis and automatically generates an organized, professional report in standard HyperText Markup Language (HTML).

A cost-effective, feature-rich FEA solution such as ALGOR software makes it possible for design engineers to perform rigorous FEA at any point in the design process. By integrating these tools into the design process, engineers can improve designs early in

the design cycle, reduce the number of prototypes needed, speed up time to market and make better, safer products at a lower cost.

Sidebar:

Designing Oceanographic Instrumentation

Oceanographic instrumentation measures temperature, pressure, current and other information about the ocean. These devices may be deployed on buoys, set adrift in the ocean to track currents or be carried by divers performing research.

The model featured in this article is for an oceanographic instrumentation housing. It was designed to withstand the pressure of the ocean at a maximum of 200 feet. The analysis was carried out by applying pressure loads that represent the ocean pressure at 100, 200 and 300 feet, while boundary condition constraints were applied to represent the screws that hold the top and bottom of the housing together. DeepSoft will also provide the programming for the electronics within this instrument in addition to performing the design optimization for the housing.

DeepSoft, Inc. (www.deepsoftinc.com) specializes in providing mechanical engineering, software engineering and ocean engineering services. Ted Fryberger, P.E., DeepSoft's principal, has a Master's degree in Mechanical and Ocean Engineering from the University of California at Berkeley. He has used FEA for over twenty years and has been an ALGOR customer since 1988. He has worked on projects in the nuclear waste, aerospace and manufacturing industries as well as oceanography projects.