Enbedded FEA - The Future of Design

Written by Tony Abbey

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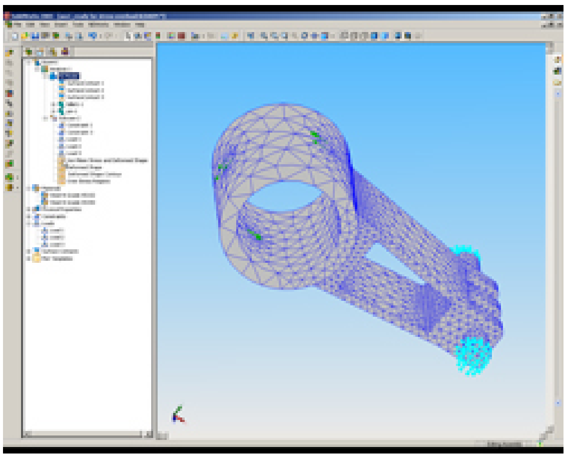
Integrating Nastran into MCAD is the next step in design.

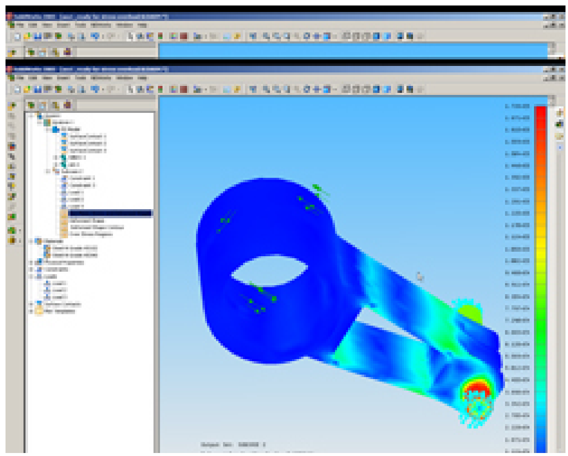
The origins of many traditional preprocessors such as FEMAP and PATRAN go back some way. The earliest third-party preprocessor I remember using was SUPERTAB, long absorbed into the Master Series family from SDRC, now absorbed into UGS. This used a purely mesh-based operation. No geometry creation was possible or even understood. The cutting-edge was digitizing a 2D mesh from a paper drawing!

FEA has evolved a long way since then, but geometry creation and analysis have remained separate and not necessarily equal parts of the process. Logically, therefore, the next step in that evolutionary path is the seamless integration of FEA and MCAD. Here’s a look at our past, where we stand today, and what we can see of tomorrow.



Early Struggles

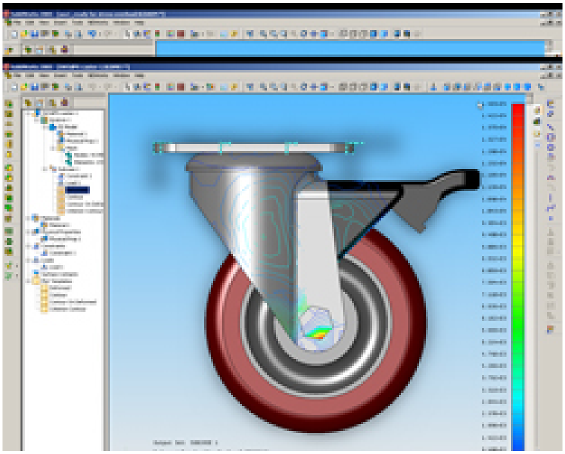
The original PATRAN of the early 1980s was a radical departure in that geometry was the basis of all mesh creation techniques. This was a difficult concept to grasp initially. There were no 3D MCAD products in existence then, so the merit of geometry was not obvious—we wanted to get on and mesh. However, after a very short but steep learning curve, the benefits of association with geometry were clear. Remeshing was independent of existing mesh; loads and boundary condition remained after mesh deletion. The irony now was that there was no MCAD data to import, as none existed. 3D MCAD was slowly emerging in the form of CV, CADAM, CATIA, etc.The geometry tools of those days inside the preprocessors were very much up to scratch with the 3D MCAD products themselves, with basic solid modeling, lofting, and skinning techniques in wide usage. GEOMOD from SDRC was a tool far ahead of it's time, able to model very sophisticated 3D shapes. The Royal College of Art, London, adopted it for a period for pioneering work in 3D modeling and visualization.



The new challenge was importing MCAD data into a preprocessor. The earliest attempts were with the IGES protocol. That was basically a disaster. Getting over 80% of curve data successfully imported was considered a success. Surfaces were a faint hope. Many analysts, still traumatized by that experience, have kept clear of MCAD data ever since and happily build geometry in the preprocessor environment. Now data import is far cleaner and robust geometry in an MCAD sense is usually obtainable with some tweaking of tolerances. My definition here of success is that the geometry is exported identically to the geometry as it is read in.
Sadly the preprocessors have largely followed their own direction in terms of geometry creation and manipulation. To some extent this is a reaction to the rapid growth of 3D geometry functionality in the MCAD industry. Rather than compete with true MCAD products head on, development has been patchy with some attempts made to integrate with ACIS or Parasolid kernels.

Embedded Analysis the Solution
These days the best advice is to create and manipulate geometry in the MCAD environment and to mesh in the preprocessor. Both are good at their own tasks, but do not crossover well.This brings us back to the issue of importing MCAD. How well does the

average preprocessor understand the native geometry it finds? The challenges are twofold: interpreting the mathematics behind the geometry definition and dealing with all the well-known geometry issues, such as incomplete, infeasible, or distorted entities. A whole industry has been built around fixing up MCAD data to make it meshable. Many palliatives exist but no real cure.
Embedded FE analysis inside the MCAD environment is a very attractive solution. After all, the analyst should find geometry creation and manipulation inside products such as SolidWorks and Autodesk Inventor a lot more straightforward than the hoops he is used to jumping through in a modern preprocessor. And since the designer lives and breathes in that MCAD environment, the introduction to analysis can at least be made in a familiar environment.



For both of these professionals, they can see the influence of the mesh as it adapts to the evolving design at every stage. The quality of the mesh is fundamental to accuracy and to the minimization of manual fixes.

The key to making this work is the quality and performance of the FE solver. At Noran Engineering we have recently released V1.1 of our embedded MCAD solution, NEiWorks. This brings Nastran, an industrial strength solver with wide acceptance, into the SolidWorks environment. The key to success here is that the Nastran data structure is transportable and can break down barriers between design and analysis. Not only will SolidWorks users be able to send their work to other Noran Engineering analysis applications like NEiEditor and NEiModeler, but also to other vendors' Nastran interfaces as well, such as MSC.Patran.

We have already seen success stories with clients using NEiWorks embedded in SolidWorks defining the design, carrying out basic analysis, and then passing the project off to analysts to carry out complex nonlinear analysis. The analyst is not constrained to the SolidWorks environment; he has access to the established Nastran analysis community with the option of using the NEiEditor and NEiModeler to harness the full capabilities of NEiNastran as needed. He can also share results with vendors, suppliers, and partners who may have other vendor Nastran interfaces.

The future of FEA is firmly linked to the embedded MCAD solution.

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Product Information

NEiWorks
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