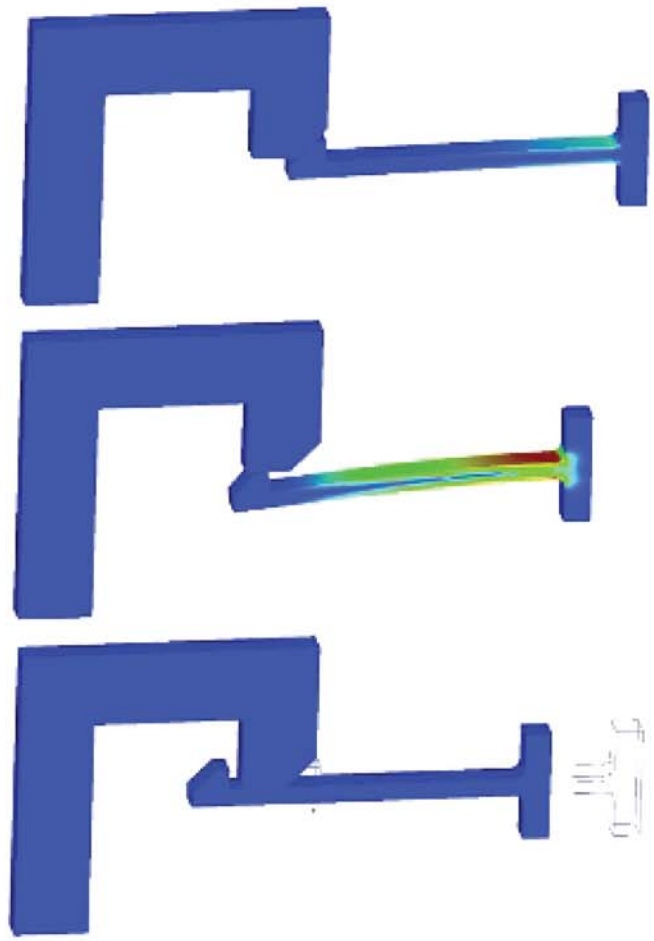
FEA works inside CAD

Edited by Leslie Gordon



NEiWorks, a finite-element analysis tool, runs inside of SolidWorks 3D CAD, letting users perform linear static, nonlinear, and dynamic analysis on parts and assemblies. The tool is based on a Nastran solver. Nastran was developed by NASA in the 1960s and is considered a standard for engineering analysis in many industries.

NEiWorks targets beginning and advanced users. Tutorials and an automatic mesher appeal to new users, while advanced users can exploit the program's nuts-and-bolts level of control, for example, in modifying input-deck data files. The FEA program comes in a basic version, which includes linear static and modalanalysis capabilities, and an expert version, which builds on this to let users perform analyses including nonlinear static, linear buckling, prestress normal modes, and linear steady-state heat transfer.

Users can perform even moreadvanced analyses with the NEiEditor. This is a separate utility with its own interface. It gives users additional control of the analysis model and provides useful information on the modeling process. The Editor displays several windows, each with a different aspect of the analysis model. For instance, the Nastran window shows the lines of the Nastran input file (the NAS file) that are passed to the solver, the program that executes the matrix-math algorithms that find solutions. The Analysis window, active only during an analysis, shows the progress of the solution and status messages coming from the solver.

The Model/Results window shows preprocessing, or preparation of the analysis model for a solution, and postprocessing, or the results of the analysis. When a solution completes, the Errors/Warning window provides messages that help diagnose and correct FEA-model errors.

The software also generates a text output and a results file. A

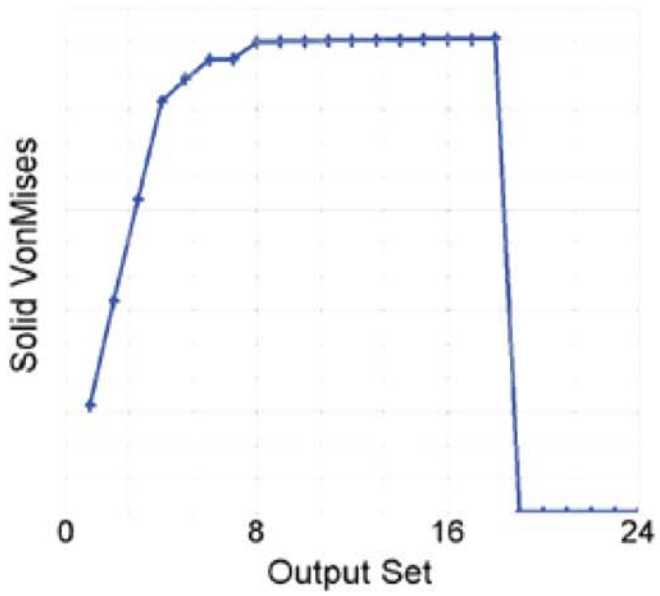
Results Summary window summarizesthe text output file, while the Model/Results window displays color-contour plots generated from the information in the results file. Users can also view the model with loads and constraints and prepare graphical presentations of results including multistep animations of solutions.

In a recent application, we performed a full multistep nonlinear static analysis of a snap-action latch, a childproofing device for securing cabinets and doors. Of particular interest is the stress in the latch, important in determining the number of use cycles. It's a nonlinear problem because the solver gradually deforms the model in several small steps. One part of the device travels over a large displacement as it contacts a catch, slides over it, and eventually engages. NEiWorks accounts for friction and contact forces while calculating and displaying

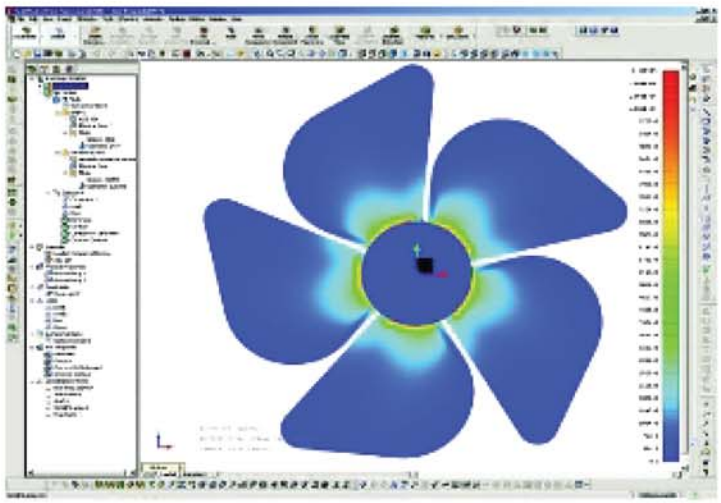
the stress from each increment of displacement. The software displays color contour models and plots of the stresses and deformationsfor each step. Another application let us take advantage of NEiWorks' support of one-way fluid-structure interaction (FSI) problems. This is a class of multiphysics problems which involves several different simultaneously occurring physical phenomena. FSI problems are set-up with third-party computationalfluid-dynamics (CFD) programs to allow using results from one simulation as loads or boundary conditions for a second simulation. This let us simulate the mechanical stress on a propeller as it is driven through water. The CFD program computes reaction forces on the propeller from the water, and NEiWorks calculates the stresses from the reaction forces.

It took less than half a day to prepare and run the analysis model. We imported a solid model of an 8-in. propeller from the **SolidWorks** Web site (solidworks.com) into SolidWorks, installed the propeller on a shaft, and "submerged it in water." We then opened NEiWorks in the SolidWorks interface, applied basic boundary conditions, meshed the model, and the program created a NAS file. After the CFD model is run, results are written into the NAS file. We then open NEiEditor to run the analysis. Postprocessing in SolidWorks or the NEiEditor shows stresses are at the roots of the blades.

NEiWorks doesn't include rotational-velocity loads, so the simulation can't show stresses on the blades due to centripetal acceleration.



NEiWorks computes and displays stress on a childproofing latch as it contacts a catch, slides over it, and engages. Each step shows stresses. The bottom image includes a wire frame of the undeformed part. The plot shows the peak von Mises stress for each step.



Postprocessing a propeller simulation in SolidWorks shows high stresses are at the blade roots.

Analysis is thus restricted to low rotational velocities of the propeller. A feature for such tasks will be available in a future version. However, advanced users can type loads such as these directly into the Nastran file using the NEiEditor.

NEiWorks is a relatively new program so a few small details are rapidly being improved. But results from good models are trustworthy because the tool is based on NEiNastran, a solver used in industry for over a decade. NEiWorks comes from **Noran Engineering Inc.,** 5555 Garden Grove Blvd., Suite 300, Westminster, CA 92683, (714) 899-1220, *NENastran.com*

— Roxanne and Alan Abul-Haj

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