Winter, 2004

Volume 2, No. 1

DEFORM™ News

Events:

- The Spring DEFORM™ Users Group Meeting in North America is being planned for the second week of May, 2004.
- A DEFORM™ Users Group Meeting in Europe is being planned for late May, 2004 in the UK.
- SFTC will present multiple papers and host an exhibit at Numiform in June in Columbus, Ohio. We will participate in a wide range of conferences and exhibits throughout the year. Contact us for more information.

Training:

- January 13 & 14, 2004: 2D training (DEFORM™-PC, DEFORM™-PC PRO & DEFORM™-2D) will be conducted at the SFTC office in Columbus, Ohio.
- January 15 & 16, 2004: 3D training will be conducted at the SFTC office.
- February 24 & 25, 2004: 2D training will be conducted at the SFTC office.
- February 26 & 27, 2004: 3D training will be conducted at the SFTC office.
- Advanced training is being planned in conjunction with the May Users Group Meeting.
- The 9th annual die stress workshop is being planned for mid-August at Marquette University.

The Newsletter

During the fall of 2003, two major releases were distributed to our users. DEFORM™-3D version 5.0 and DEFORM™-2D version 8.0 included a number of new capabilities.

In this edition of the DEFORM™ News, we will highlight a few of the more significant advancements that are now available to our users.

Drop Positioning

The initial positioning of the workpiece in the bottom die has been a challenge to users running three-dimensional simulations. This has particularly been difficult for hammer parts in the early blows. The original location can be a tedious task, but can have a significant influence on the final solution. In cases where a part falls into a cavity and many stable positions exist, judgment is required to determine the most likely position.

With the addition of gravity-based positioning, accurate results are obtained with very little time and effort by the user. This new method allows for both part rotation as well as any shifting within the cavity that would occur in the shop. The required inputs are the object to be dropped and the direction of gravity. Additionally, a single allowable axis of rotation can be specified for cases where the part is positioned can be placed in a cavity in a specific manner. This provides an allowance for cases where symmetry can be used in the simulation.

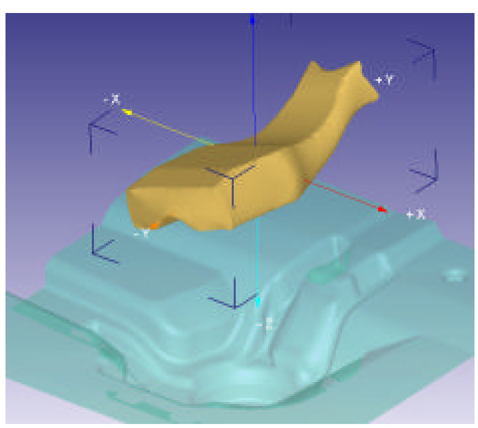
Shown in Figures 1 and 2 are the initial and final positions for a steering link simulation where the result was sensitive to accurate initial positioning of the part. The part both dropped into the cavity and rotated to find the correct initial position. This capability resulted in a correct solution in a process that is sensitive to the initial workpiece position in the bottom die.

This algorithm is very efficient. Interactive positioning of the workpiece is completed in seconds for most cases.

Modeling Fracture in 3D

Metal forming processes frequently include an operation where a 'slug' or flash is mechanically removed using a shearing process. This is essentially a controlled form of ductile fracture. Simulating fracture has been performed by geometric manipulation (boolean in a CAD system) or process simulation. Geometric methods may approximate the final shape, but require a user to determine the fracture path. Simulation methods have included element deletion, user-defined fracture path, flow softening and others. DEFORM™-2D was the first commercial FEM program to offer the automated calculation of trimming operations in 1995.

(over)



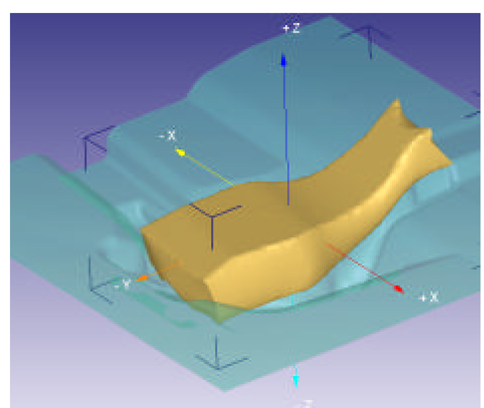


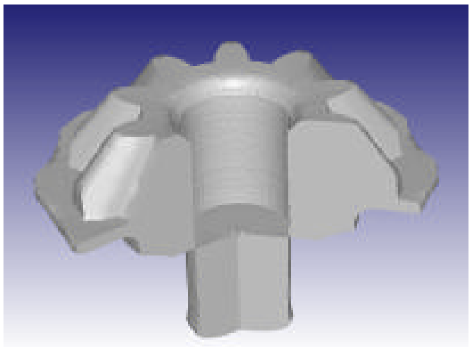
Figure 1 (left) shows the steering knuckle preform arbitrarily positioned above the die cavity. Figure 2 (right) shows the location after positioning.

DEFORM™

Design Environment for FORMing

(continued)

The simulation of three-dimensional trimming operations has been a challenge in the past. Recent developments have resulted in two methods of modeling fracture. Damage-induced flow softening and element deletion are both available in DEFORM™-3D version 5.0. Fracture initiation and crack growth is based on critical damage value using one of a number of popular models. This value is a function of the material and processing history. Damage model and critical values should be obtained experimentally.



To illustrate the capability, the bore of a hot forged gear is trimmed using a piercing operation. This was simulated using both element deletion and flow softening. The final results of a section can be seen in Figures 3 and 4. Flow softening provides a noticeably smoother result. Over time, this capability will be enhanced to optimize the methodology and improve resolution without mesh-induced surface roughness.

Figure 3 (left) demonstrates the trimming of a hot forged gear with a center slug using damage-based flow softening. Figure 4 (right) shows the element deletion methodology.

Three-Dimensional Die Stress Analysis

A very sophisticated die stress analysis capabilty has been available in DEFORM™ in two dimensional simulations since the early 1990's. Small elements are required to accurately model the high localized stresses in small features associated with net and near-net shape forming operations. In three-dimensional simulations, die stress models could grow quite large. This resulted in high memory requirements and long solution times. The problem was compounded by the requirement to include multiple objects in the analysis.

With DEFORM™-3D version 5.0, the conjugate-gradient (C-G) solver can now be used to significantly reduce the memory requirements and improve computing speed for elastic die analysis. As seen in Figure 5, the amount of memory required for an elastic die analysis is significantly reduced compared to the sparse solver. Figure 6 also shows that the simulation times are significantly reduced from an identical model running with the sparse solver. This provides DEFORM Users an opportunity to run very complex three-dimensional die stress models.

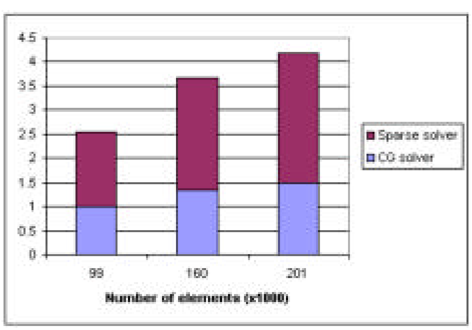


Figure 5 shows the improvement in memory requirements with the C-G solver. The 'Y' (vertical) axis in this graph represents memory requirmenets.

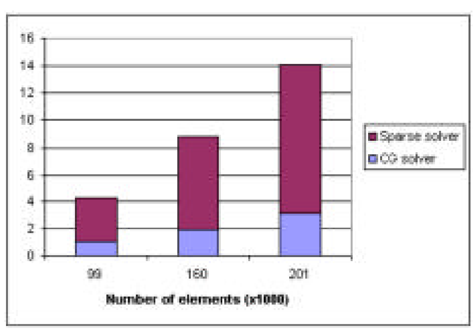


Figure 6 (right) shows the reduction in CPU time using the C-G solver. Note that the relative performance improves in larger models for both measurements. The 'Y' axis n this graph is solution time.

Upcoming Releases

DEFORM™-3D version 5.0 and DEFORM™-2D version 8.0 were released in the fall of 2003. As a result of continued testing, additional enhancements will be available in the form of a service pack in early 2004.

Continued developments will be released in rapid-fire pace in 2004.

A transition plan for DEFORM™-PC and DEFORM™-PC PRO to a new GUI (graphical user interface) is in process.

An application server is under development for DEFORM™-3D. This will provide a utility for a simulation to be submitted to a remote computer. This will require a floating license and simulation queue.

Ongoing developments in geometry, mesh generation, FEM speed, heat treat applications, ALE (steady state) solutions, GUI, preform design and optimization are all underway. An improved 2D induction heating model has been developed. Future development of a 3D induction heating model is planned. More details will be available as the year progresses.

Scientific Forming Technologies Corporation

5038 Reed Road
Columbus, Ohio
43220-2514
Tel: (614) 451-8330
Fax: (614) 451-8325

www.deform.com

email: sales@deform.com