Fall, 2003

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DEFORM™ News

Events:

- The Fall DEFORM™ Users Group Meeting in North America will be held on October 28 & 29, 2003 at the Sawmill Creek Resort in Huron (northern), Ohio. Contact us for more information.

Training:

- October 21 & 22, 2003 - 2D training (DEFORM™-PC, DEFORM™-PC PRO and DEFORM™-2D) at the SFTC offices in Columbus, Ohio
- October 23 & 24, 2003 - 3D training at the SFTC offices in Columbus, Ohio
- October 30, 2003 - advanced 2D training at the SFTC offices in Columbus, Ohio
- October 31, 2003 - advanced 3D training at the SFTC offices in Columbus, Ohio

DEFORM™
Design Environment for FORMing

The Newsletter

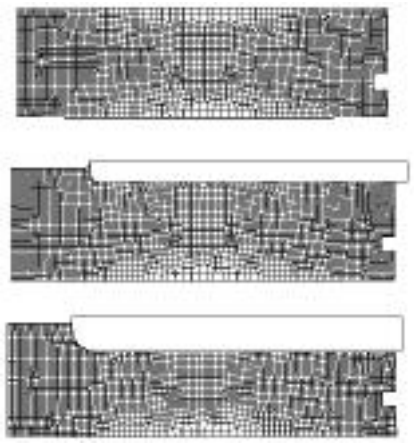
Scientific Forming Technologies Corporation is pleased to announce the first edition of the DEFORM™ News. This newsletter will be published quarterly and will feature a schedule of upcoming events, DEFORM™ applications and current developments.

In this edition, we will highlight the topic of machine distortion. A paper is being published at this time with more details. Additionally, new DEFORM™ capabilities are summarized on the reverse side.

Machining Distortion

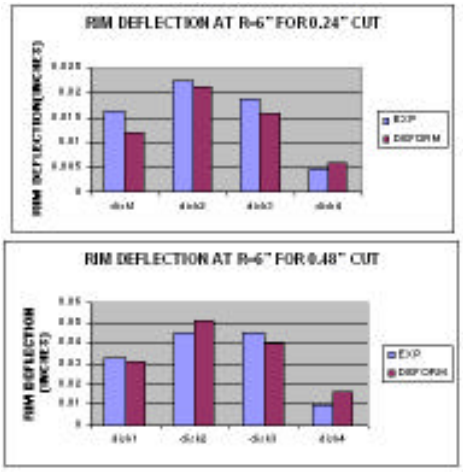
The uncontained failure of rotating turbofan components, while uncommon, is the leading cause of aviation accidents related to engine failure. In order to reduce the number of rotating component failures, the number of potential defects in these parts must be reduced.

Aircraft engine rotating components are generally manufactured by forging followed by heat treatment. Due to the residual stresses induced during heat treatment, the component distorts when material is removed during the machining process. This distortion must be minimized. The parts must be manufactured to very tight dimensional tolerances to perform properly in an aircraft engine.



A sequence of machining operations which ensures that the final component is produced to the required tolerances was developed in a joint project by Scientific Forming Technologies Corporation, GE Aircraft Engines, Air Force Research Laboratory, and NASA. This machining sequence was created using a simulation procedure that can predict distortions created during the machining process.

To validate the procedure and the developed model, four disks were forged and then heat treated under different conditions. Multiple machining cuts were carried out on the top side of the disks (figure - lower left). The distortion at the bottom of the disks was measured. Distortion is dependent on the magnitude and distribution of the internal residual stress resulting from the heat treatment process.



DEFORM™-HT was used to model the four heat treatment processes. The stress evolution during the heating, cooling, and stress relief processes was accounted for. The residual stress state at the end of heat treatment was used as the initial condition of the material removal analysis. A local remeshing capability was developed to minimize the interpolation error when material was removed from the workpiece. The workpiece deformed as the stress reached a new equilibrium state after each material removal pass. Excellent agreement between the measured distortion and the model prediction was observed (figure - above).

The developed model is a useful tool to understand heat treatment and machining distortion and can be used in the design and optimization of these processes.

Upcoming Releases

DEFORM™-3D version 5.0 and DEFORM™-2D version 8.0 will be released in the upcoming weeks. We are in the final stages of testing at this time. A summary of new and enhanced capabilities is included below. The new graphical user interface (GUI) has been developed for both systems in this release. Additionally, a partial list of the most popular shortcuts is included (sidebar) for your reference.

DEFORM™-2D version 8.0

- Interbody radiation heating has been added to DEFORM™-2D. The new algorithm will include a view factor calculation between discrete bodies or between different surfaces of a single object.
- Trapped gas between a workpiece and die has been implemented. Defects resulting from trapped gas and lube appear as an underfill in production. This new implementation will allow an accurate study of this phenomena.
- A derivative of the DEFORM™-3D graphical user interface (GUI) has been implemented. This GUI was initially released with version 4.0 service pack 5. It runs in native mode in WINDOWS and UNIX.
- New 'wizard-style' modules are available to prepare the input for inverse calculation of heat transfer coefficients and the setup of heat treatment simulations.
- The mechanical press model has been enhanced to improve solution accuracy.
- An infrastructure for multi-language support has been included in this release of DEFORM™-2D.
- State variables can be plotted as a histogram showing the variable distribution throughout the part.

DEFORM™-3D version 5.0

- A new and improved graphical user interface (GUI) has been included in DEFORM™-3D. See the sidebar (right) for some of the popular key-board shortcuts. This GUI is very sophisticated and offers a powerful Open-GL visualization running in native mode for both WINDOWS and UNIX.
- New 'wizard-style' modules are available to assist with quick problem setup for forming (hot and cold) processes, as well as a new blocker design and verification program.
- Symmetry has been improved to provide a more robust simulation with simplified data input. See the release notes for details.
- A sophisticated contact algorithm has been implemented that provides a true three-dimensional multiple deforming body capability for large deformation.
- A new formulation has been developed for elasto-plastic objects, which has exhibited improved robustness.
- DEFORM™-3D now supports fracture & damage-based material softening for applications in shearing, blanking, trimming and machining.
- A gravity-based positioning feature in the preprocessor provides a fast and accurate method of calculating the initial positioning of the workpiece in a die - especially in hot forging.
- New variables are available for better determination of die fill and the occurrence of folding.
- Folds (laps) are now automatically removed and marked in the postprocessor.
- Anisotropic material properties have been implemented in DEFORM™-3D.

Frequently Used Shortcuts New Graphical User Interface

File Menu

Ctrl-N	new problem	MAIN
Ctrl-O	change browse location	MAIN
Ctrl-H	go to problem directory	MAIN
Ctrl-O	import database	PRE or POST
Ctrl-K	import keyword	PRE
Ctrl-S	save	PRE or POST
Ctrl-P	print	PRE or POST
Ctrl-M	image setup	PRE or POST
Ctrl-I	capture image	PRE or POST
Ctrl-Shift-I	copy image	PRE or POST
Ctrl-W	close	POST
Ctrl-Q	quit	MAIN, PRE or POST

Display Menu (PRE or POST)

Shift + left mouse button	pan
Alt + left mouse button	dynamic zoom
Ctr + Alt + left mouse button	box zoom
Ctrl + left mouse button	free rotate

Tools Menu (POST)

Ctrl-A	animation setup
Ctrl-D	database comparison
Ctrl-U	summary
Ctrl-G	X-Y graph
Ctrl-R	state variable
Ctrl-K	point tracking
Ctrl-F	FLOWNET
Ctrl-L	slicing
Ctrl-Y	symmetry
Ctrl-X	data extraction
Ctrl-L	slicing

Miscellaneous

Shift + F1	what's this?
F2	refresh
F3	view fit
F4	previous view
F5	view shading
F6	view mesh
F7	view shaded mesh
F8	view surface patches

~ see help files for other shortcuts ~

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