Winter, 2014

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DEFORM™ News

Multiple Operations, DOE and Optimization

Events:

- May 6 and 7, 2014: DEFORM User Group meeting in Columbus, OH

Training:

- April 8-11, 2014: DEFORM training will be conducted at the SFTC office in Columbus, OH.
- June 10-13, 2014: DEFORM raining will be conducted at the SFTC office in Columbus, OH.

The release of DEFORM version 11 (V11) represents a milestone in process simulation technology. Considered the "next generation" of DEFORM, the release introduces revolutionary new architecture with multiple operations (MO), design of experiments (DOE) and advanced optimization capabilities.

The foundation is a fourth generation MO interface and data structure. This environment allows the creation of a process sequence that be simulated with one click of the 'Run' button. When one operation finishes, the system extracts data for use in the following one. Then, it automatically prepares and starts the next operation. This cycle repeats until all defined operations are completed.

The MO interface is both flexible and easy to use. Creation of a process sequence is done through a flowchart-style interface. Operation controls are a powerful blend of guided and open systems. It allows operations to be added, modified, rearranged and cycled. The sequence can include dissimilar operations, such as heating, rolling, forging, cooling and heat treatment.

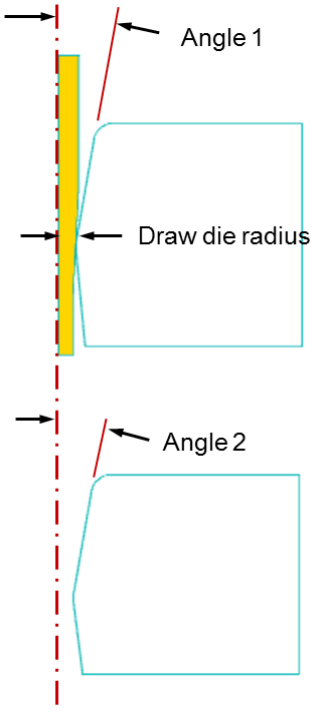
For F2/F3 users, the automated MO environment is supported through the integrated 'Forming Express' and 'Heating Express' tools. These allow a user to set up forming and heating operations, within a process sequence, with minimal input. This is fast, efficient and very capable.

The new DOE/Optimization Module extends these powerful MO capabilities to the study of process and design variations.

DOE is a systematic method to investigate design parameters or process variations. Structured changes are made to one or more input variables of a system. The effects of these changes on output variables are then assessed with a range of powerful graphic outputs.

Optimization is an iterative method used to predict "optimum" design or process variables. A control program examines a system's response to predefined inputs. The program iteratively refines the inputs, in subsequent simulations, with the goal of converging to an 'optimum' output response, within a predefined range and without defects.

The power of the DOE/Optimization Module is in how variations are studied. Input variables can come from different operations and are not required to be homogeneous. For example, they can include furnace temperature, preform geometry and press speed. Once the sequence, inputs and target outputs are defined, the software will automatically run all of the necessary simulations and compile the relevant output data.



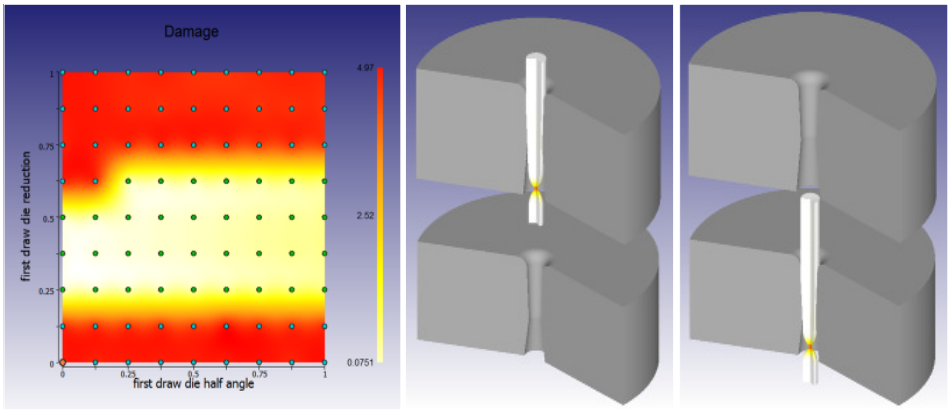
A DOE was performed on the two-die wire drawing process shown above. Variations in the die half angles and the initial draw diameter were evaluated within specified ranges.

DEFORM™
Design Environment for FORMing

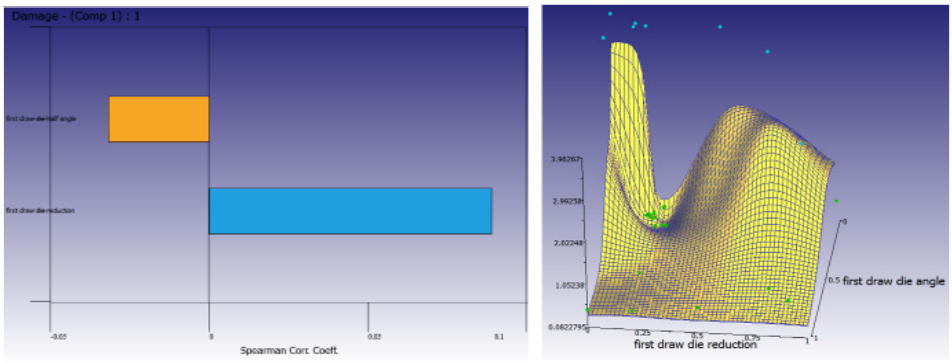
The efficiency of the DOE/Optimization Module is illustrated by the minimum setup time. For example, setting up a 'nominal' process might take 15 minutes, once the input data is available. Running 20 variations of this process would take over an hour for a very efficient user. Finally, there is a task of reviewing the results of 20 simulations, which takes significantly more time. Now, the user might spend only 30 minutes total, with output plots created as part of the batch simulation process! The postprocessor automatically extracts data from each simulation and creates 3D surface plots, 2D contour plots, tornado charts, sensitivity graphs and tabular results.

Preprocessing and postprocessing in DOE and optimization are almost identical. DOE simulation iterations can either be run in series or parallel, if multiple licenses are available. Even optimization can be a series of parallel runs.

A two-die wire drawing process (below) was studied using the DOE method. The goal was to determine the die geometries that would successfully produce wire of a particular size, without necking defects. High damage (red) values indicate a risk of necking. The input variations were die half angles, the angles and draw diameter of the first (top) draw die. The DOE studied nine iterations of each variable, for a total of 81 simulations.



DOE results (left) predicted high damage when the initial draw diameter is too small or too large. When it is too small, the wire necks in the first die (center). When it is too large, the wire necks in the second die (right). Tornado plots (lower left) indicated the output was most sensitive to changes in the draw diameter. The DOE established meaningful input variables for a subsequent optimization study. Optimization determined the ideal mix of parameters for the process, within the already verified ranges.



While optimization is a powerful tool, a blend of optimization and DOE can provide far more information about the process. For example, one can review variations in a surface response plot to better understand the robustness or risk of a given design.

These 'state of the art' features will dramatically alter how process simulation is utilized for years to come. Please contact your local DEFORM distributor if you would like additional details on the new DOE/Optimization Module.

DEFORM Version 11 Release

DEFORM V11.0 was recently released, bringing exciting new features and capabilities to DEFORM users. The release includes the following major additions and enhancements:

- DEFORM Integrated 2D/3D (similar look and feel to version 10.x)
- DEFORM Integrated F2/F3 (similar look and feel to version 10.x)
- DEFORM Multiple Operations (MO) interface (new look and feel)
- DOE/Optimization Module
- DEFORM next-generation post-processor with automated report generation
- DEFORM License Manager version 3.0.4 with core licensing capability

A new DEFORM.PWD license file is required to run version 11.

Basic version 11 capabilities are supported by DEFORM License Manager version 3.0.3 (released with DEFORM v10.2.1)

Design of experiments, optimization and core licensing require DEFORM License Manager version 3.0.4

Major New Features

New multiple operations system

DOE and optimization

New cogging module

64-bit preprocessor and postprocessor

New solvers:
- Dynamic explicit elastic-plastic solver
- MUMPS sparse direct solver
- Improved conjugate gradient iterative solver

New material developments:
- Crystal plasticity material model
- Mesoscale microstructural model
- Improved handling of precipitation hardening alloys
- Flow stress as a function of grain size

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