Summer, 2021

Volume 19, No. 3

DEFORM News

Training

SFTC offers DEFORM training for U.S. and Canadian customers on the following dates in late 2021.

- October 12-14
- December 7-9

Additional training details are listed on the DEFORM website.

For users outside the U.S. and Canada, please contact your local DEFORM distributor for more information on the training events available in your region.

Events

SFTC will exhibit in Booth 1020 at ASM Heat Treat 2021, to be held in St. Louis, MO on Sept. 14-16, 2021. The conference is co-located with IMAT 2021 and the Motion + Power Technology Expo.

SFTC will exhibit in Booth 215 at Forge Fair 2021, to be held in Detroit, MI on Oct. 26-28, 2021. Forge Fair is North America's leading forging industry event.

Social Media

SFTC can be found on LinkedIn and YouTube, via the following links.

www.deform.com/linkedin
www.deform.com/youtube

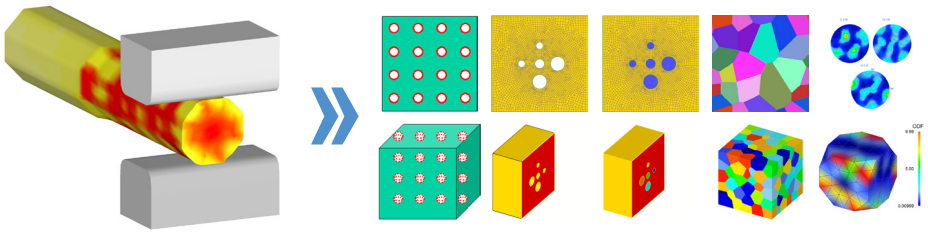
DEFORM®
Design Environment for FORMing

RVE Modeling

Metal forming is a multi-scale problem, involving microscale features (voids, microstructure, etc.) and macroscale (component-level) parts and processes. Simulating certain microscopic behaviors directly within a macroscopic model is, in many cases, impractical due to the time and effort it would require.

SFTC has introduced Representative Volume Element (RVE) modeling, in the DEFORM Material Suite, as a means to efficiently relate the macroscale to the microscale. It utilizes the point-tracked, thermo-mechanical history from a component-level DEFORM simulation to predict response in RVE submodels.

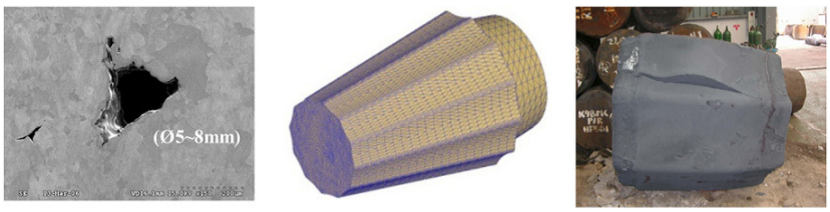
2D/3D RVE modeling offers a generic framework for analyzing microscale features such as porous density, voids, inclusions, grain structure and texture (below). RVE outputs may include micro-level shape, local stress/strain fields, void closure/formation, grain shape/size/orientation, particle size, texture, etc.



Component Model RVE Models

Void Closure Example

Internal porosities, or voids, are typical defects in cast ingots. These voids need to be closed, during initial deformation operations, so they do not later act as initiation sites for cracks or other defects.

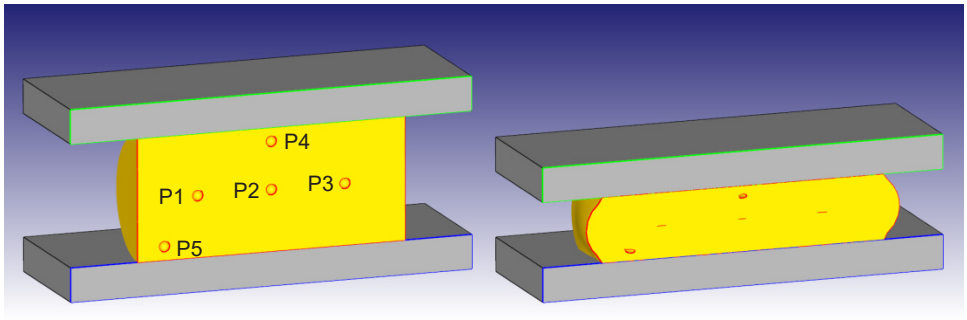


(Internal void) (Cast ingot) (Surface crack)

Lee, Y. S., et al. "Internal void closure during the forging of large cast ingots using a simulation approach." (2011).

Two approaches for evaluating void closure are illustrated in the cylinder upsetting example shown on the next page. A component-level model (top) included discrete void geometries at five locations. DEFORM predicted that voids along the centerline (P1 to P3) closed midway through the forging process. The near-surface voids (P4 and P5) did not fully close by the end of the operation.

The challenge with this approach is that a very fine mesh is required to model small voids in a large part model. As the difference in scale or complexity becomes more extreme, the model size and required runtime become prohibitive.

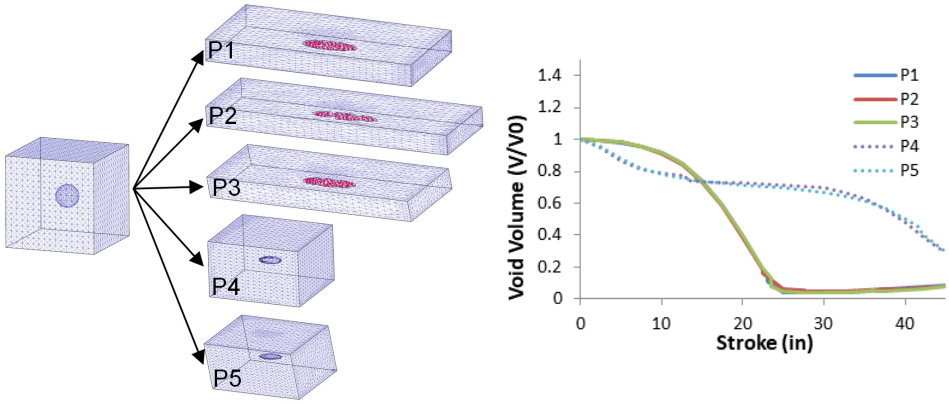


Contrast that with the RVE approach. The first step in the RVE approach is to run a component-level simulation without microscale features. This runs relatively quickly due to the moderate model size. Point-tracking provides the thermo-mechanical history that will be used as an input to subsequent RVE models.

A void closure analysis is then performed using the RVE Model feature in Material Suite. Users may vary the RVE setup and run multiple RVE iterations, all without rerunning the component-level simulation. The RVE models are relatively fast, allowing for efficient evaluation of microscale behaviors.

In the example, a RVE model was also used to predict whether voids at the five locations would close. The five points (P1 to P5) were selected in the component-level model. The strain, stress and temperature of those points were extracted and used for the subsequent void simulations.

The RVE setup for each void started out with the same geometry and mesh. Yet, each model deformed differently depending on the simulation history at that location (below; left). Voids at P1 to P3 closed (red is self-contact) at the same stroke as the above simulation, while voids at P4 and P5 did not close. The volume of the voids was also output, as shown in the plot below (right).



RVE modeling is one important feature of the DEFORM Material Suite, but there are many others. Material Suite will be further discussed in a future DEFORM News. In the meantime, please contact your local DEFORM distributor for more information on this product and its capabilities.

Anniversary Milestone

This year marks SFTC's 30th anniversary! Our company was founded in August 1991 to provide state-of-the-art process design and analysis technologies to the metal forming industry. We would like to take this opportunity to sincerely thank our partners and DEFORM users for their valued trust and support over the years.

30th Anniversary SFTC

DEFORM V12.1.1 Release

DEFORM V12.1.1 (V12.1 Service Pack 1) was released in June. The service pack builds upon V12.1 with an emphasis on bug fixes and small enhancements. Changes in V12.1-V12.1.1 include:

- Multiple object importing
- Enhanced object management
- 2D geometry digitization tools
- Advanced material library search
- Integrated Graph Digitizer
- Hoffman anisotropic yield criteria
- Anisotropic friction improvements
- Multi-blow lift enhancements
- 2D 2nd rotation axis
- Contact pair importing (reuse)
- Max. diameter stopping criteria
- Local stopping criteria windows
- Heat transfer op. die movement
- Mech-to-heat conversion functions
- 2D linear friction welding
- Shape rolling enhancements
- Tube piercing spinning template
- Spinning (express) solver
- Automatic weld path generation
- Heat source path & orientation
- Heat source element activation
- Heat flux boundary condition
- Tool life prediction
- Worn geometry updating
- 2nd gen. cellular automata model
- RVE model with inclusion
- Custom views
- Custom hotkeys
- Cylindrical coordinate indicator
- Region of Interest backtracking
- Heat flux state variable
- Forming limit diagrams
- Next-Gen Presentation Editor
- Geo/Mesh Tool (Beta)
- New (Beta) 2D/3D meshers
- New (Beta) User Manual

The complete list of changes in V12.1.1 is available in the V12.1.1 Release Notes.

Scientific Forming Technologies Corporation
2545 Farmers Drive
Suite 200
Columbus, OH 43235
Tel: (614) 451-8330
Fax: (614) 451-8325
www.deform.com