Simpleware Software Solutions for Materials & Manufacturing
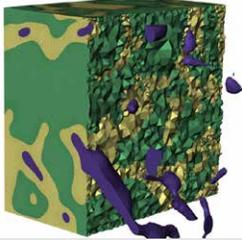From 3D Images to Models

# Applications in Materials Science & Manufacturing

Complex Material Modeling

Multi-Phase Material Meshes

- Optimized segmentation for multiphase, granular and porous materials
- Automatic material/grain/ pore distribution analysis and multiphase material meshing
- FE-based linear homogenization for mechanical, flow and thermal properties

Digital Rock Physics
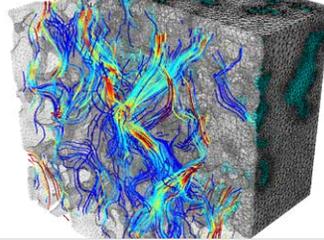
Produce Reservoir Forecasting Data

- Automated and semi-automated segmentation to characterize pore space
- Use patented meshing technology to accurately represent flow path geometry
- Calculate absolute permeability from image data using fully integrated Stokes Solver in Simpleware FLOW

Non-Destructive Evaluation

Simulation-Driven NDE

- Visualize component scan data to observe occluded features, damage and defects
- Characterize features with extensive statistics framework
- Export multi-part FE/CFD meshes to determine the effect of unintended features without the need for CAD idealization
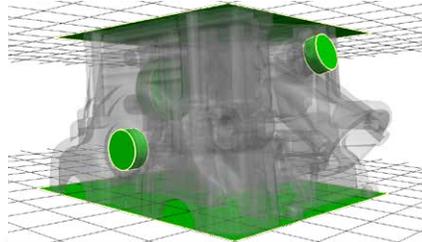
Inspection & Metrology

Visualize and Quantify Defects

- Use automated and semi-automated segmentation tools to model manufacturing defects
- Automatically assess wall thickness, and compare image with CAD
- Export meshes for simulation to determine defect allowables more efficiently

Reverse Engineering

High Value Part Models from Image

- For components lacking CAD data, produce NURBS-based IGES files for import into CAD packages
- Quantify internal geometries with centerline statistics tools and shape fitting.
- Generate meshes for simulation to verify designed features and identify features created by wear
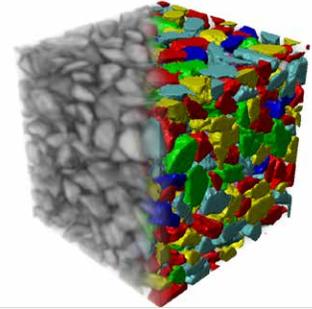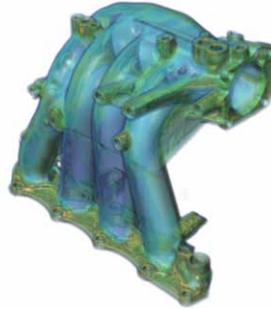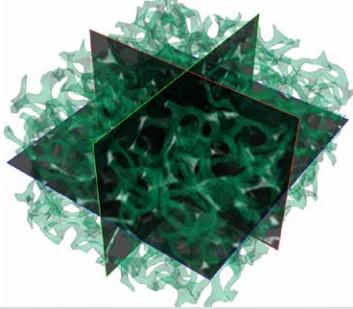
Additive Manufacturing

Robust STL Creation and Design

- Generate watertight STL files ready for Additive Manufacture
- Add internal lattices to reduce weight
- Generate simulation-ready meshes to simulate performance prior to manufacture

From Image Processing through to Model Generation

Import

Modalities

- CT / Micro-CT / Nano-CT
- MRI / Ultrasound
- FIB-SEM
- Confocal microscopy
- 3D EBSD

Formats

- Raw image data (RAW, IMG, VOL…)
- 2D image stacks (BMP, JPEG, TIFF…)
- DICONDE
- DICOM

Options

- Co-registration of multiple datasets

Visualization & Image Processing

Volume rendering

- Fast and memory efficient
- GPU rendering

Mask rendering

- Clipping and opacity settings
- 3D stereo mode options

Image and mask filters

- Noise reduction
- Smoothing and morphological filters
- Wide range of image transforms

Visualization

- Animations toolbox and video export
- Interactive image reslicing
- Export 3D PDF

Segmentation Tools

Automated and semi-automated segmentation

- Region growing and magnetic lasso
- Threshold, floodfill and painting
- 3D editing tools
- Multilevel Otsu segmentation
- Automated watershed-based particle separation tool
- Image-space lofting (interpolation) tool
- Split/merge watershed-based segmentation
- Greyscale-based slice-to-slice propagation

The Simpleware Solution

Synopsys' Simpleware™ software provides an industry-leading, comprehensive 3D image processing platform for handling 3D scan data. Accurately process images with a wide range of tools for visualizing data, obtaining image statistics and carrying out segmentation, right through to generating 3D printing and simulation ready models.

Improve Materials & Manufacturing Workflows

Simpleware software is accessible to both beginners and more advanced users in Materials & Manufacturing. The intuitive interface provides quick-and-easy access to a range of powerful tools. Rapidly handle data from multiple samples and save time when processing even the most complex datasets.

From Image Processing through to Model Generation
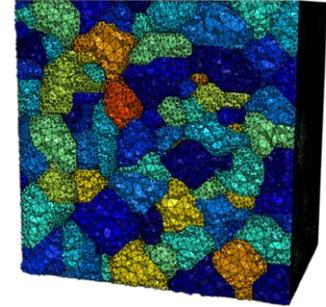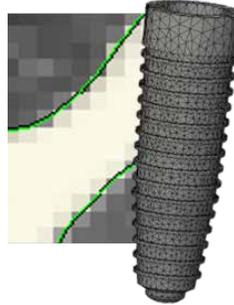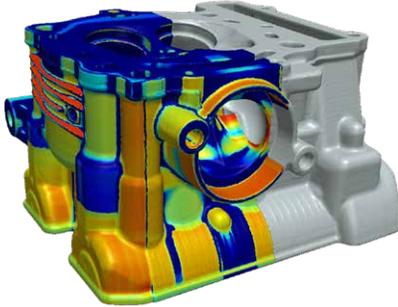
Measurement & Statistics

Interactive tools

- Quick measurements/statistics
- Measure volumes, surface areas, orientations, distributions
- Automatic wall thickness assessment
- Shape fitting and analysis

Image statistics framework

- Quantify phases, grains, fractures, cracks, delamination, particles…
- Inspect porosity distribution
- Centerline fitting and analysis within dedicated tools
- Generate one-click reports to record statistics of interest
- Assess statistics globally or in local regions of interest

Surface Model/Mesh

- Volume and topology preserving smoothing
- High quality triangulations
- Guaranteed watertight surfaces
- Conforming multi-part surfaces
- Range of surface mesh exports
- Verify & visualize contours on image data
- Full user control over global and local mesh coarseness / refinement
- Mesh quality checking tool

FE/CFD Volume Mesh

- Conforming multi-part volume meshes
- Feature-based and user-defined mesh refinement
- Per part meshing controls
- Define contacts, node sets and shells
- Boundary layer meshing for CFD
- Automated positioning of CFD clipping planes
- Dedicated exports for major solvers
- Optimize element qualities against a choice of multiple metrics
- Import and remesh existing volumetric meshes

Fast Quantitative Analysis

With quick, push button statistics and simple measurement functionality, Simpleware software offers easy access to quantitative analysis and rapid quantity calculation. The extended statistical framework provides you with an extensive range of values and statistics templates, as well as the flexibility and ability to input custom functions and create custom templates.
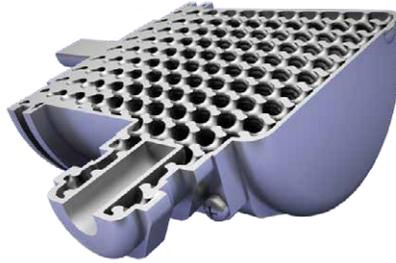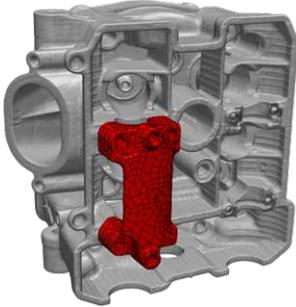
Customize your Workflow with Scripting

All functionality within Simpleware products is accessible from a fully documented API with bindings available for Python, C# and Java. Use this API to automate repeatable workflows, build wizards and integrate custom plugins. By using our macro recording functionality, you can generate code without needing any prior experience.
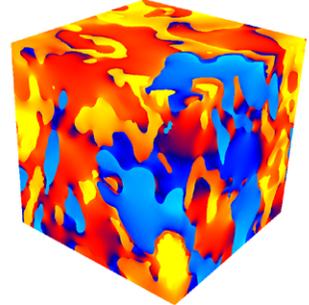
From Image Processing through to Model Generation

Simpleware CAD & NURBS

CAD Integration

- Fast and easy-to-use tools to combine CAD and image data
- Import and natively work with CAD files in image space (STL, IGES, STEP...)
- Landmark registration tools for positioning CAD in image data
- Automatic registration with "Snap" tool for alike surfaces
- Automatic fixing of erroneous CAD data on import
- Preserve CAD feature edges when combined with image data
- Surface deviation analysis for CAD and image data comparisons

Lattice Generation

- Streamlined and flexible process for integrating lattice structures into CAD or image data
- Reduce material weight and customize the mechanical properties of industrial parts
- Library of lattice designs available
- Full control over specific volume fractions and unit cell size

NURBS/CAD Models

- Automated NURBS patch fitting
- Highly accurate conversion
- Inspection tool to check models
- Export as IGES or STEP

Physics Modules


Simpleware SOLID, FLOW and LAPLACE

- Calculate effective stiffness tensor/elastic moduli, absolute permeability, effective electrical conductivity and permittivity
- Calculate thermal conductivity and molecular diffusivity
- Full simulations with built-in FE solver
- Analyze in 3D, 2D or 1D
- Model multiphase materials
- Quick semi-analytical estimates
- Visualize deformations, stress, strain, velocities and pressures
- Assess isotropy/orthotropy of data
- Export material property tensors

Combine Image and CAD Data

Unique capabilities allow you to integrate CAD models within 3D image data to obtain comparisons of scans of as-built parts with original CAD designs. Avoid the difficulties associated with combining multiple sources of data in different formats by working directly with powerful image and CAD tools within the Simpleware software platform.

From Image to Mesh

Simpleware software offers a direct route from image data to simulation. Generated meshes are ready to use in the FE/CFD solver of your choice, with extensive options for tailoring your models to different simulation requirements. Rely on software that generates simulation-ready models, with no need for post-processing or fixing. Export directly to all major solver formats.
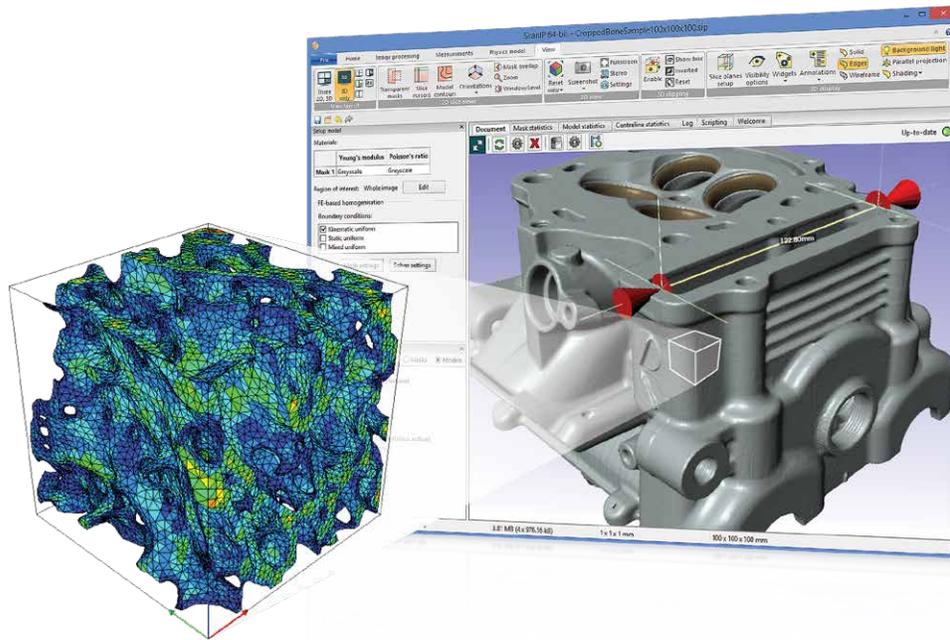
Expert Model Generation and Services

Our service team can generate models for any application. We will work with you to develop a model, or series of models, that are tailored to your specific needs. This can be based on your own scan data or data generated within a contracted project.

Fully Supported Training at All Levels

Receive step-by-step training and personalized support on all areas of Simpleware software, including one-to-one sessions, web-meetings, and bespoke training courses in-house or on-site. Attend one of our regular workshops or webinars on how to get the most out of the software. Contact us at **simpleware-support@synopsys.com** if you have any questions about using our solutions.

Expert Support for your Requirements

All licenses come with full support from our team of experts. Our engineers can help you develop your unique workflows, ensuring your use of the software is as efficient as possible, and your final output matches your requirements. Our support is offered via email, phone or web-meetings, or we can even visit you on-site.

Try Simpleware Software

Try the software for yourself with a free evaluation version, available on our website. The trial is fully functional and gives you access to the complete Simpleware software suite, full range of tutorials and technical support.

Simpleware Software Solutions

The Simpleware product group at Synopsys develops an industry-leading 3D image processing platform for the visualization, quantification and conversion of 3D scan data (MRI, CT, micro-CT...) into high quality design, simulation and 3D printing models. Simpleware software is used in the Life Sciences, Clinical Applications, and Materials & Manufacturing. Easy-to-learn and use, the software offers a robust bridge between the latest imaging technologies and multiple design and simulation applications.

For more information, go to **www.synopsys.com/simpleware**

Email: **simpleware@synopsys.com**

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