3D Image Visualization, Model Generation and Analysis with Simpleware and COMSOL

Simpleware provides industry-leading software solutions for converting 3D image data (MRI, CT, micro-CT...) into robust computational models. Simpleware software enables direct import of multi-part volume meshes to COMSOL Multiphysics® for FE and CFD analysis, removing the need for further processing in other packages.

Key application areas for using Simpleware and COMSOL together include:

**INDUSTRIAL REVERSE ENGINEERING**
- Non-destructive Evaluation (NDE)
- Fault Inspection
- Legacy Parts

Simpleware’s technology opens up new opportunities for the analysis of industrial components, allowing for the inspection and measurement of defects, and for the reverse engineering of legacy parts. Volume meshes can be generated for further analysis and characterization of material properties and microstructures in COMSOL Multiphysics®.

**MATERIALS & GEOLOGY**
- Rock Physics
- Composite & Material Analysis
- Pore Scale Fluid Flow

Simpleware software is capable of rapidly visualizing, processing and meshing samples from imaging modalities such as micro-CT and FIB-SEM. Identify pore networks and cracks, obtain statistics and measurements for pore volumes, surface areas and fiber orientations, and export multi-phase meshes for further testing in COMSOL Multiphysics®.

**MEDICAL & DENTAL**
- Biomechanics & Orthopedics
- Implant Design
- Physiological Flows & Hemodynamics

Simpleware provides detailed, simulation-ready models for medical and dental research. Visualize, segment and analyze complex anatomical datasets and integrate with CAD models of implants or stents. Generate robust multi-part meshes and export with contact surfaces, shells, nodes and material properties to COMSOL Multiphysics® for further analysis.
User Case Studies

There are many ways in which Simpleware and COMSOL users can streamline their workflows for generating and solving image-based models. The case studies below highlight two applications for biomedical and materials based research.

STUDYING DIRECT CURRENT STIMULATION ACROSS SKULL DEFECTS

A. Datta • M. Bikson • F. Fregni
Department of Biomedical Engineering, The City College of New York of CUNY

Simpleware and COMSOL have been used together to improve research into how transcranial direct current stimulation (tDCS) can help patients with neuropsychiatric conditions and skull defects. In this project, MRI images of the skull were imported to Simpleware ScanIP for visualization, segmentation and integration with CAD models of stimulation pads. The final model was then converted into a multi-domain mesh and exported to COMSOL Multiphysics®. Researchers were able to gain insights into how current distribution might affect the neurological responses of different patients. The findings help researchers to better understand how tDCS can be safely applied to different parts of the brain for specific patients.

MODELING THE EFFECTS OF POROSITY ON THE ELASTIC PROPERTIES OF SYNTHETIC GRAPHITE

G. Sowa • R. Paul • R. Smith
GrafTech International Inc., Parma, OH, USA

Simpleware has also been used by materials researchers to prepare high quality models for FEA and CFD analysis in COMSOL. In this project, Simpleware and COMSOL were used to model the effects of porosity on the elastic properties of synthetic graphite. Industrial CT images of synthetic graphite were imported into Simpleware ScanIP for visualization, measurement and segmentation into solid and porous regions. A simulation-ready mesh was generated and exported into COMSOL Multiphysics®, where tests were successfully carried out into how different degrees of porosity affect stress concentration in graphite.

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About Simpleware
Simpleware develops industry-leading image processing software solutions for 3D image data visualization, analysis and model generation.

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