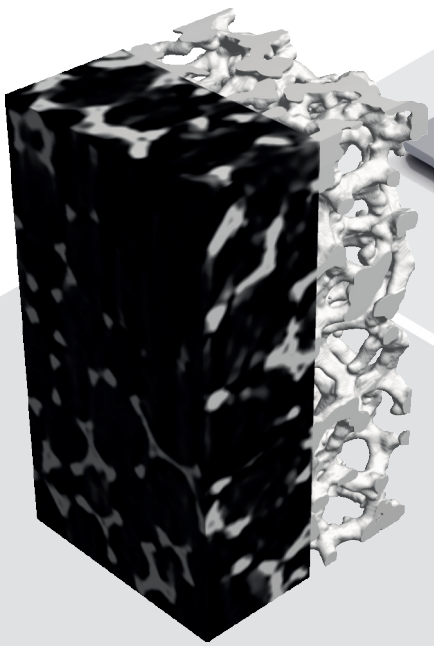
GeoDict

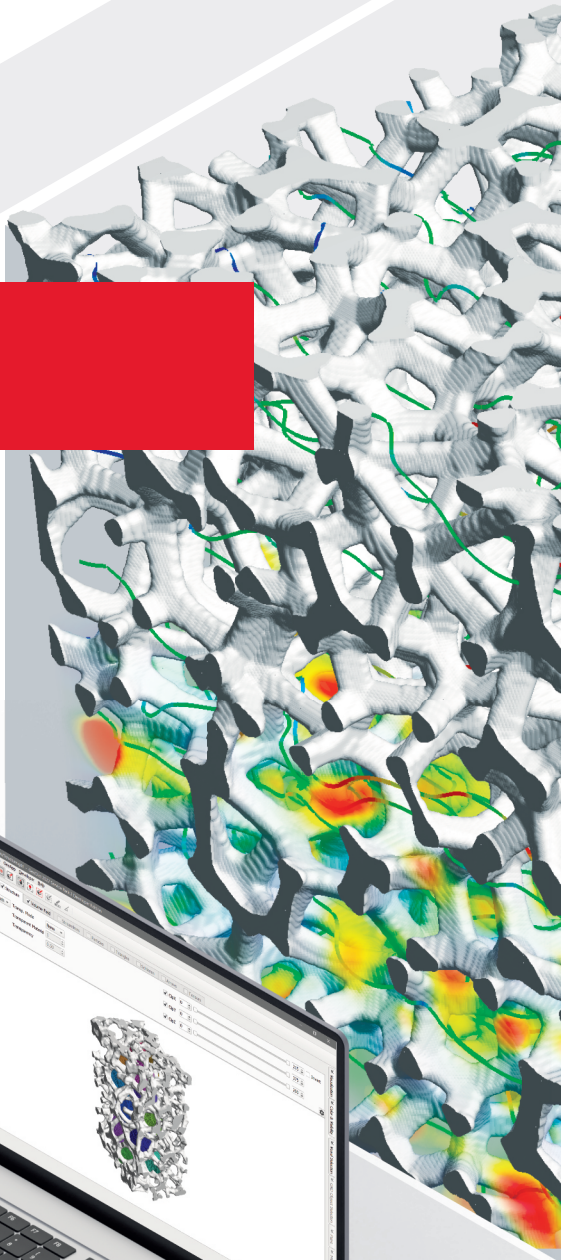
The Digital Material Laboratory

GeoDict Workflow for Simulations on Foams

Digital Twin of an Aluminum Foam

- Analysis and optimization of the pore space of open cell metallic foams is essential in development of new foams.
- 100% digital workflow using GeoDict software instead of conducting complex, time-consuming experiments.
- A CT scan imported into GeoDict is used to create a statistical digital twin of the foam.
- Fully parametrized digital twin is then used for digital parameter studies.





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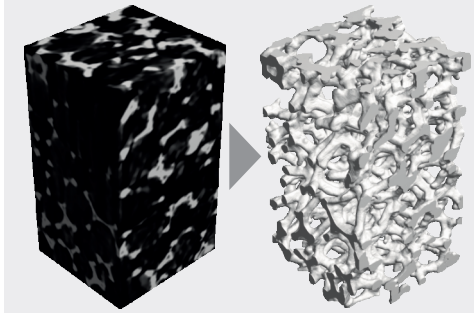
GeoDict® Workflow for Material Development

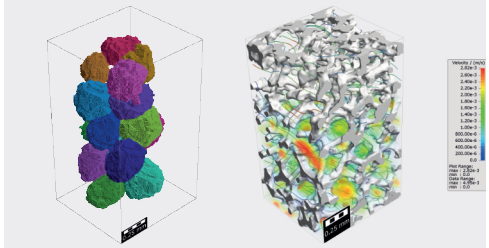
1 Data Acquisition



- Import a µCT scan of the foam
- Improve the scan's quality through GeoDict image processing tools
- Segment the scan into different phases via
  - Manual thresholds
  - Automatic thresholds (OTSU, k-Means)
  - Multiphase threshold via watershed algorithm
  - AI-based segmentation

Result: Digital twin of the foam

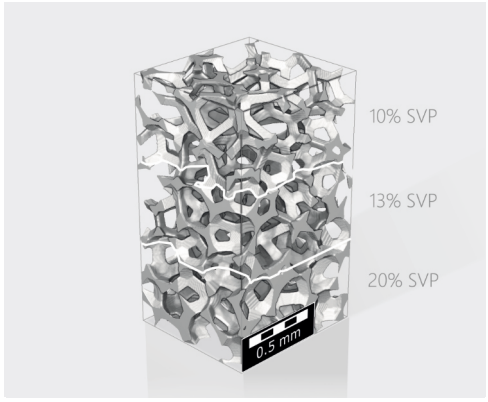
2 Analysis



- Analyze the pore space with PoroDict
  - Pore size distribution
  - Shapes of pores
  - Percolation paths
- Analyze the strut thickness and solid volume fraction with MatDict
- Determine physical properties of the digital twin
  - Permeability
  - Electrical and thermal conductivity
  - Mechanical behavior

Result: Statistical description of the digital twin

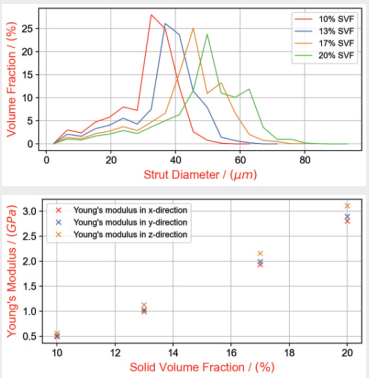
3 Modeling & Design



- Model a statistical digital twin in FoamGeo using the PoroDict and MatDict results
- Design new foams by modifying parameters, such as:
  - Pore sizes and shapes
  - Anisotropy and gradients
  - Solid volume fraction
  - Strut thickness
- Model digital prototypes for parameter studies
- Compare properties of the scan and statistical digital twin of the foam

Result: Multiple digital prototypes of new foams

4 Simulation & Prediction



- Compare the newly designed digital prototypes
- Analyze the interdependency of the foam design and its properties
- Determine the properties of the digital prototypes
  - Strut thickness and pore sizes
  - Flow properties, such as permeability
  - Electrical and mechanical conductivity
  - Stiffness tensor
- Run single parameter studies, e.g. changing only the pore size, which are almost impossible to conduct in the lab

Result: Most promising digital prototype

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