Simpleware SOLID, FLOW, LAPLACE
Release Version T-2022.03

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FE-Based Homogenization

- Meshing is carried out internally using the Simpleware FE meshing algorithms, with full access to advanced options for fine tuning volume meshes and inspecting element qualities.
- Simulation carries out a full finite element analysis
- Rapidly calculate analytical upper and lower bounds on the effective properties directly from the 3D image data (Simpleware SOLID and LAPLACE)
- Choose between several predefined boundary conditions in order to adopt the appropriate homogenization method
- Reduction of boundary effects by averaging fields over model sub-volumes
- Simulate multi-part models with separate material properties (Simpleware SOLID and LAPLACE)
- Material properties of each model part can be homogeneous or greyscale-based
- Monitor the progress of the iterative solver via convergence graphs
- Reduce simulation complexity and computer resources by treating appropriate 3D models as 2D or 1D
- Preference option to use more memory (RAM) to reduce solving time

Results

- Mesh clipping allows easy visualization of the fields within the sample

- Calculation of effective property tensors:
  - Automatic determination of the directions of models principal axes
  - Automatic calculation of best-fit isotropic, orthotropic (Simpleware SOLID) and uniaxial (Simpleware LAPLACE and FLOW) approximations to calculated effective tensors
  - Compare results calculated for the different boundary condition types
  - Quickly alter the number of decimal places displayed
  - Determine and plot average orientations of anisotropic samples using principal coordinate axes
- Visualization of fields generated in finite element simulations:
  - Display modes include streamlines, magnitudes and individual tensor components
  - Display scaled mesh deformation (Simpleware SOLID)
  - Many preset color scales available as well as the option to import custom scales from XML files
  - Manually adjust the range of values plotted

Export

- Calculated tensors to XML file format
- Calculated fields to VTK file format
- Visualized field plots to images (PNG, BMP, JPEG, PNM, EPS, PDF and VRML formats)
- Analytical bounds to XML file format

Simpleware SOLID, FLOW and LAPLACE are used to carry out finite element (FE) based homogenization in order to calculate the effective stiffness (Simpleware SOLID), absolute permeability (Simpleware FLOW), and effective conductivity/permittivity/diffusivity (Simpleware LAPLACE) of samples.

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