Title:

Role of slice thickness quantification in the 3D reconstruction of FIB tomography data of nanoporous materials

Keywords:

FIB, Slice thickness determination, Slice repositioning, Accurate reconstruction, Image inpainting, Machine learning

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Abstract of the paper:

In focused ion beam (FIB) tomography, a combination of a FIB with a scanning electron microscope (SEM) is used for collecting a series of planar images of the microstructure of nanoporous materials. These planar images serve as the basis for reconstructing the three-

dimensional microstructure through segmentation algorithms. However, the assumption of a constant distance between consecutively imaged planar sections is generally invalid due to random variations in the FIB milling process. This variation complicates the accurate reconstruction of the three-dimensional microstructure. Using synthetic FIB tomography data, we present an algorithm that repositions slices according to their actual thickness and interpolates the results using machine learning-based methods. We applied our algorithm to real datasets, comparing two standard approaches of microstructure reconstruction: on-the-fly via image processing and ruler-based via sample structuring. Our findings indicate that the ruler-based method, combined with our novel slice repositioning and interpolation algorithm, exhibits superior performance in reconstructing the microstructure.

Description

This dataset contains synthetic structures of hierarchical nanoporous gold, which mimics real hierarchical nanoporous gold structures, segmentation results and repositioned interpolated structures of the real hierarchical nanoporous gold dataset and trained weights of machine learning model used for interpolation. For more information, please refer to the published research article: Role of slice thickness quantification in the 3D reconstruction of FIB tomography data of nanoporous materials

Folder structure

- `Root`
  - `Supplementary_Material.pdf` Supplementary material for manuscript.
  - `Paper_Data`
    - `Tables` All CSV files used to generate tables in manuscript.
    - `Figures` All Figures included in manuscript and suppl. material.
    - `ML_Model` Machine learning model and training data files.
      - `train_data` Training validation and test data
      - `ml_model.pth.tar` Trained machine learning model
    - `Real_Data` Segmented and interpolated structures of real hnpg.
    - `Synthetic_Data` All processed synthetic files
      - `structure*` Generated dnn_s srcs_s rcs_s and rml_s
      - `original*` Synthetic mimicking structures