Karlsruhe Institute of Technology

Institute of Microstructure Technology

Google Maps for Small Things: Structure Development for Micro and Nano sized Material based on Measurement Results

Increasing Information Quality and Precision of Micro-/Nanostructures enable Predictions to create new Materials and Structures using GUI based Correlative Characterisation

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Introduction:

The project deals with metrological characterisation of micro- and nano structures with different and not collocated technologies.

The correlation of different characterisation methods may gain more information and improved precision of manufactured structures and materials.

The obtained measurement results, as well as the correlated data, will be shown in a three-dimensional Map. With an overlay it is possible to switch between different measurement and characterisation methods.

➔ **Google Maps for Metrology**

Redefining ROI

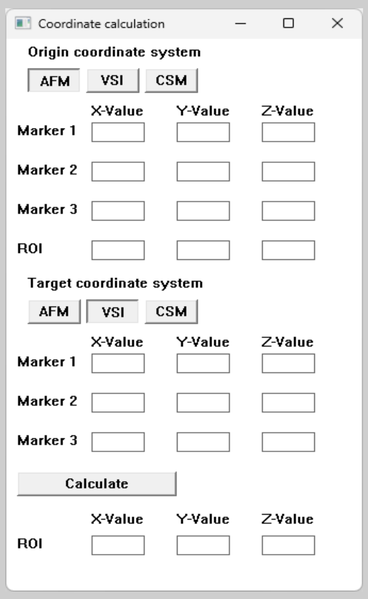
Varying Sample Orientation
To measure a sample with different systems a sample inter-change is needed. Coordinates and orientation might change. So we need a correction for both translation and rotation.

GUI Level 1

To find the position of the ROI in other coordinate systems back, a C++ tool has been developed.

GUI input:
1. Positions of three fiducials + ROI
2. Fiducial positions of target coordinate system.
3. Calculated output is the ROI position converted in target coordinate system.

➔ **Reproducibility**



Overlay-Technology via GUI Level 2

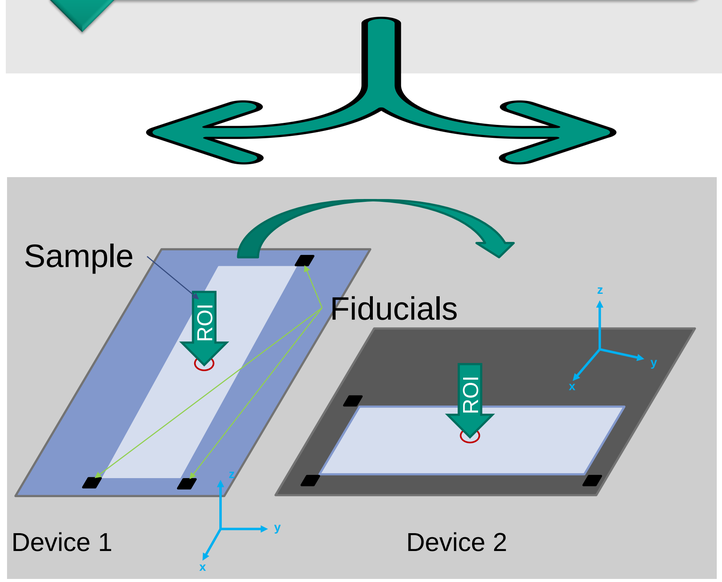
The final version of the software unifies the results of different devices in a 3D map.
Every magnification or measuring method gets it's own layer.

- It is possible to navigate using an overview layer and than move into layers with more details.
- It can be switched between different measurement methods, and different layers can be superimposed
- ➔ **Visualization**

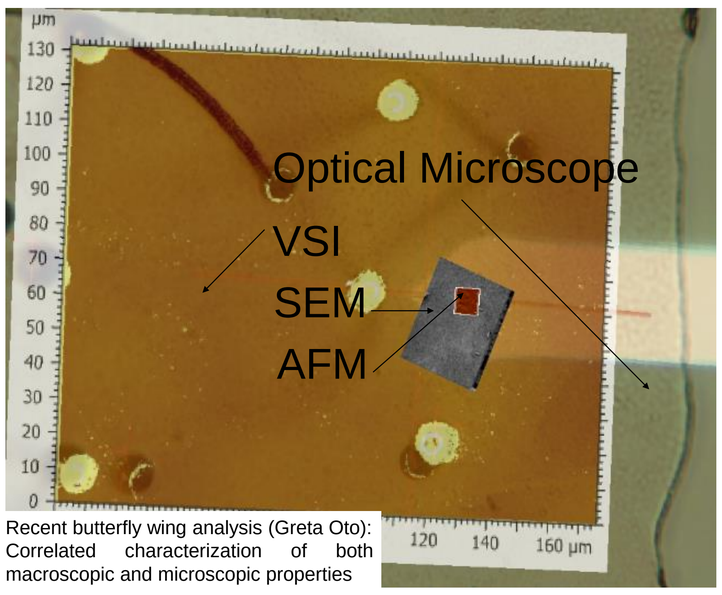
Workflow

The conditions defined by a task and the question to be answered by a sample results in a workflow. A series of measurements will be composed to a single evaluation.

1. Sample and Scientific Question
2. Measuring of a ROI on a Sample
3. Measuring of that ROI with a different device
3.n Repetition of step 3 with multiple devices
4. Interpretation and correlation of measurement results



Application

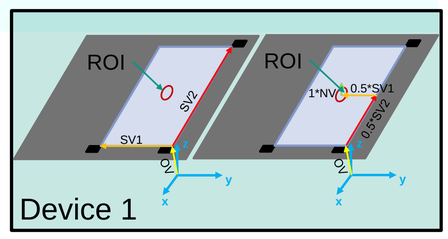


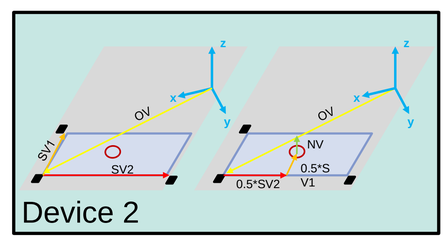
Recent butterfly wing analysis (Greta Oto): Correlated characterization of both macroscopic and microscopic properties

Calculation:

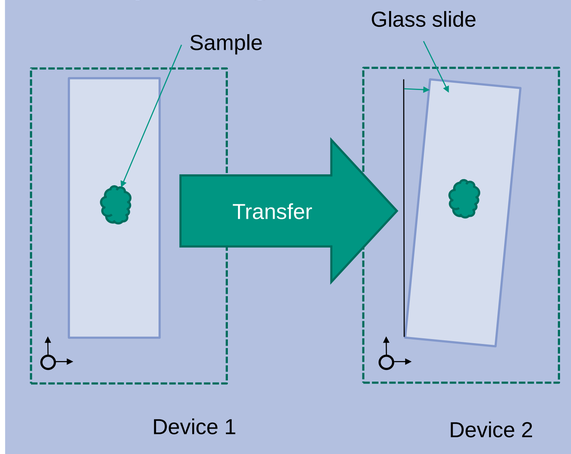
To determinate ROI position in target coordinate system a plane is defined using three fiducials. Than a perpendicular line is used to define the ROI position.
With the parameters of plane and line, the ROI position for the target coordinate system are calculated

I. Calculate plane + perpendicular line for reference coordinate system
II. Calculate plane + line parameters
III. Calculate plane + perpendicular line for target coordinate system
IV. Use GUI to calculate ROI position in target coordinate system





Sample Alignment

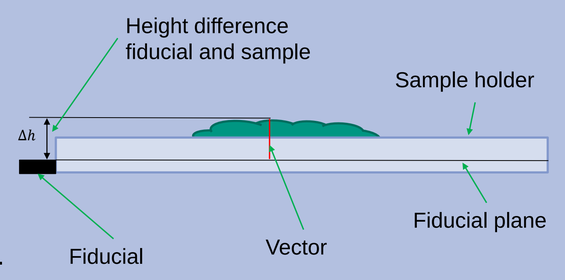


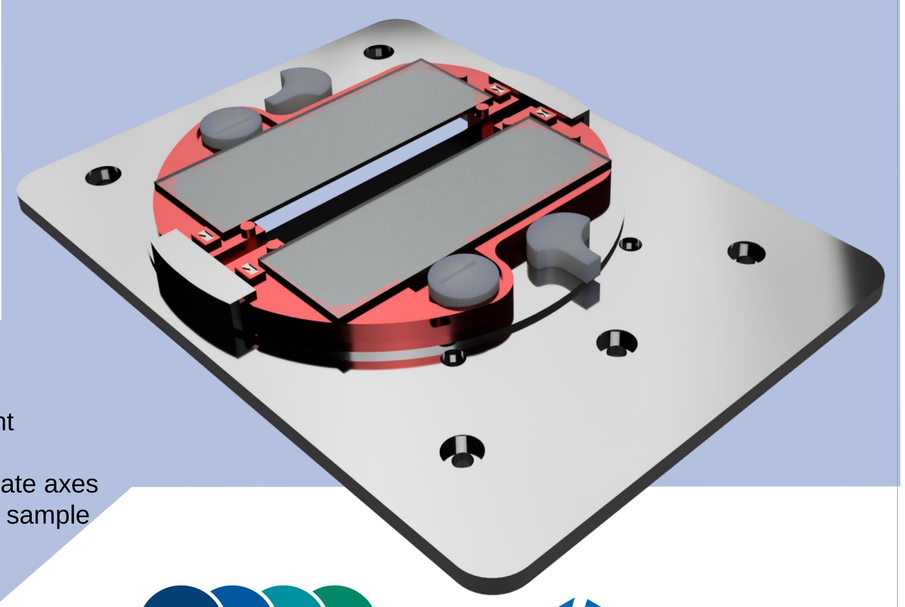
Transferred between different devices, the sample might rotate in relation to the devices coordinate axes.
Each motion has to be defined by two components x and y.
Caused by incremental resolution, the motion of mechanical axes is performed stepwise.

➔ **Limitation**

Height Offset

Depending on fiducial position, the expanded plane might be above or below the ROI.
A vector is used to compensate offset between plane and ROI.





Customized Carriers:

To adjust the samples orientation to coordinate axes of different devices, a customized carrier was developed for:
- Adjusting the samples orientation related to devices coordinate axes
- Transport between different devices without unclamping the sample
- Providing fiducials for orientation an navigation on sample

The carrier is manufactured with 3D-printing process SLA

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