Motivation
- Two different microscopy techniques are applied to analyze alpine/polar ice cores.
- Both image types are processed and matched automatically.
- Which additional information is obtained?

Overview: Microscopy techniques and processing

Transmission microscopy/Fabric Analyzer

Reflection microscopy of sublimation grooves

Both image types are processed and matched automatically.

Automatic matching

As an "optimal" matching shows displacements between corresponding grains as the Fabric Analyzer (FA) records volume information and sublimation grooves occur on the surface. The scanner used is denoted as LASM (Large Area Scanning Microscope) in the following. A global affine transformation is applied to transform coordinates:

\[
T^{\text{FA}} \rightarrow T^{\text{LASM}} = A \cdot T^{\text{FA}} + \vec{x}_{\text{offset}}
\]

The topological characteristics (number and size of neighbors) are utilized to detect high probable pairs applied to transform coordinates:

Identification of sub-grain boundaries

In ice sub-grains are defined as regions with orientation differences smaller than 5°. For a reliable identification, information on the orientation of c- and a-axes is required. The distribution of c-axes can be measured by the Fabric Analyzer, whereas the characterization of sublimation grooves as boundaries of sub-grains is more difficult. By matching both image types misorientation estimates are assigned to sublimation grooves.

Figure 5: Upper left corner of Fig. 2 illustrating displacement vectors (alpine KCI core, 44 m). Interestingly, the scattering of displacement vectors varies from image to image even if the way of processing the ice core section is very similar. The mean displacement of FA grain center of mass points with respect to the LASM grain center of mass points has been calculated in pixel sampling. For KCI, 44 m depth: 79.2°, 101.1°, and for KCI, 55 m depth: 79.2°, 101.1°, 77.6°, 103.1°.

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Figure 6: Assignment of misorientations to sublimation grooves by matching (NEEM, 1026 m). The influence of gray values on the camera configuration is larger than on the duration of sublimation.

Figure 7: Upper left corner of Fig. 1 illustrating displacement vectors (alpine KCI core, 44 m) for KCI, 44 m depth: 79.2°, 101.1°, and for KCI, 55 m depth: 79.2°, 101.1°, 77.6°, 103.1°. For a reliable identification, information on the orientation of c- and a-axes is required. The distribution of c-axes can be measured by the Fabric Analyzer, whereas the characterization of sublimation grooves as boundaries of sub-grains is more difficult. By matching both image types misorientation estimates are assigned to sublimation grooves.