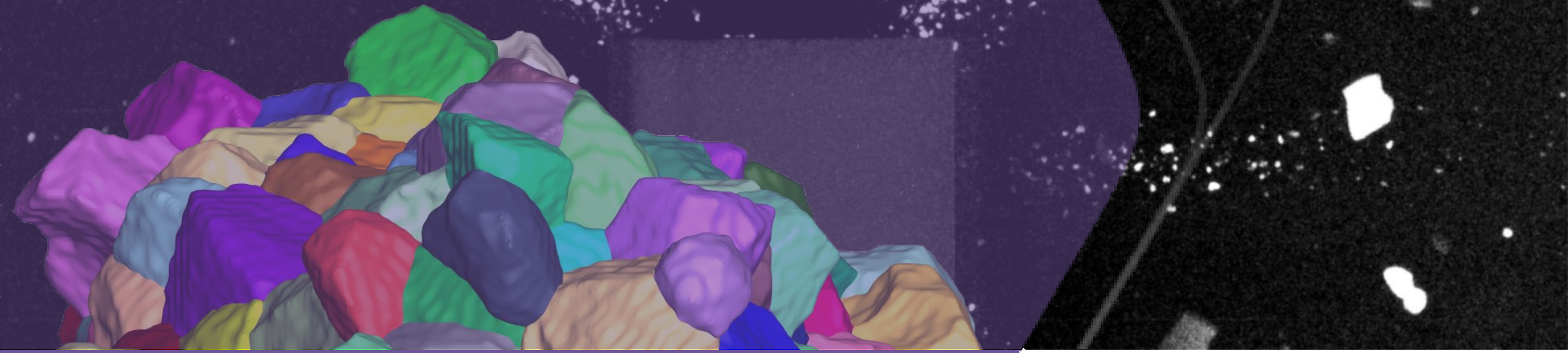

GrainMapper3D *Technote*

GrainMapper3D v4.0 – Reconstruction Speed Test

Introduction

Along with releasing the main feature of multi-phase indexing in *GrainMapper3D v4.0*, another speed boost is added to the reconstruction engine. By optimizing the illumination volume computation and indexing implementations, GrainMapper3D now dramatically reduces processing time for large datasets, offering ×3 ~ ×6 faster reconstruction speed than before.

In this technote, a benchmark speed testing has been summarised to record the reconstruction performance of GrainMapper3D v3.0, v3.2 and v4.0

Performance Test

The following table summarizes the reconstruction speed with various GrainMapper3D versions using the same dataset. The dataset represents a typical reconstruction task given the number of diffraction projections and defined dimension of sample volume.

Sample & Data Description

- Polycrystalline MgO recyclates
- Crystal system: face-centered cubic ($Fm\bar{3}m$)
- Reconstruction Volume: 325 x 93 x 588 voxels
- Voxel size: 4 µm
- Number of projections: 3705

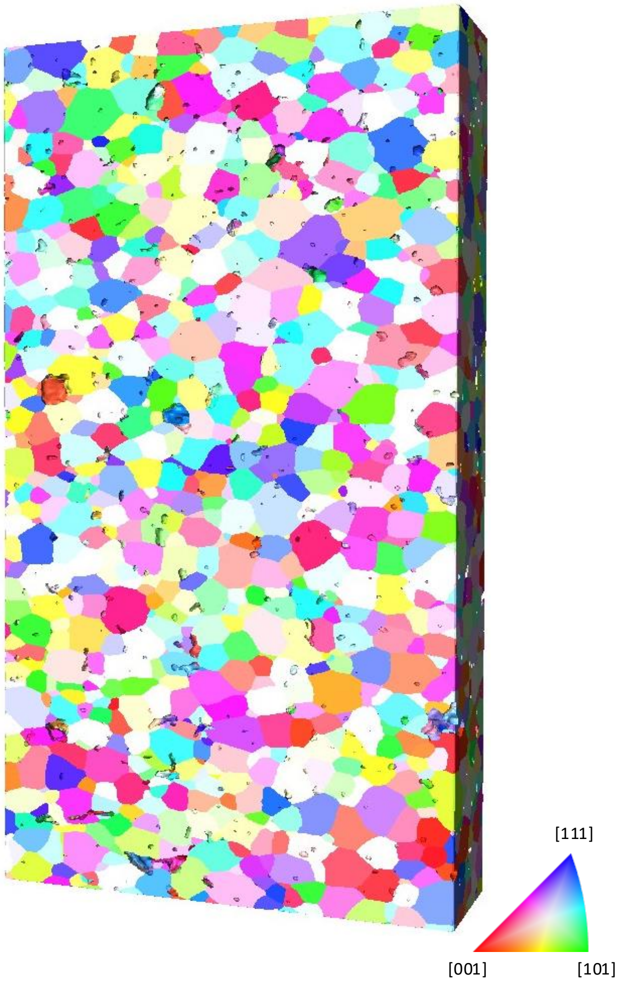

Fig. 1 *Reconstruction as 3D grain map by lab-based DCT with grains colored according to crystallographic orientation (inverse pole figure). Sample courtesy of Dr. Jana Hubálková, TU Bergakademie Freiberg, Institute of Ceramics, Refractories and Composite Materials, Germany*

GrainMapper3D version	Recon. L3*	Recon. L2*	Reconstruction speed-improvement
3.0	*<10 h*	*31.5 h*	
3.2	*<6 h*	*<20 h*	*×1.6 faster (than 3.0)***
4.0	*<2 h*	*<7 h*	*×4.5 faster (than 3.0)*** *×3.0 faster (than 3.2)***

** 'Recon L3 (L2)' stands for reconstruction level 3 (2) is reached within the time periods listed*
***reconstruction speed is compared to defined test sample volume*

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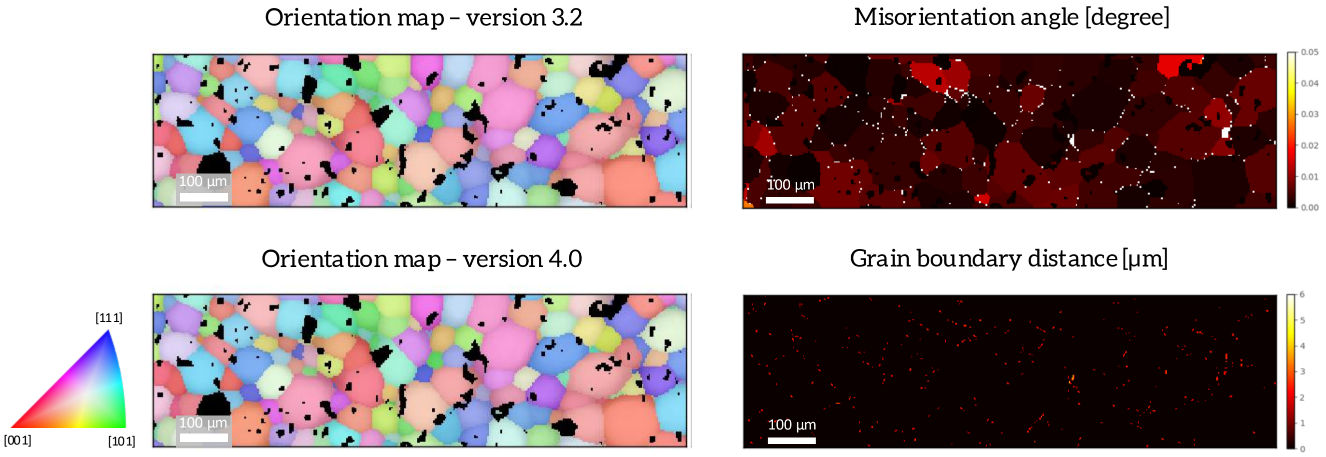

Fig. 2 *Cross-section slice of polycrystalline MgO recyclates orientation map comparison of GrainMapper3D versions 3.2 and 4.0 with corresponding misorientation angle and grain boundary distance correlation. Left data pair: Reconstructed 3D grain maps lab-based DCT with grains colored according to crystallographic orientation (inverse pole figure). Right data pair: Virtual cross sections through the same grain maps and point-to-point misorientations (scale max 0.05°) and grain boundary distances (scale max 2 µm) between the two scans.*

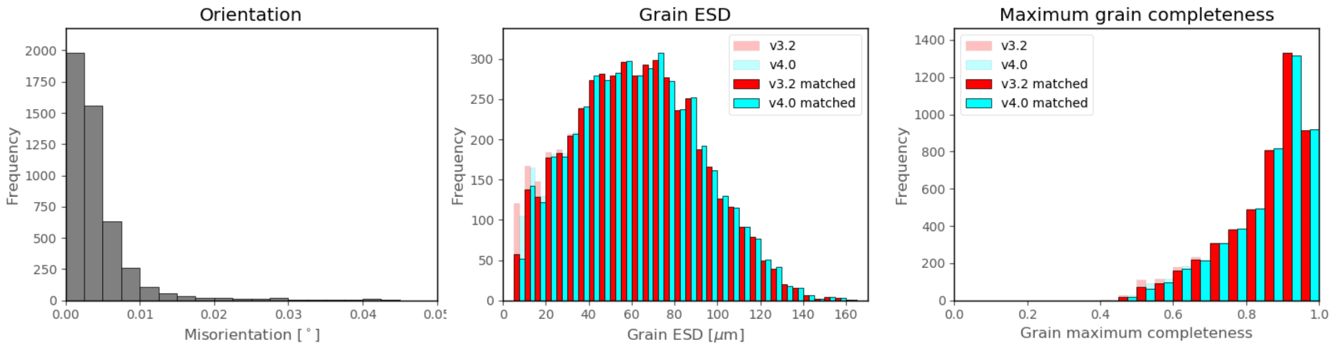

Fig. 3 *Comparative grain analysis of GrainMapper3D versions 3.2 and 4.0. The left panel displays the orientation histogram, highlighting a minimal misorientation of less than 0.05°, indicating high precision across both versions. The middle panel illustrates the grain equivalent spherical diameter (ESD) distribution, while the right panel shows maximum grain completeness, where the most significant discrepancies occur in smaller grains below 20 µm.*

Validation

A voxel-by-voxel comparison has been conducted to validate the reconstructed results. The orientation maps of Figure 2 demonstrate an exceptional alignment between the two GrainMapper3D reconstructions, exhibiting a negligible misorientation deviation of less than 0.2°. The grain boundary map reveals virtually no differences, underscoring the high degree of consistency and dataset quality achieved in both reconstructions.

The first histogram of Figure 3 shows a misorientation of less than 0.05°, with most significant discrepancy between GrainMapper3D versions 3.2 and 4.0 occurring in smaller grains below 20 µm, which inherently exhibit lower completeness as illustrated by the second and third plots. Overall, the comparison demonstrates exceptional performance, with matching results that validate the reconstruction quality, now achieved with over three times the speed.