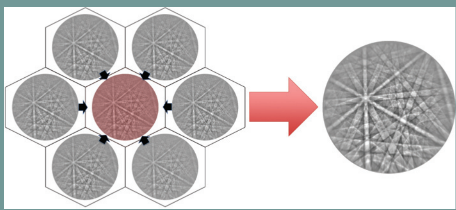
Smart Insight

AMETEK® MATERIALS ANALYSIS DIVISION

Product Bulletin - EBSD

NPAR™



- Patent-pending approach for reducing noise and improving signal to noise ratio (SNR)
- Collected EBSD patterns are averaged with neighboring EBSD patterns to improve SNR
- Allows operation at higher noise levels than conventional indexing
- Faster acquisition times
- Faster collection rates at constant beam currents
- Constant collection rates at lower beam currents
- Ideal for beam-sensitive samples
- Ideal for in-situ and 3D experiments

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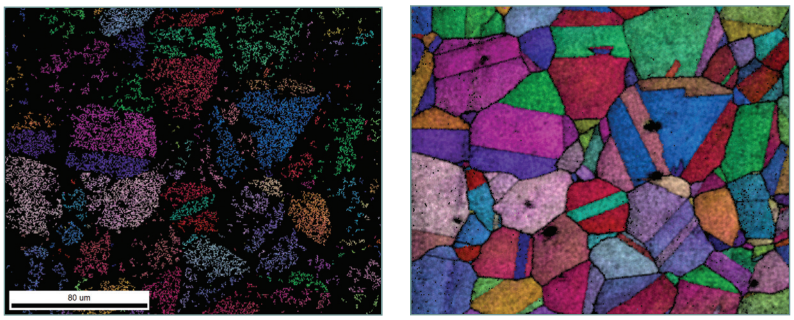
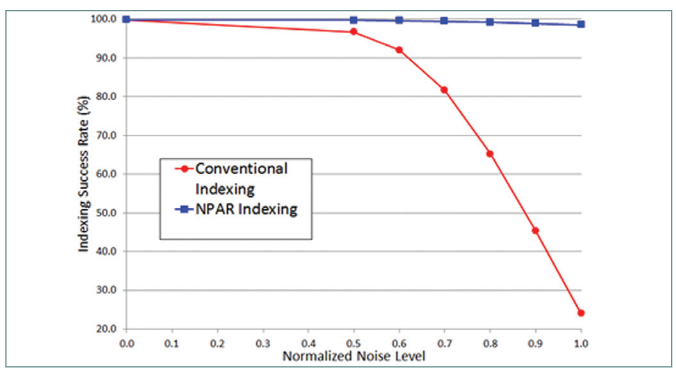
NPAR™, or Neighbor Pattern Averaging & Reindexing, is an innovative approach to measuring crystallographic orientation from EBSD patterns. Noise can reduce Electron Backscatter Diffraction (EBSD) indexing performance by hindering the detection of the diffraction bands. Noise is introduced into EBSD patterns through amplification of the signal in order to obtain faster camera frame rates. EDAX's advanced indexing and band detection routines perform well even with considerable noise. However, band detection becomes unreliable and indexing performance suffers when the noise exceeds allowable limits. Noise levels can be lowered by reducing the gain on the detector, and also by averaging multiple frames together. However both of these approaches increase the acquisition time necessary for both EBSD pattern collection and orientation mapping.

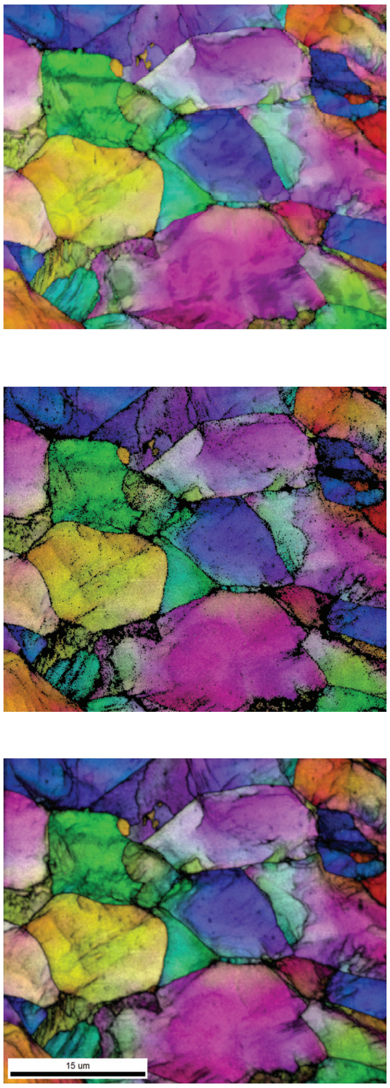


Orientation Maps with Indexing Success Rates of 22% (left) using conventional indexing and 96% (right) using NPAR™ indexing on Inconel 600 superalloy sample.

With NPAR™, the collected EBSD pattern is averaged with all the closest surrounding EBSD patterns on the mapping grid and then indexed. This approach reduces the image noise similar to frame averaging, but without the associated time penalty. This improves the SNR of the pattern and allows the EBSD detector to be operated at higher gain settings than conventionally used without sacrificing indexing performance. NPAR™ can be used to operate the EBSD detector faster at a given beam current, run at lower beam currents and voltages, or improve the quality of data collected under traditional settings.



Comparison of conventional and NPAR™ indexing rates with increasing EBSD image noise



Orientation maps from deformed ferritic steel at (top) ≈ 6 nA current with 99% indexing success, (middle) ≈ 1 nA current with 86% indexing success (both using conventional indexing), nd (bottom) ≈ 1 nA current with 99% indexing success using NPAR™ indexing. Acquisition rate constant at both beam currents.

Features and Benefits

Improved Indexing Performance through Increased SNR

- EBSD patterns averaged with neighboring patterns to reduce temporal noise improving band detection and pattern indexing
- Time penalty of traditional frame averaging eliminated

Faster Collection Speeds at Any Given Beam Current

- Operation at higher gains allows for faster frame rates with successful indexing results

Operation at Lower Acceleration Voltages and Beam Currents

- Improved spatial resolution
- Ideal for non-conductive and beam sensitive samples

Enhanced EBSD Image Quality Mapping

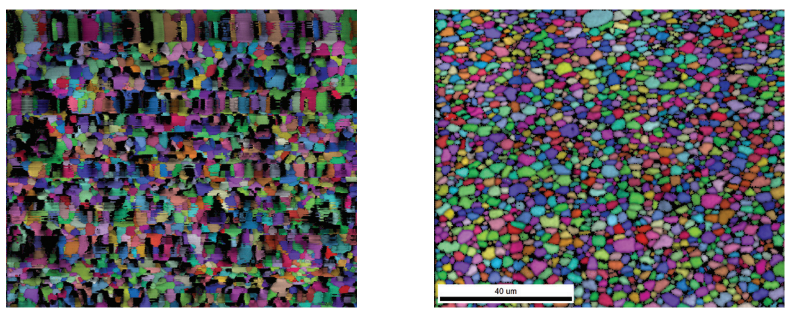
- Averaging of patterns adjacent to grain boundaries increases pattern overlap and image quality contrasts relative to grain interiors

Improved Orientation Precision

- Increased EBSD pattern SNR improves band detection and resulting orientation precision
- Improved characterization of deformed materials when step size is less than the scale of the deformation substructure

Compatible with both TEAM™ EBSD and OIM Analysis™ software

- OIM Analysis Data Collection users can import patterns into OIM Analysis™ for NPAR™ indexing



Orientation maps from a non-conductive ceramic sample. (Left) Collected at 20 kV with conventional indexing and (right) 12 kV with NPAR™ indexing with constant acquisition speed. Lower voltage operation reduced charging and distortion effects.

Conclusion

NPAR™ improves the indexing performance of the TEAM™ EBSD system by averaging spatially related EBSD patterns to increase signal to noise ratio. This approach provides faster acquisition speeds, operation at lower acceleration voltages and beam currents, and improved EBSD data quality.