Method for grain boundary triple junction analysis by 3D EBSD

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A new method for characterizing triple junctions (TJ) makes use of 3D EBSD datasets and is based on the Elementary Facet technique of EBSD grain boundary plane characterization. Here, a dataset is examined to determine the location of all TJs, which are comprised of line "segments" at voxel edges common to at least three different grains. Segments surrounded by the same grain triplet are regarded as belonging to the same TJ, and can form a single continuous line or multiple discontinuous lines separated by other TJs. Since all line segments in the voxilated dataset are necessarily aligned in one of three directions, a convolution procedure is applied to each sufficiently long TJ section (> 15 segments) to approximate true local line direction. These directions can then be compared with a variety of information regarding the adjacent grains and boundaries, including crystal axis orientation, local grain boundary plane normal direction, and inter-grain misorientation rotation axis direction.

A TJ between two Σ3 boundaries, and a Σ9 boundary in a nickel superalloy serves as an example. One of the Σ3 boundaries is flat and coherent, perpendicular to its associated misorientation axis, while the other is highly curved. The TJ lies in a plane shared by the Σ9 and coherent Σ3 boundaries, and exhibits an overall elliptical shape. Comparison with the orientations of the three adjoining grains reveals that the elongation direction lies between a [110] direction common to all three grains, and another [110] common to two of them.