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Exploring orientation relationships – the need for proper normalisation

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With the wide availability of spatially resolved crystal orientation data obtained from e.g. EBSD, questions of orientation relationships (OR) can be addressed most easily. The orientation relationship of grains with their neighbours is usually expressed in the form of a misorientation, where misorientations are often inspected as axis-angle pairs. While for many studies related to intragranular deformation, only axes with small misorientation angles are of interest, there are cases where all misorientation axes have to be considered. Examples include the study of OR caused by crystallisation processes in magmatic systems, recognition of epitaxial growth or the study of OR produced by preferred grain alignment during solid state flow (grain boundary sliding).
However, the distribution of misorientation axes is governed by the explicit OR and also by the crystal symmetry of participating phases; i.e. in the simplest case, a uniform distribution of orientations (grains) inherently produces an axis distribution that is non-uniform. Similarly, any polycrystalline material that has a crystallographic preferred orientation will possess an axis distribution function that is determined to one part by the distribution of orientations and their crystal symmetries and to another part by any special OR.

We present a normalisation scheme that will help to properly recognise OR-induced parts of axis distribution functions and we will give examples for growth (garnet-ilmenite-magnetite), deformation (naturally and experimentally deformed quartzites) and combined growth and deformation (phase relations in polymineralic ultramylonites) induced OR.