QUANTIFYING THE EXTENT TO WHICH EXPERIMENTAL POLE INTENSITY DATA DETERMINE AN ORIENTATION DENSITY FUNCTION EXPLAINING THE DATA

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Considering that the odd order Fourier coefficients of an orientation probability density function are not determined by experimentally accessible crystallographic pole densities, resolving the inverse problem of texture analysis to recover an orientation probability density function from experimental pole density data appears a hopeless venture. The large lack of information conveyed by the diffraction experiment must be counterbalanced by additional mathematical modeling assumptions, and we may expect that the resolution depends rather on these assumptions than on the data. Thus we may ask ourselves what makes texture analysis usually work well in practice, i.e., why its results are sufficient for valid technical applications, e.g., quality control of rolling steel, or instructive scientific applications, e.g., reconstruction of geological deformation processes.

Generalizing the notion of variance of a probability distribution to crystallographic orientation and pole distributions, we show that both quantities are bounded by each other, i.e. the dispersion of crystallographic orientations and their crystallographic axes are mutually bounded by each other. More specifically, we show that weak pole figures with a large variance allow to conclude for a weak texture, whereas sharp pole figures with a small variance allow to conclude for sharp textures. We give a quantitative description of this relationship which depends on the number and the specific choice of experimental pole figures. Hence, our results can be used to optimize experimental data acquisition. The presentation will be completed by numerical examples. The results justify to be more optimistic than initially expected.