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Abstract

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Statistical aspects of random tessellations with microstructure marks

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A random marked tessellation is obtained by attaching a random mark to each cell of a random tessellation. This mathematical model is useful when dealing with 3D polycrystalline materials. The tessellation describes grain microstructure while the marks may describe microstructure morphology parameters or elastic grain interaction parameters. It means that the marks could be categorical or numerical, e.g. grain volumes, grain shape sphericity or numbers of neighbouring grains. However, they could be also more complex, e.g. vectors representing grain orientations or grain-wise averaged stress tensors. Since we are interested in the effect of microstructure parameters on elastic grain interactions, also the combination of above-mentioned marks can be considered.

We investigate dependence between marks and cells of random marked tessellations as well as dependence structure among marks. Two basic approaches are followed. By associating the cell with its center of mass each random marked tessellation naturally generates a marked point process. The first approach is thus based on the analogy of second-order summary characteristics introduced for marked point processes. If the marks have more components we also study dependence structure within marks. In this case, cross-type characteristics are considered. The second approach exploits geostatistical methods developed for random fields. In both approaches, the summary characteristics have to be estimated from data. We present some results of the analysis of NiTi wire microstructure that was reconstructed from 3D-XRD data using the Laguerre tessellation.