Graz University of Technology

Institut für Statistik

Seminarvortrag

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SR MBI (NT03128L), 3.OG. Kopernikusgasse 24

Stereological determination of particle size distributions for similar convex bodies in simulated and real microstructures

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Abstract:

This talk presents a unified stereological framework for inferring 3D size distributions of similarly shaped convex particles from 2D observations. We consider an opaque medium that contains 3D randomly positioned and oriented particles that cannot be observed directly. All particles are convex bodies of the same shape, but they vary in size. Taking a planar section of the medium we obtain a sample of observed 2D section profile areas of the intersected particles.

In our instance of the problem we highlight that we can separate the shape of the particles from their sizes in the sense that an observed area may be interpreted as the product of two independent random variables, one related to the particle size and the other related to the known particle shape. The density function of the shape-related random variable is explicitly known only in exceptional cases, therefore we propose a simulation procedure that can be used to approximate it arbitrarily well. Using the shape-related distribution as an ingredient, we design a maximum likelihood procedure to estimate the size distribution of the particles belonging to a large class of possible shapes. The estimator is proven to be consistent and its performance is assessed in a simulation study. Finally, we apply this procedure to space filling structures, we investigate the impact of the choice of grain shape and propose a heuristic to choose the best grain shape. To validate our approach, we employ simulations using Laguerre–Voronoi diagrams and apply our methodology to a sample of Interstitial-Free steel.

M. Neumann