NEW BOOK

3D IMAGES OF MATERIAL STRUCTURES, PROCESSING AND ANALYSIS

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3D image data captured by various recent modalities yield a wealth of information on the samples under study. The 3D data may origin in a sequence of 2D optical sections, but their efficient analysis requires inherently 3D methods, that can be obtained either directly by generalization of 2D methods (e.g. in case of separable filters like the Gaussian filter) or have to be developed from scratch taking into account the rich structure of the 3D lattice of voxels – the 3D image elements (e.g. in case of the measurement of geometric characteristics in 3D). The book is an indispensable source of receipts for processing and analysis of 3D images of materials based on long term experience of the authors with the subject, especially with designing new methods for measurement of geometrical properties of subsets of discreet lattice of voxels.

The introductory part of the book exposes some data from 3D microscopy and CT synchrotron tomography, the next part introduces relevant mathematical notions. The following part on lattices of image elements contains a rigorous treatment of the adjacency systems, Euler-Poincare characteristic of sets and also visualization of 3D data and isosurface constructions in 3D. The image processing part contains both the classical linear theory, using image properties like spatial frequencies, and mathematical morphology methods based on more feasible properties of the objects, like size or connectedness. Treatment of various material structures is demonstrated here. It is a pity the recent powerful methods based on combinatorial optimization (Graph Cut) were not treated here. Next chapters on measurement of intrinsic volumes and related quantities contain a comprehensive list of important characteristics of materials with internal structure and appropriate measurement methods. The chapters on image spectral analysis describe methods of measurement of second order properties of the internal structure that can reveal e.g. correlation between phases of the material. The part on model based image analysis presents particle models of the material structure with either overlapping particles (Boolean models) or nonoverlapping particles (packings), realistic fiber-like structures and models of foams based on spatial tessellations. The last part of the book contains an introduction to the simulation of the material properties based on geometrical and FEM models of the material.

The book unfortunately contains a lot of typographic errors, mostly in introductory chapters throughout the book, that can easily confuse a beginner, e.g. in Choquet theorem on page 28 the symbol for convex sets is used instead of that for compact sets, which results in an invalid statement. Authors should perhaps provide errata on their web pages to make the book more useful for beginners in image analysis. In spite of the mentioned minor problems the book can be recommended to all readers with deep interest in 3D image analysis and development of the image analysis methods.

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