GUEST EDITORIAL

Special Section on Random Models in Imaging

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This special section of the *Journal of Electronic Imaging* is devoted to random models in imaging. This topic is not new, since random models are applied in such different fields as filtering noisy data, simulating more or less complex textures, or describing microstructures in materials.

The seven papers published in this special section cover a wide range of applications of random models, and are representative of some of the latest developments in random modeling and simulations.

Two papers present models in the continuum (Euclidean) space: Serra gives the algebraic and topological properties of the class of equicontinuous functions, and introduces their random version as a subclass of the semicontinuous random functions studied in the general framework of the theory of random sets by Matheron. Jeulin and Laurenge, starting from experimental data on rough surfaces, present a review of the random functions with primary grains (Boolean, dead leaves, sequential alternate, dilution models), and illustrate a procedure of identification of random textures from second-order statistics on images and simulations.

The five remaining papers present discrete models of random structures. Sivakumar and Goutsias use Monte Carlo simulations of Markov random fields to estimate their opening and closing size distributions; this information is used for a reliable texture classification, and for the design of new optimal filters of noisy or spoiled images. Barrera, Dougherty, and Tomita do not introduce models of images but a probabilist and statistical methodology for the automatic design of binary morphological operations; it combines a learning procedure to a statistical optimization and to a simplification of Boolean operations (an algorithm named incremental splitting of intervals is proposed), and it is illustrated by applications to pattern and texture recognition, image restoration, and segmentation. Zuyev, Desnogues, and Rakatoarisoa introduce a hierarchical graph model to simulate telecommunication networks; from simulations of Delaunay trees, they can evaluate the performance of large networks, using a methodology close to operation research.

The last two papers use the dynamics of populations of particles to simulate various physical phenomena. Decker and Jeulin simulate reaction-diffusion random textures and droplet deposition by means of lattice gas models reproducing hydrodynamic processes on a hexagonal grid. Bouvier, Cohen, and Najman use particle systems in the 3-D Euclidean space to generate computer graphics; their model is able to reproduce the behavior of fluids (such as a gas filling an airbag), and also of human crowds. Interesting (and realistic) effects emerge on a macroscopic scale, starting from random decisions taken on a microscopic scale: This approach could connect random image modeling to sociology, but this is another story.

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Dominique Jeulin is Maitre de Recherche at the Ecole des Mines de Paris, which he joined in 1986. He has been doing research and teaching in three laboratories: the Centre de Morphologie Mathématique (Fontainebleau), where he leads a research group on the physics of hetereogeneous media, the Centre de Géostatistique (Fontainebleau), and the Centre des Matériaux P.M. Fourt (Evry), where he is scientific adviser. He received his civil mining engineer degree from the Nancy's School of Mines in 1972, his doctor-engineer degree in geostatistics and in mathematical morphology from Ecole des Mines de Paris in 1979, and became a Docteur d'Etat ès Sciences Physiques in 1991. He has been involved in research in image analysis and materials science for 25 years, and he is author or coauthor of over 150 scientific papers. He is in charge of courses on models of random structure at the Ecole des Mines de Paris. In 1974 he joined the IRSID (French steel industry research laboratory), where he developed an image analysis research group for the characterization of materials. His current areas of interest are the theoretical prediction of overall physical properties of random heterogeneous media from their microstructure (such as the probability of fracture of materials or the composition of permeability of porous media), models and simulations of random structures, and applications of geostatistics, image analysis, and mathematical morphology to materials science.