Stochastic geometry, stochastic analysis and spatial statistics

Stochastic geometry is the theory of random sets, which form random processes of points, particles, fibres or surfaces in the Euclidean space. They may also fill the whole space in a form of a tessellation with systems of vertices, edges and faces. There is a variety of models of these random processes which may involve inhomogeneity, marking, anisotropy, temporal dynamics and different kinds of interactions. Complex models are described by simpler characteristics which are based on moment measures, packings, distances, while individual objects are described by their number, size, shape or orientation. Invariant global characteristics come from integral geometry and form curvature measures. The spatial geometrical statistics makes statistical inference on these random processes and their characteristics. In parametric and semiparametric models it develops estimators of parameters and investigates their asymptotic properties. For some classes of characteristics also nonparametric estimators are available. Various related statistical tests have to be developed. Edge effects present a special issue for an observation in a compact window. Stereological analysis concerns geometrical data based on sections or projections and their inference to higher dimension. While in theory the dimension is arbitrary, the applications concern typically two- or three-dimensional random sets. They are useful especially for the investigation of microstructures in biology, medicine and materials research, but also in macroscale in geology, environmental sciences, physics, etc. Additionally, stochastic analysis is the theory of random processes; in the present case the research is focused on space-time models described by stochastic partial differential equations which are used in various fields of mathematical physics and mathematical biology.

Selected outputs