

INSTITUTUL DE MATEMATICA "SIMION STOILOW" AL ACADEMIEI ROMANE

*Structures and patterns in spatial data:
probabilistic modelling and statistical inference*

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Abstract: *Spatial data are sets of observations made of elements having two components. The first component gives the coordinates where the observation took place. The second component, represented usually by a multi-dimensional real vector, represents the measures associated at the corresponding location. Digital images, environmental data in epidemiology or catalogues of celestial bodies in astronomy are some typical examples of spatial data. The spatial character of the data induces a strong morphological component to the possible answers that may be given to questions arising from the data analysis. This explains why the question almost always arising is what is the pattern hidden in the data? The main assumption of our work is that the pattern we are looking for is made of random objects that interact. Marked point processes are a probabilistic tool able to model random configurations of interacting objects. The interactions are taken into account by specifying a probability density with respect to a reference Poisson measure. The main difficulty with these models is that they do not always exhibit a precise analytical form for their normalising constants. Hence sampling from such a probability density requires adapted MCMC simulation. Therefore, the construction of the model together with the appropriate sampler needs to fulfill integrability and convergence criteria. Within this framework, statistical inference can be done, using methods such as the simulated annealing algorithm, the Monte Carlo maximum likelihood, permutation tests and bootstrap methods. This talk is double aimed. The first aim is to give a detailed description for marked point processes models and their appropriate simulation algorithms. The second aim is to point out open mathematical and practical problems. The talk is illustrated with concrete examples and data sets coming from : image analysis, astronomy and epidemiology.*