Marked point processes for object extraction in high resolution images. Application to Earth observation and cartography

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Stochastic methods are now widespread in image analysis. They have proved to be powerful tools to solve inverse problems such as image segmentation or image restoration. Since the mid-nineties, many research works have extended the initial pixel based approach to the concept of object in order to deal with shape detection problems. In particular, stochastic models have shown good potentialities in extracting simple shapes. Generally, configurations of parametric functions are sampled from probability distributions defined in a configuration space, Markov Chain Monte Carlo (MCMC) being one of the most popular families of samplers. In various application domains, from line detection to 3D reconstruction, the MCMC samplers are efficient for object extraction in large configuration spaces from any type of probability distribution.

Models based on marked point processes are among the most efficient stochastic approaches and have lead to convincing experimental results in various shape detection applications (such as extraction of line segments, rectangles, circles, ellipses, …). The marked point processes exploit random variables whose realizations are configurations of geometrical objects. After specifying a probability distribution measuring the quality of each object configuration, the maximum density estimator is searched for by MCMC techniques coupled with a stochastic relaxation. Such processes are especially adapted to the description of complex spatial interactions between the objects.

Various examples on road network detection in 2D, crown tree extraction in 2D and 3D, and finally 3D building reconstruction will be given during the talk.