Spatial statistics for the analysis of polar ice cores

JProf. Dr. Claudia Redenbach
(TU Kaiserslautern)

January 29, 2014

We discuss methods for the analysis of anisotropic marked point processes which are motivated by the investigation of the pore system in ice cores. These cores are drilled from the Antarctic ice shield and consist of compacted snow. During the compression process, air pores are isolated within the ice. The system of these pores can be analysed using tomographic images. In earlier work, directional versions of the K-function and the nearest neighbour distance distribution were used to analyse the anisotropy of the ice. It was shown that the spatial arrangement of the pores yields information on the compaction and the flow of the ice shield.

However, directional analysis is hampered by the fact that some extra pores form due to relaxation when the ice core is taken out of the drilling hole. These do not carry any information on the movement. Hence, they should be detected and removed prior to the directional analysis. For that purpose, we assume that the pattern of true pore centers is a realization of a regular Strauss point process, while the centers of noise pores can be modelled by a Poisson process. The aim is to decide which of the two processes each pore belongs to. To this end, we construct an MCMC algorithm which estimates the parameters of the mixture model and obtains posterior probabilities for each point of being a Strauss point. Based on these, the points can be classified.