

Isotropic random fields and point processes on graphs and their edges

Speaker : Ethan Anderes

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We present theoretical work on the existence of second order isotropic stochastic processes and non-homogeneous spatial point processes defined on the edges and the vertices of a graph. The edges of such a graph are equipped with a coordinate system which is in one-to-one correspondence with an open interval of the real line. The edge coordinate system leads naturally to a graph geodesic metric defined, not just over vertices, but also over the edges. A process over the graph (and edges) is considered second order isotropic if the covariance function depends only on this extended graph metric. The work is motivated by remote sensing problems for networks type problems such as river networks and flow networks. We present both positive results and negative results for the existence of such processes. Our negative results come in the form of forbidden subgraphs for which do not support certain OrnsteinUhlenbeck processes. Graph embeddings, in particular classic results of Schoenberg, play a key role in our results.