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Abstract

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Cluster counting in the random connection model

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The classical random connection model is a spatial random graph, whose vertices are given by a stationary Poisson point process η in $\mathbb{R}^d$. In order to generate the edges of this graph, a connection function $\varphi\colon \mathbb{R}^d \to [0,1]$ is required. Each pair of distinct vertices $x, y \in \eta$ is connected via an edge with probability $\varphi(x-y)$, independently of all other vertices and connections.

This model can be extended by adding a random and independent mark in $[0,\infty)$ to each vertex. In this marked model, the probability for drawing an edge between two Poisson points also depends on the marks of the two points. A notable example is the Gilbert graph with random radii. Here the marks of the vertices are interpreted as radii of spheres around the points. Two vertices are connected by an edge if and only if the corresponding spheres intersect.

We are interested in the number of components of the (marked) random connection model that are isomorphic to a given finite connected graph and are located in a compact convex observation window. In addition, we consider the total number of finite components within the observation window. For increasing observation windows asymptotic variances are studied and quantitative central limit theorems are shown. These results are based on bounds for the normal approximation of functionals of pairwise marked Poisson point processes that are derived from the Stein-Malliavin method.