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Random topology in soft-thresholded Gaussian models

The soft-thresholded Gaussian model have been developed in biostatistics with applications in brain imaging. It has a Bayesian structure, and hence requires a rule to choose an appropriate prior distribution. This often means choosing the height of the threshold according to known information, for example, the number of active areas, which corresponds to the number of connected components of the excursion set above the threshold. In this talk we discuss the recent results that we obtained concerning the distribution of such a number. More precisely, for certain Gaussian random fields, when the threshold tends to infinity and the searching area expands with a matching speed, both the location of the excursion sets and the location of the local maxima above the threshold will converge weakly to a Poisson point process. We will further discuss the possibility to approximate these locations when the threshold is high but not extremely high, by studying the local behavior of the critical points above the threshold of the random field. This work provides theoretical support to predict the number of active areas in the brain when using a particular threshold. This is a joint work with Jian Kang, Paul Marriott and Weinan Qi.