RARE EVENTS IN RANDOM GEOMETRIC GRAPHS

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Abstract. This talk introduces and compares approaches for estimating rare-event probabilities related to the number of edges in the random geometric graph on a Poisson point process. In the one-dimensional setting, we derive closed-form expressions for a variety of conditional probabilities related to the number of edges in the random geometric graph and develop conditional Monte Carlo algorithms for estimating rare-event probabilities on this basis. We prove rigorously a reduction in variance when compared to the crude Monte Carlo estimators and illustrate the magnitude of the improvements in a simulation study. In higher dimensions, we use conditional Monte Carlo to remove the fluctuations in the estimator coming from the randomness in the Poisson number of nodes. Finally, building on conceptual insights from large-deviations theory, we illustrate that importance sampling using a Gibbsian point process can further substantially reduce the estimation variance.

This talk is based on joint work with Sarat B. Moka, Thomas Taimre, and Dirk P. Kroese.