Seminar on Combinatorial Computing
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365 Fifth Avenue, New York

Undecidable statements and the zero-one law in random geometric graphs

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Abstract

A well known result in Erdős-Rényi graphs is that for any fixed value of p the Zero-One Law holds and that there is a decision procedure for the limiting probability. Recently, there has been much interest in studying the properties of geometrically defined random graphs as they find application in modeling wireless networks, cluster analysis, layout problems and percolation to name a few. We show that in sharp contrast with Erdős-Rényi graphs, random geometric graphs over two and higher dimensional spaces do not satisfy the zero-one law for many large values of the radius of connectivity. This result also resolves some conjectures of McColm in the negative. We further show in these cases that there is no decision procedure to determine if the limiting probability of a first order sentence is zero.

Random geometric graphs have edge dependence because of triangle inequality, so most of the techniques used for Erdős-Rényi graphs cannot be applied here. We apply novel methods to prove our results, an instance of which is the undecidability reduction from the Post correspondence problem.

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http://www.math.nyu.edu/p̃ach/public_html/combinatorics_seminar.html