Institut für Optimierung und Diskrete Mathematik

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Homological connectivity of random simplicial 2-complexes

Oliver Cooley

(TU Graz)

Linial and Meshulam introduced a model of random simplicial 2-complexes with n 0-simplices (or vertices) in which all pairs of vertices form 1-simplices (or edges) and each triple of vertices forms a 2-simplex (or face) with probability p independently. They showed that this model undergoes a phase transition with respect to $\mathbb{F}_2$-homological 1-connectivity at around $p = \frac{2\log n}{n}$, and that the critical obstruction to connectivity is the presence of an edge which is in no face.

We consider a similar model, but in which each pair of vertices forms an edge only if it lies in a face. Thus the complex is generated by a random 3-uniform hypergraph by taking the down-closure. Now by definition the previous critical obstruction to connectivity no longer exists. We show that in this model, the phase transition for $\mathbb{F}_2$-homological 1-connectivity occurs at around $p = \frac{\log n + \frac{1}{2}\log\log n}{n}$ and describe what the new critical obstruction is. The arguments are complicated by the fact that in this setting, connectivity is not a monotone property.

This talk is based on joint work with Penny Haxell, Mihyun Kang and Philipp Sprüssel.

Mihyun Kang