Contribution ID: **65** Type: **not specified**

Improved mixing for the convex polygon triangulation flip walk

Wednesday, July 12, 2023 11:45 AM (20 minutes)

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Abstract: We prove that the well-studied triangulation flip walk on a convex point set mixes in time O(n^3 log^3 n), the first progress since McShine and Tetali's O(n^5 log n) bound in 1997. In the process we give lower and upper bounds of respectively Omega(1/(sqrt n log n)) and O(1/sqrt n)—asymptotically tight up to an O(log n) factor—for the expansion of the associahedron graph K_n. The upper bound recovers Molloy, Reed, and Steiger's Omega(n^{3/2}) bound on the mixing time of the walk. To obtain these results, we introduce a framework consisting of a set of sufficient conditions under which a given Markov chain mixes rapidly. This framework is a purely combinatorial analogue that in some circumstances gives better results than the projection-restriction technique of Jerrum, Son, Tetali, and Vigoda. In particular, in addition to the result for triangulations, we show quasipolynomial mixing for the k-angulation flip walk on a convex point set, for fixed k >= 4.

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Session Classification: Track A-3