

# Improved mixing for the convex polygon triangulation flip walk

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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  $k \geq 4$ .

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