Bocconi

05 JUNE 2025
12:00 AM

Bocconi University
Room 2-E4-SR03
Via Röntgen 1, Milano (2° floor)

Sparsest cut and eigenvalue multiplicities on low degree Abelian Cayley graphs

Speaker

Jaje Ruotolo
Computer Science Phd student in the Theory of Computation group
Harvard

Università Bocconi
DEPARTMENT OF COMPUTING SCIENCES

Abstract

Whether or not the Sparsest Cut problem admits an efficient O(1)-approximation algorithm is a fundamental algorithmic question with connections to geometry and the Unique Games Conjecture.

Revisiting spectral algorithms for Sparsest Cut, we present a novel, simple algorithm that combines eigenspace enumeration with a new algorithm for the Cut Improvement problem.

The runtime of our algorithm is parametrized by a quantity that we call the cut dimension CD(G): the smallest k such that the subspace spanned by the first k Laplacian eigenvectors contains all but a small fraction of a sparsest cut.

Our algorithm matches the guarantees of prior methods based on the threshold-rank paradigm, while also extending beyond them. To illustrate this, we study its performance on low degree Cayley graphs over Abelian groups---canonical examples of graphs with poor expansion properties.

Along the way to bounding the cut dimension of Abelian Cayley graphs, we prove a bound of 2^{O(d)} the multiplicity of the second smallest laplacian eigenvalue. This bound is tight and improves on a previous bound of 2^{O(d^2)} by Lee and Makarychev.