

# Graph Decompositions and Length-Constrained Expanders

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## Abstract

Graph decompositions are powerful algorithmic tools with wide applications to graph structures (e.g., spanners, hopsets, sparsifiers, oblivious routings, etc.) and network optimization algorithms, including parallel, distributed and dynamic algorithms for flow and distance problems.

Classical graph decompositions include

- low-diameter decomposition, which captures  $\ell_1$ -quantities like lengths and costs, and
- expander decomposition, which captures  $\ell_\infty$ -quantities like flows and congestion.

This keynote starts with a brief survey of these classical decompositions, then presents length-constrained expanders and length-constrained expander decompositions – a recent and technically rich generalization that simultaneously controls length and congestion ( $\ell_1$  &  $\ell_\infty$ ). Length-constrained expander decompositions significantly broaden and extend the range of applications for graph decompositions, and this talk will discuss several examples and ways to leverage their power.

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