Survivable Network Design for Group Connectivity in Bounded-Treewidth Graphs

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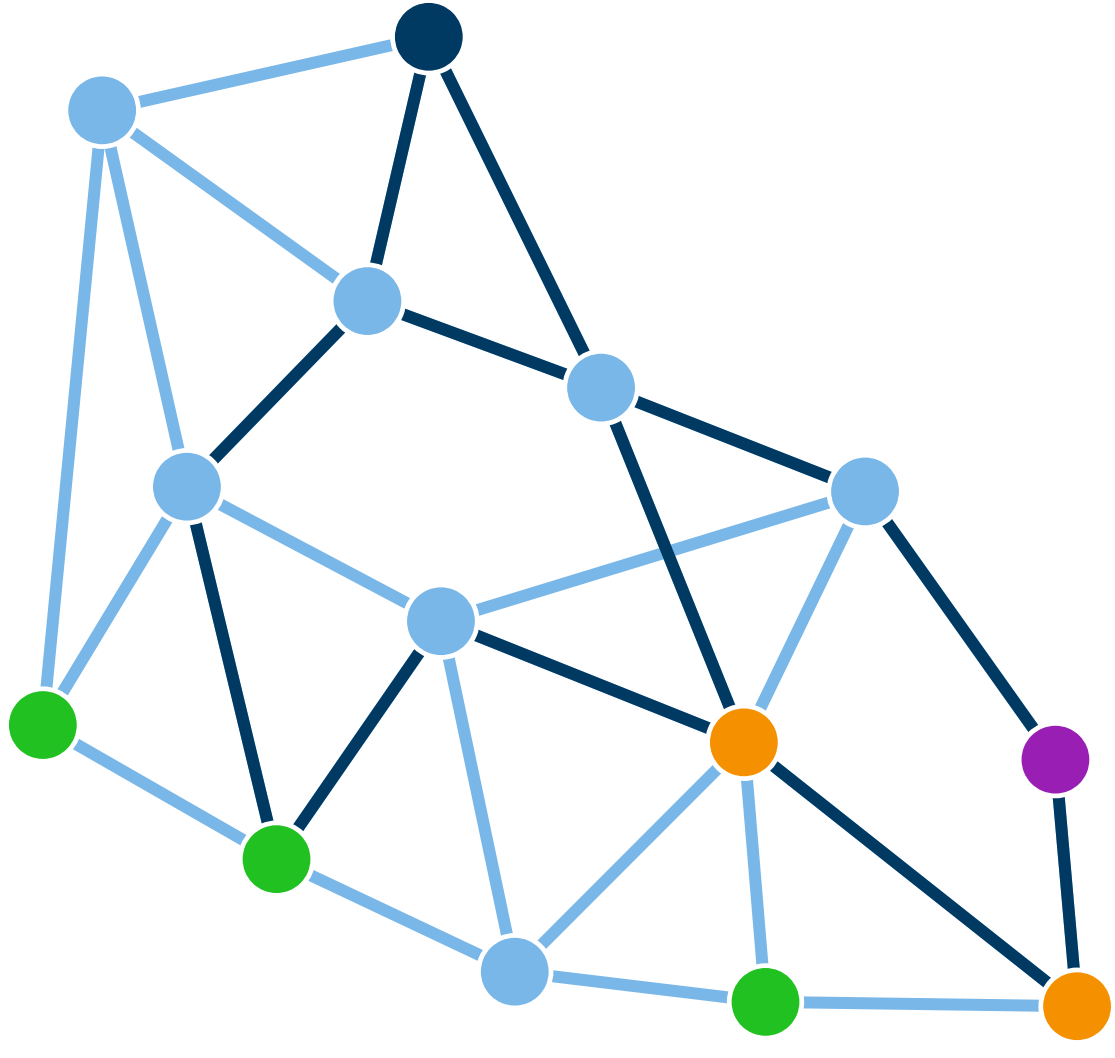
Group SNDP



Group SNDP

- Input:
  - Graph G, edge/vertex costs
  - Groups S_i with connectivity demands k_i
  - Root r
- Goal: Find a min-cost graph that
  - Contains k_i disjoint paths from r to $v_i \in S_i$

Known Results

- $k_i = 1$: Group Steiner Tree
  - $O(\log^3 n)$-approx*, $O(\log^2 n)$-hardness [GKR'98], [HK'03]
  - Bounded Treewidth: $O(\log^2 n)$-approx [**CDLV**17']
- $k_i \leq 2$
  - $\tilde{O}(\log^4 n)$-approx* [GKR'10]
- *** Cannot be improved beyond** $O(\log n)$
  - Both use tree embedding, which has distortion $\Omega \log n$

Known Results

- Groups of size 1: SNDP
  - 2-approx [Jain'00]
- In general: Label-Cover hard [KKN'12]
  - $2^{\log^{1-\epsilon} n}$ hardness
  - $\Omega(n^{\delta})$ hardness under Sliding Scale Conjecture

Our Results

- Group SNDP:
  - $O(\log^2 n)$-approx in $n^{f(k,tw(G))}$
- SNDP:
  - Exact algorithm in time $n2^{f(k,tw(G))}$
- Both results for vertex weights / connectivity

Main Idea

- Develop a DP without group constraints
- Turn the DP into an LP and add the group constraints
- New LP represents a variant of Group Steiner Tree

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19th Max Planck Advanced Course on the Foundations of Computer Science

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Ramamohan Paturi

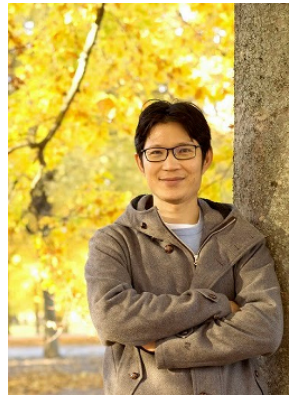
UC San Diego

Foundations of Fine-grained Complexity

Amir Abboud

IBM Almaden

Hardness in P



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