D I S S E R T A T I O N P R O P O S A L

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“Polyhedral and Algorithmic approaches to Network Connectivity”

Monday, October 10, 2022
8:30am
Tepper 4242

This proposal contains five chapters, each concerning an algorithmic or polyhedral problem in network connectivity.

The first chapter describes progress towards resolving Woodall's conjecture - a well-known min-max conjecture on directed graphs. We reduce the conjecture to a class of “almost bipartite” instances and prove the conjecture in various special cases.

In the second chapter, we discuss new integrality gap bounds for a linear relaxation of the Weighted Tree Augmentation Problem (WTAP). In particular, we show that the integrality gap of the ODD-LP is at most $2 - \left(\frac{1}{2}\right)^{k-1}$ on depth-k trees.

In the third chapter, we discuss the Steiner Tree Augmentation Problem (STAP) - a generalization of Tree Augmentation - and give the first better-than-2 approximation algorithm for STAP in the edge-weighted case.

In the fourth chapter, we define and analyze the Base Augmentation Problem, a matroidal generalization of WTAP, and characterize it’s approximability in certain matroid classes.

In light of recent breakthroughs on the Cactus Augmentation Problem, the goal for the fifth chapter is to extend the results for STAP to achieve an improved approximation ratio for the Steiner Cactus Augmentation problem.