Graz University of Technology

Institut für Optimierung und Diskrete Mathematik

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A Hierarchy of Subgraph Projection-Based Semidefinite Relaxations for some NP-Hard Graph Optimization Problems

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Many important NP-hard combinatorial problems can be efficiently approximated using semidefinite programming relaxations. We propose a new hierarchy of semidefinite relaxations for classes of such problems that are based on graphs and for which the projection of the problem onto a subgraph shares the same structure as the original problem. In particular, we will focus on the well-studied max-cut problem.

Each level k of the proposed hierarchy consists of the basic semidefinite relaxation of the problem augmented by the constraints enforcing the structural projection condition on every k-node subgraph of the problem. This hierarchy has the distinguishing feature that all the relaxations are formulated in the space of the original semidefinite relaxation.

Preliminary computational results show that the proposed hierarchy yields improved bounds when compared to the initial relaxation for benchmark instances of the max-cut and stable-set problems, and that the improved bounds result in significantly smaller enumeration trees when the relaxation is used in a branch-and-bound scheme.

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