SIAM/APPLIED AND NUMERICAL ANALYSIS SEMINAR

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Title: Cutting plane generation through sparse principal component analysis

Abstract: Quadratically-constrained quadratic programs (QCQPs) are optimization models whose remarkable expressiveness have made them a cornerstone of methodological research for nonconvex optimization problems. However, modern methods to solve a general QCQP fail to scale, encountering computational challenges even with just a few hundred variables. Specifically, a semidefinite programming (SDP) relaxation is typically employed, which provides strong dual bounds for QCQPs, but relies on memory-intensive algorithms. An appealing alternative is to replace the SDP with an easier-to-solve linear programming relaxation, while still achieving strong bounds. In this work, we make advances towards achieving this goal by developing a computationally-efficient linear cutting plane algorithm that emulates the SDP-based approximations of nonconvex QCQPs. The cutting planes are required to be sparse, in order to ensure a numerically attractive approximation, and efficiently computable. We present a novel connection between such sparse cut generation and the sparse principal component analysis problem in statistics, which allows us to achieve these two goals. We show extensive computational results advocating for the use of our approach.

Based on joint work with Santanu S. Dey, Andrea Lodi, and Gonzalo Muñoz. Preprint available at `http://www.optimization-online.org/DB_HTML/2021/02/8259.html`.