Infeasible Constraint-Reduced Methods for Quadratic and Semidefinite Optimization

DOE Grant DESC0002218

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We consider the (dual) problem
\[ \max f(y) \quad s.t. \quad A^T y \preceq c, \]  
where \( A \in \mathbb{R}^{m \times n} \) and we assume \( m \ll n \).

Constraint Reduction
We expect many of the constraints in unbalanced (\( m \ll n \)) problems are redundant or at least not strictly necessary.

We consider quadratic problems of the form
\[ \min f(x) = \frac{1}{2} x^T D x + b^T x \quad \text{subject to} \quad A x = b, \]
where \( D \geq 0 \) is a symmetric matrix and \( A \) is a matrix of constraints.

Theoretical Results
- We develop a constraint-reduced primal-dual affine-scaling interior-point algorithm, following that of He and Tits (2011), but with adaptive adjustment of the penalty parameter.
- We prove that the penalty parameter is increased finitely many times.
- We prove that the algorithm is globally convergent to a point that satisfies the optimality conditions for the QP.
- Generalizes the results obtained for the LP case in He and Tits (2011).

Numerical Results
- First figure: Randomly generated problems
- Second figure: Application in Model Predictive Control

References