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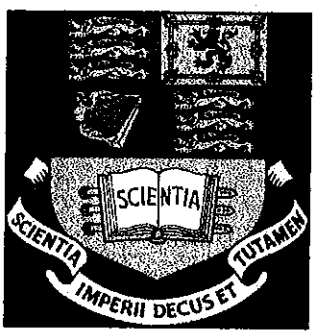
Optimization Over Symmetric Positive Semidefinite Matrices Using Conical Hulls



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Abstract

The research concerns the development of algorithms for solving convex optimization problems over the set of symmetric positive semidefinite (PSD) matrices. The iterative algorithms developed here are based on the characterization of the PSD set as a cone and the representation of constrained sets as linearly-mapped PSD cones. The feasible set for a certain problem can be represented as the intersection of various cones and the problem is transformed into a norm minimization problem. To solve the problem, the notion of the supporting hyperplane of the PSD cone is introduced. The contact points of the hyperplanes with the corresponding cones determine the set within which the solution will be computed iteratively. Two approaches will be used in forming the solution set. The first approach uses the contact point for defining a search line as the set on which a quadratic problem is solved to obtain the minimizer. In the second approach, the contact points are used to form a conical hull as the approximation of the solution set over which the quadratic problem is solved. The approach is then applied in the study of the stability of a multi-configurations system, that is for finding a common quadratic Lyapunov function (CLF) of a family of stable linear systems. Further the proposed algorithm is investigated for the case of minimization over the intersection of cones. The numerical results suggest that the proposed algorithm can perform moderately well for some cases, compared to the projective method.