Course on LMI optimization with applications in control

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Venue and dates

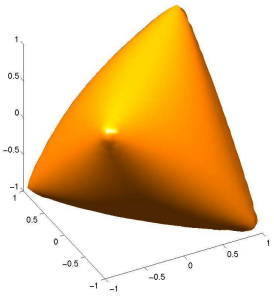
The course is given at the Czech Technical University in Prague, Charles Square, down-town Prague (Karlovo Náměstí 13, 12135 Praha 2) from Monday February 2 to Friday February 6, 2009. It consists of six two-hour lectures and two two-hour Matlab labs. There is no admission fee, students and reseachers from external institutions are particularly welcome, but please send an e-mail to henrion@laas.fr to register.

Description

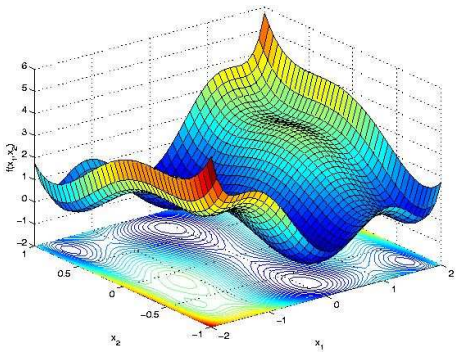
This is a course for graduate students or researchers with some background in linear algebra, convex optimization and linear control systems. The focus in on semidefinite programming (SDP), or optimization over linear matrix inequalities (LMIs), an extension of linear programming to the cone of positive semidefinite matrices.

Outline

In the first part of the course, historical developments of LMIs and SDP are surveyed. Convex sets that can be represented with LMIs are classified and studied. LMI relaxations are introduced to solve non-convex polynomial optimization problems, with a focus on the theory of measures and moments. Finally, interior-point algorithms are described to solve LMI problems and latest achievements in software and solvers are reported. The second part of the course focuses on the application of LMI techniques to solve control problems. Standard control problems are revisited thanks to recent results on invariant measures and SDP. Finally, more difficult control problems, such as robustness analysis of linear systems, or design of fixed-order robust controllers with H-infinity specifications, are addressed thanks to the flexibility of the LMI framework. For the labs we use YALMIP, GloptiPoly and SeDuMi under a Matlab environment. The originality of the approach is in the simultaneous use of algebraic or polynomial techniques (as opposed to classical state-space methods) and modern convex optimization techniques.



Affine section of the positive semidefinite cone



Non-convex polynomial optimization