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LMIs for Optimization and Control

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LMIs, linear matrix inequalities, have been studied extensively since the 1990s in connection with Lyapunov techniques for ensuring stability and performance of linear and nonlinear control systems. This approach to systems control constantly benefits from developments and improvements of efficient interior-point primal-dual algorithms for conic optimization by the mathematical programming community.

Recent achievements of real algebraic geometry have provided powerful results for the representation of positive polynomials as sum-of-squares (SOS) and its dual theory of moment problems. Many difficult nonlinear nonconvex optimization and control problems can now be solved numerically and efficiently by moment-SOS LMI hierarchies, with mathematically sound convergence guarantees and explicit certificates of global optimality. Our public-domain Matlab package GloptiPoly, developed since 2002, implements many of these techniques and ideas.

The main purpose of this course is to introduce the basic concepts of this general methodology and detail its application for solving nonlinear nonconvex optimal control problems with polynomial data.