

M6 : LMIs in Control
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Introduction

- Overview: What can be expected from LMI techniques?
- What are LMI's and what are they good for?
- Stability: linear time-invariant, time-varying or non-linear systems
- LMI regions
- Discrete-time versus continuous-time

Performance

- Dissipativity
- Quadratic performance and specializations (H_1 , passivity)
- H_2 performance and generalizations
- Guaranteeing hard bounds through positively invariant ellipsoids
- From nominal to robust performance

Synthesis

- State-feedback and estimation problems
- Output feedback synthesis - convexifying controller parameter transformation
- Mixed-objective control

Multi-objective control

- Youla parametrization and genuine multi-objective controller synthesis
- Robust controller design
- Parameter Elimination and Dualization

Parametric Robust Stability

- Robust stability against time-invariant and time-varying uncertainties
- Parameter dependent Lyapunov functions
- Semi-infinite LMI problems and relaxations

Robust Optimization and Lagrange Duality

- Introduction to robust optimization and robust LMI problems
- Lagrange duality
- How to construct tractable relaxations

Dynamic Robustness

- Linear fractional representations
- Robust stability tests with multipliers
- Relations to the structured singular value
- Extension to dynamic uncertainties: Integral quadratic constraints

LPV synthesis

- Linear parametrically-varying controller synthesis
- Direct approach
- Multiplier approach
- A missile example

Relaxations

- Polynomial optimization
- Lagrange relaxation and higher-order relaxations
- Robust LMI problems and testing relaxation exactness



Carsten W. Scherer earned the Ph.D. degree in mathematics from the University of Würzburg (Germany) in 1991. After six months of research at the University of Groningen (The Netherlands), the University of Michigan (Ann Arbor) and Washington University (St. Louis) respectively, he joined Delft University of Technology (The Netherlands) in 1993 where he held positions as an assistant and associate professor. In fall 1999, he spent a three months sabbatical as a visiting professor at the Automatic Control Laboratory of ETH (Zurich). Since fall 2001, he is a full professor within Delft Center for Systems and Control at Delft University of Technology. His main research interests cover various topics in applying optimization techniques for developing new advanced controller design algorithms and their application to mechatronics and aerospace systems. Dr. Scherer served as an associated editor for IEEE Transactions on Automatic Control and Automatica (two terms). He is currently active on the editorial boards of Systems & Control Letters and European Journal of Control, and chairing the IFAC technical committee on Robust Control.

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