Linear Matrix Inequality (LMI)

$$F(\mathbf{x}) = F_0 + \sum_{i=1}^{m} \mathbf{x}_i F_i > 0 \ (< 0)$$

$$\mathbf{x} \in R^m, \quad F_i = F_i^T \in R^{n \times n} \ i = 0, 1, 2, ..., m$$

➤Set of n polynomial inequalities in x, e.g.,

$$F(\mathbf{x}) = \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix} + \mathbf{x}_1 \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} + \mathbf{x}_2 \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 2 + \mathbf{x}_1 - \mathbf{x}_2 \\ 2 + \mathbf{x}_1 - \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 3 + \mathbf{x}_2 \\ 3 + \mathbf{x}_1 + \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 3 + \mathbf{x}_2 \\ 3 + \mathbf{x}_1 + \mathbf{x}_2 & 3 + \mathbf{x}_2 \end{bmatrix} > 0 \Leftrightarrow \begin{bmatrix} 1 + \mathbf{x}_1 + \mathbf{x}_2 & 3 + \mathbf{x}_2 \\ 3 + \mathbf{x}_1 + \mathbf{x}_2 &$$

Convex constraint on x

Matrix Inequalities

Roberto Tempo, Giuseppe Calafiore, Fabrizio Dabbene

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Kwon,Soo Hee Han,2005-10-04 Receding Horizon Control RHC introduces the essentials of a successful feedback strategy that has emerged in many industrial fields RHC has several advantages over other types of control greater adaptability to parametric changes than infinite horizon control better tracking than PID and good constraint handling among others The text builds understanding starting with optimal controls for simple linear systems and working through constrained systems to nonlinear cases RHC is applied to discrete time systems for easier computer application and its techniques are unified using the state space framework Examples and exercises allow you to practise as you go MATLAB files for the solution of selected examples can be downloaded from http extras springer com Students following masters and doctoral courses in control will find this book an excellent companion to tuition and research Tutors and academics researching predictive control can use it not only as a scholarly textbook but as a co ordinated reference for its wide range of RHC schemes

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that act on the plant are broadened beyond those that are common in classical output regulation and thus permitting us to deal with exact as well as almost output regulation under a variety of controllers etc The Schur Complement and Its Applications Fuzhen Zhang, 2005-03-04 This book describes the Schur complement as a rich and basic tool in mathematical research and applications and discusses many significant results that illustrate its power and fertility Coverage includes historical development basic properties eigenvalue and singular value inequalities matrix inequalities in both finite and infinite dimensional settings closure properties and applications in statistics probability and numerical analysis Library of Congress Subject Congress Subject Headings Library of Congress. Cataloging Policy and Support Office, 2007 Headings Library of Congress, Library of Congress. Office for Subject Cataloging Policy, 2012 Randomized Algorithms for Analysis and Control of Uncertain Systems Roberto Tempo, Giuseppe Calafiore, Fabrizio Dabbene, 2012-10-21 The presence of uncertainty in a system description has always been a critical issue in control The main objective of Randomized Algorithms for Analysis and Control of Uncertain Systems with Applications Second Edition is to introduce the reader to the fundamentals of probabilistic methods in the analysis and design of systems subject to deterministic and stochastic uncertainty The approach propounded by this text guarantees a reduction in the computational complexity of classical control algorithms and in the conservativeness of standard robust control techniques. The second edition has been thoroughly updated to reflect recent research and new applications with chapters on statistical learning theory sequential methods for control and the scenario approach being completely rewritten Features self contained treatment explaining Monte Carlo and Las Vegas randomized algorithms from their genesis in the principles of probability theory to their use for system analysis development of a novel paradigm for convex and nonconvex controller synthesis in the presence of uncertainty and in the context of randomized algorithms comprehensive treatment of multivariate sample generation techniques including consideration of the difficulties involved in obtaining identically and independently distributed samples applications of randomized algorithms in various endeavours such as PageRank computation for the Google Web search engine unmanned aerial vehicle design both new in the second edition congestion control of high speed communications networks and stability of quantized sampled data systems Randomized Algorithms for Analysis and Control of Uncertain Systems second edition is certain to interest academic researchers and graduate control students working in probabilistic robust or optimal control methods and control engineers dealing with system uncertainties. The present book is a very timely contribution to the literature I have no hesitation in asserting that it will remain a widely cited reference work for many years M Vidyasagar

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