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AND INFORMATION SCIENCES

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Didier Henrion  
Andrea Garulli (Eds.)

# Positive Polynomials in Control

 Springer

# Positive Polynomials In Control

**Didier Henrion, Andrea Garulli**



## **Positive Polynomials In Control:**

**Positive Polynomials in Control** Didier Henrion, Andrea Garulli, 2009-09-02 Positive Polynomials in Control originates from an invited session presented at the IEEE CDC 2003 and gives a comprehensive overview of existing results in this quickly emerging area This carefully edited book collects important contributions from several fields of control optimization and mathematics in order to show different views and approaches of polynomial positivity The book is organized in three parts reflecting the current trends in the area 1 applications of positive polynomials and LMI optimization to solve various control problems 2 a mathematical overview of different algebraic techniques used to cope with polynomial positivity 3 numerical aspects of positivity of polynomials and recently developed software tools which can be employed to solve the problems discussed in the book

**Positive Polynomials in Control** Didier Henrion, Andrea Garulli, 2005-01-14 Positive Polynomials in Control originates from an invited session presented at the IEEE CDC 2003 and gives a comprehensive overview of existing results in this quickly emerging area This carefully edited book collects important contributions from several fields of control optimization and mathematics in order to show different views and approaches of polynomial positivity The book is organized in three parts reflecting the current trends in the area 1 applications of positive polynomials and LMI optimization to solve various control problems 2 a mathematical overview of different algebraic techniques used to cope with polynomial positivity 3 numerical aspects of positivity of polynomials and recently developed software tools which can be employed to solve the problems discussed in the book

**Homogeneous Polynomial Forms for Robustness Analysis of Uncertain Systems** Graziano Chesi, Andrea Garulli, Alberto Tesi, Antonio Vicino, 2009-07-13 This book presents a number of techniques for robustness analysis of uncertain systems In it convex relaxations for several robustness problems are derived by exploiting and providing new results on the theory of homogenous polynomial forms

**Optimization of Polynomials in Non-Commuting Variables** Sabine Burgdorf, Igor Klep, Janez Povh, 2016-06-07 This book presents recent results on positivity and optimization of polynomials in non commuting variables Researchers in non commutative algebraic geometry control theory system engineering optimization quantum physics and information science will find the unified notation and mixture of algebraic geometry and mathematical programming useful Theoretical results are matched with algorithmic considerations several examples and information on how to use NCSOSTools open source package to obtain the results provided Results are presented on detecting the eigenvalue and trace positivity of polynomials in non commuting variables using Newton chip method and Newton cyclic chip method relaxations for constrained and unconstrained optimization problems semidefinite programming formulations of the relaxations and finite convergence of the hierarchies of these relaxations and the practical efficiency of algorithms

*Geometric and Numerical Foundations of Movements* Jean-Paul Laumond, Nicolas Mansard, Jean-Bernard Lasserre, 2017-05-02 This book aims at gathering roboticists control theorists neuroscientists and mathematicians in order to promote a multidisciplinary research on movement analysis It

follows the workshop Geometric and Numerical Foundations of Movements held at LAAS CNRS in Toulouse in November 2015 1 Its objective is to lay the foundations for a mutual understanding that is essential for synergetic development in motion research In particular the book promotes applications to robotics and control in general of new optimization techniques based on recent results from real algebraic geometry Sum of Squares: Theory and Applications Pablo A. Parrilo, Rekha R. Thomas, 2020 This volume is based on lectures delivered at the 2019 AMS Short Course Sum of Squares Theory and Applications held January 14 15 2019 in Baltimore Maryland This book provides a concise state of the art overview of the theory and applications of polynomials that are sums of squares This is an exciting and timely topic with rich connections to many areas of mathematics including polynomial and semidefinite optimization real and convex algebraic geometry and theoretical computer science The six chapters introduce and survey recent developments in this area specific topics include the algebraic and geometric aspects of sums of squares and spectrahedra lifted representations of convex sets and the algorithmic and computational implications of viewing sums of squares as a meta algorithm The book also showcases practical applications of the techniques across a variety of areas including control theory statistics finance and machine learning Moment and Polynomial Optimization Jiawang Nie, 2023-06-15 Moment and polynomial optimization is an active research field used to solve difficult questions in many areas including global optimization tensor computation saddle points Nash equilibrium and bilevel programs and it has many applications The author synthesizes current research and applications providing a systematic introduction to theory and methods a comprehensive approach for extracting optimizers and solving truncated moment problems and a creative methodology for using optimality conditions to construct tight Moment SOS relaxations This book is intended for applied mathematicians engineers and researchers entering the field It can be used as a textbook for graduate students in courses on convex optimization polynomial optimization and matrix and tensor optimization **Handbook on Semidefinite, Conic and Polynomial Optimization** Miguel F. Anjos, Jean B. Lasserre, 2011-11-19 Semidefinite and conic optimization is a major and thriving research area within the optimization community Although semidefinite optimization has been studied under different names since at least the 1940s its importance grew immensely during the 1990s after polynomial time interior point methods for linear optimization were extended to solve semidefinite optimization problems Since the beginning of the 21st century not only has research into semidefinite and conic optimization continued unabated but also a fruitful interaction has developed with algebraic geometry through the close connections between semidefinite matrices and polynomial optimization This has brought about important new results and led to an even higher level of research activity This Handbook on Semidefinite Conic and Polynomial Optimization provides the reader with a snapshot of the state of the art in the growing and mutually enriching areas of semidefinite optimization conic optimization and polynomial optimization It contains a compendium of the recent research activity that has taken place in these thrilling areas and will appeal to doctoral students young graduates and experienced

researchers alike The Handbook's thirty one chapters are organized into four parts Theory covering significant theoretical developments as well as the interactions between conic optimization and polynomial optimization Algorithms documenting the directions of current algorithmic development Software providing an overview of the state of the art Applications dealing with the application areas where semidefinite and conic optimization has made a significant impact in recent years

*Algebraic and Geometric Methods in Discrete Mathematics* Heather A. Harrington, Mohamed Omar, Matthew Wright, 2017-03-16 This volume contains the proceedings of the AMS Special Session on Algebraic and Geometric Methods in Applied Discrete Mathematics held on January 11 2015 in San Antonio Texas The papers present connections between techniques from pure mathematics and various applications amenable to the analysis of discrete models encompassing applications of combinatorics topology algebra geometry optimization and representation theory Papers not only present novel results but also survey the current state of knowledge of important topics in applied discrete mathematics Particular highlights include a new computational framework based on geometric combinatorics for structure prediction from RNA sequences a new method for approximating the optimal solution of a sum of squares problem a survey of recent Helly type geometric theorems applications of representation theory to voting theory and game theory a study of fixed points of tensors and exponential random graph models from the perspective of algebraic statistics with applications to networks This volume was written for those trained in areas such as algebra topology geometry and combinatorics who are interested in tackling problems in fields such as biology the social sciences data analysis and optimization It may be useful not only for experts but also for students who wish to gain an applied or interdisciplinary perspective

*Switched and Impulsive Systems* Zhengguo Li, Yengchai Soh, Changyun Wen, 2005-02-16 In this volume the important concept of switched and impulsive control is discussed with a wide field of applications in the analysis and control of complex systems This monograph provides the reader with a comprehensive coverage of switched and impulsive systems including new original work with various applications such as switched server systems scalable video coding systems chaotic based secure communication or quality of service on the internet Switched and Impulsive Systems can be used as a reference or a text for a course at graduate level

**Optimization Based Clearance of Flight Control Laws** Andreas Varga, Anders Hansson, Guilhem Puyou, 2011-09-28 This book summarizes the main achievements of the EC funded 6th Framework Program project COFCLUO Clearance of Flight Control Laws Using Optimization This project successfully contributed to the achievement of a top level objective to meet society's needs for a more efficient safer and environmentally friendly air transport by providing new techniques and tools for the clearance of flight control laws This is an important part of the certification and qualification process of an aircraft a costly and time consuming process for the aeronautical industry The overall objective of the COFCLUO project was to develop and apply optimization techniques to the clearance of flight control laws in order to improve efficiency and reliability In the book the new techniques are explained and benchmarked against traditional techniques currently used by

the industry The new techniques build on mathematical criteria derived from the certification and qualification requirements together with suitable models of the aircraft The development of these criteria and models are also presented in the book Because of wider applicability the optimization based clearance of flight control laws will open up the possibility to design innovative aircraft that today are out of the scope using classical clearance tools Optimization based clearance will not only increase safety but it will also simplify the whole certification and qualification process thus significantly reduce cost The achieved speedup will also support rapid modeling and prototyping and reduce time to market

An Introduction to Polynomial and Semi-Algebraic Optimization Jean Bernard Lasserre, 2015-02-19 The first comprehensive introduction to the powerful moment approach for solving global optimization problems

*Emerging Applications of Algebraic Geometry* Mihai Putinar, Seth Sullivant, 2008-12-10 Recent advances in both the theory and implementation of computational algebraic geometry have led to new striking applications to a variety of fields of research The articles in this volume highlight a range of these applications and provide introductory material for topics covered in the IMA workshops on Optimization and Control and Applications in Biology Dynamics and Statistics held during the IMA year on Applications of Algebraic Geometry The articles related to optimization and control focus on burgeoning use of semidefinite programming and moment matrix techniques in computational real algebraic geometry The new direction towards a systematic study of non commutative real algebraic geometry is well represented in the volume Other articles provide an overview of the way computational algebra is useful for analysis of contingency tables reconstruction of phylogenetic trees and in systems biology The contributions collected in this volume are accessible to non experts self contained and informative they quickly move towards cutting edge research in these areas and provide a wealth of open problems for future research

*Realization Theory and Design of Digital Images* Yasumichi Hasegawa, Tatsuo Suzuki, 2006-10-20 This monograph offers a thorough examination of the description and design of digital images Regarding digital images as special input output relations in the authors previous book in the series Lecture Notes in Control and Information Sciences the description problem of digital images is transformed into the realization problem of digital images This book is intended for researchers and graduate students who specialize in image processing and system theory

Modal Array Signal Processing: Principles and Applications of Acoustic Wavefield Decomposition Heinz Teutsch, 2007-01-10 This book deals with the problem of detecting and localizing multiple simultaneously active wideband acoustic sources by applying the notion of wavefield decomposition using circular and spherical microphone arrays A rigorous derivation of modal array signal processing algorithms for unambiguous source detection and localization as well as performance evaluations by means of measurements using an actual real time capable implementation are discussed

**Explicit Stability Conditions for Continuous Systems** Michael I. Gil, 2005-03-17 Explicit Stability Conditions for Continuous Systems deals with non autonomous linear and nonlinear continuous finite dimensional systems Explicit conditions for the asymptotic absolute input to state and orbital stabilities are discussed This

monograph provides new tools for specialists in control system theory and stability theory of ordinary differential equations with a special emphasis on the Aizerman problem A systematic exposition of the approach to stability analysis based on estimates for matrix valued functions is suggested and various classes of systems are investigated from a unified viewpoint

**Fuzzy Systems and Data Mining VI** A.J. Tallón-Ballesteros, 2020-11-13 The interdisciplinary field of fuzzy logic encompass applications in the electrical industrial chemical and engineering realms as well as in areas of management and environmental issues while data mining covers new approaches to big data massive data and scalable parallel and distributed algorithms This book presents papers from the 6th International Conference on Fuzzy Systems and Data Mining FSDM 2020 The conference was originally due to be held from 13 16 November 2020 in Xiamen China but was changed to an online conference held on the same dates due to ongoing restrictions connected with the COVID 19 pandemic The annual FSDM conference provides a platform for knowledge exchange between international experts researchers academics and delegates from industry This year the committee received 316 submissions of which 76 papers were selected for inclusion in the conference an acceptance rate of 24% The conference covers four main areas fuzzy theory algorithms and systems which includes topics like stability foundations and control and fuzzy applications which are widely used and cover various types of processing as well as hardware and architecture for big data and time series Providing a current overview of research and developments in fuzzy logic and data mining the book will be of interest to all those working in the field of data science

Mathematical Control Theory I M. Kanat Camlibel, A. Agung Julius, Ramkrishna Pasumarthi, Jacqueliem M.A. Scherpen, 2015-07-15 This treatment of modern topics related to mathematical systems theory forms the proceedings of a workshop Mathematical Systems Theory From Behaviors to Nonlinear Control held at the University of Groningen in July 2015 The workshop celebrated the work of Professors Arjan van der Schaft and Harry Trentelman honouring their 60th Birthdays The first volume of this two volume work covers a variety of topics related to nonlinear and hybrid control systems After giving a detailed account of the state of the art in the related topic each chapter presents new results and discusses new directions As such this volume provides a broad picture of the theory of nonlinear and hybrid control systems for scientists and engineers with an interest in the interdisciplinary field of systems and control theory The reader will benefit from the expert participants ideas on exciting new approaches to control and system theory and their predictions of future directions for the subject that were discussed at the workshop

*Sound Capture for Human / Machine Interfaces* Wolfgang Herboldt, 2005-03-22 With a continuously increasing desire for natural and comfortable human machine interaction the acoustic interface of any terminal for multimedia or telecommunication services is challenged to allow seamless and hands free audio communication Sound Capture for Human Machine Interfaces introduces the practical aspects of microphone array signal processing and presents various combinations of beamforming and acoustic echo cancellation

On the Numerical Solution of Nonlinear and Hybrid Optimal Control Problems Matthias Rungger, 2012 Front cover

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## Reviewing **Positive Polynomials In Control**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is really astonishing. Within the pages of "**Positive Polynomials In Control**," an enthralling opus penned by a very acclaimed wordsmith, readers set about an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve to the book is central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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