

Robust Control

Systems, Theory and Analysis

Sharon Bennett

Editor

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Robust Control

Jürgen Ackermann



Robust Control:

Robust Control Jürgen Ackermann, 2012-12-06 Many plants have large variations in operating conditions To ensure smooth running it is essential to find a simple fixed gain controller that guarantees rapidly decaying and well damped transients for all admissible operating conditions Robust Control presents design tools developed by the authors for the solution of this design problem Examples of simple and complex cases such as a crane a flight control problem and the automatic and active four wheel steering of a car illustrate the use of these tools This book is intended for anyone who has taken an undergraduate course in feedback control systems and who seeks an advanced treatment of robust control with applications Drawing on the resources and authoritative research of a leading aerospace institute it will mainly be of interest to mechanical and electrical engineers in universities institutes and industrial research centres

Linear Robust Control

Michael Green, David J. N. Limebeer, 2012-09-19 Recent years have witnessed enormous strides in the field of robust control of dynamical systems unfortunately many of these developments have only been accessible to a small group of experts In this text for students and control engineers the authors examines all of these advances providing an in depth and exhaustive examination of modern optimal and robust control

Robust Control Jürgen Ackermann, 2002-07-26 New results fresh ideas and new applications in automotive and flight control systems are presented in this second edition of Robust Control The book presents parametric methods and tools for the simultaneous design of several representative operating conditions and several design specifications in the time and frequency domains It also covers methods for robustness analysis that guarantee the desired properties for all possible values of the plant uncertainty A lot of practical application experience enters into the case studies of driver support systems that avoid skidding and rollover of cars automatic car steering systems flight controllers for unstable aircraft and engine out controllers The book also shows the historic roots of the methods their limitations and research needs in robust control

Recent Advances in Robust Control

Peter Dorato, Rama K. Yedavalli, 1990

Robust Control Design with MATLAB®

Da-Wei Gu, Petko Petkov, Mihail M Konstantinov, 2005-06-20 Shows readers how to exploit the capabilities of the MATLAB Robust Control and Control Systems Toolboxes to the fullest using practical robust control examples

Robust Control Kang-Zhi Liu, Yu Yao, 2016-09-15 Comprehensive and up to date coverage of robust control theory and its application Presented in a well planned and logical way Written by a respected leading author with extensive experience in robust control Accompanying website provides solutions manual and other supplementary material

Robust Control in Power Systems

Bikash Pal, Balarko Chaudhuri, 2006-07-02 Robust Control in Power Systems deals with the applications of new techniques in linear system theory to control low frequency oscillations in power systems The book specifically focuses on the analysis and damping of inter area oscillations in the systems which are in the range of 0.2-1 Hz The damping control action is injected through high power electronic devices known as flexible AC transmission system FACTS controllers Three commonly used FACTS controllers controllable series capacitors CSCs

controllable phase shifters CPSs and static var compensators SVCs have been used in this book to control the inter area oscillations The overview of linear system theory from the perspective of power system control is explained through examples The damping control design is formulated as norm optimization problem The H_∞ H_2 norm of properly defined transfer functions are minimized in linear matrix inequalities LMI framework to obtain desired performance and stability robustness Both centralized and decentralized control structures are used Usually the transmission of feedback signal from a remote location encounters delays making it difficult to control the system Smith predictor based approach has been successfully explored in this book as a solution to such a problem Robust Control in Power Systems will be valuable to academicians in the areas of power control and system theory as well as professionals in the power industry

Optimal and Robust Control
Luigi Fortuna, Mattia Frasca, Arturo Buscarino, 2021-11-24 There are many books on advanced control for specialists but not many present these topics for non specialists Assuming only a basic knowledge of automatic control and signals and systems this second edition of Optimal and Robust Control offers a straightforward self contained handbook of advanced topics and tools in automatic control The book deals with advanced automatic control techniques paying particular attention to robustness the ability to guarantee stability in the presence of uncertainty It explains advanced techniques for handling uncertainty and optimizing the control loop It also details analytical strategies for obtaining reduced order models The authors then propose using the Linear Matrix Inequality LMI technique as a unifying tool to solve many types of advanced control problems Topics covered in the book include LQR and H approaches Kalman and singular value decomposition Open loop balancing and reduced order models Closed loop balancing Positive real systems bounded real systems and imaginary negative systems Criteria for stability control Time delay systems This easy to read text presents the essential theoretical background and provides numerous examples and MATLAB exercises to help the reader efficiently acquire new skills Written for electrical electronic computer science space and automation engineers interested in automatic control this book can also be used for self study of for a one semester course in robust control This fully renewed second edition of the book also includes new fundamental topics such as Lyapunov functions for stability variational calculus formulation in terms of optimization problems of matrix algebraic equations negative imaginary systems and time delay systems

A Course in Robust Control Theory
Geir E. Dullerud, Fernando Paganini, 2013-03-14 Research in robust control theory has been one of the most active areas of mainstream systems theory since the late 70s This research activity has been at the confluence of dynamical systems theory functional analysis matrix analysis numerical methods complexity theory and engineering applications The discipline has involved interactions between diverse research groups including pure mathematicians applied mathematicians computer scientists and engineers This research effort has produced a rather extensive set of approaches using a wide variety of mathematical techniques and applications of robust control theory are spreading to areas as diverse as control of fluids power networks and the investigation of feedback mechanisms in biology During the 90 s the theory has

seen major advances and achieved a new maturity centered around the notion of convexity The goal of this book is to give a graduate level course on robust control theory that emphasizes these new developments but at the same time conveys the main principles and ubiquitous tools at the heart of the subject Its pedagogical objectives are to introduce a coherent and unified framework for studying robust control theory to provide students with the control theoretic background required to read and contribute to the research literature and to present the main ideas and demonstrations of the major results of robust control theory The book will be of value to mathematical researchers and computer scientists wishing to learn about robust control theory graduate students planning to do research in the area and engineering practitioners requiring advanced control techniques

Challenges and Paradigms in Applied Robust Control Andrzej Bartoszewicz, 2011-11-16 The main objective of this book is to present important challenges and paradigms in the field of applied robust control design and implementation Book contains a broad range of well worked out recent application studies which include but are not limited to H_∞ sliding mode robust PID and fault tolerant based control systems The contributions enrich the current state of the art and encourage new applications of robust control techniques in various engineering and non engineering systems

Robust Control System Design Chia-Chi Tsui, 2022-06-01 This book presents a synthesized design principle versus the existing separation principle of modern control theory of over six decades since the start Guided by this new principle a generalized state feedback control can be designed based on the parameters of observer and for a great majority of plant systems and the robust property of this control can be fully realized The robust property of the existing state feedback control which is designed separate from the parameters of its realizing observer cannot be realized for a great majority of plant systems By freely design and adjust the observer order the corresponding generalized state feedback control can unify completely the existing state feedback control and static output feedback control and can adjust effectively the tradeoff between performance and robustness This generalized state feedback control can assign eigen structure and can improve performance and robustness far more effectively than the control designed using classical control theory Equally significant the results of this book are very simple that can be comprehended and grasped very easily These results are introduced and illustrated from the basic level and use only the basic mathematical tools Ample examples and exercise problems that can be solved by hand computation are provided This third edition made substantial improvement on this aspect Modern control theoreticians only formulated the feedback control design problem in various ways the point however is to really solve this problem

Uncertain Models and Robust Control Alexander Weinmann, 2012-12-06 Control systems particularly designed to manage uncertainties are called robust control system Choosing appropriate design methods the influence of uncertainties on the closed loop behaviour can be reduced to a large extent Most of the important areas of robust control are covered The aim of the book is to provide an introduction to the theory and methods of robust control system design to present a coherent body of knowledge to clarify and unify presentation of significant derivations and

proofs The book contains a thorough treatment of important material of uncertainties and robust control which is scattered throughout the literature

Robust Control for Unstructured Perturbations – An Introduction Peter Dorato, Luigi Fortuna, G. Muscato, 1992 These lecture notes focus on the synthesis of robust controllers for feedback systems in the presence of unstructured perturbations It is assumed as a prerequisites that the reader is familiar with the basic linear system and automatic control concepts In part I interpolation theory is used to solve various single input single output SISO robust control problems While the interpolation approach is awkward for multivariable systems it provides a very natural and simple approach for SISO systems In particular the interpolation approach requires only elementary knowledge of complex variables and provides a great deal of physical insight into various robust control problems The required interpolation theory is developed in some detail Part II is devoted to multivariable systems Two approaches are outlined the Hankle norm approach and the two Riccati equation approach In this part only a limited number of results are proven However MATLAB software is presented for numerical solution The book is addressed to researchers practicing engineers and students who wish to get an introduction to robust control theory for unstructured plant perturbations The organization of the book as lecture notes and the presence of examples and of exercises at the end of many chapters allow to use the book as an introductory text in Robust Control courses

Robust Control Systems Uwe Mackenroth, 2004-05-12 Self contained introduction to control theory that emphasizes on the most modern designs for high performance and robustness It assumes no previous coursework and offers three chapters of key topics summarizing classical control To provide readers with a deeper understanding of robust control theory than would be otherwise possible the text incorporates mathematical derivations and proofs Includes many elementary examples and advanced case studies using MATLAB Toolboxes

Applications of Robust Control to Nonlinear Systems Richard Dean Colgren, 2004

Robust Control of Robots Adriano A. G. Siqueira, Marco H. Terra, Marcel Bergerman, 2011-08-14 Robust Control of Robots bridges the gap between robust control theory and applications with a special focus on robotic manipulators It is divided into three parts robust control of regular fully actuated robotic manipulators robust post failure control of robotic manipulators and robust control of cooperative robotic manipulators In each chapter the mathematical concepts are illustrated with experimental results obtained with a two manipulator system They are presented in enough detail to allow readers to implement the concepts in their own systems or in Control Environment for Robots a MATLAB based simulation program freely available from the authors The target audience for Robust Control of Robots includes researchers practicing engineers and graduate students interested in implementing robust and fault tolerant control methodologies to robotic manipulators

Robust Control Engineering Mario Garcia-Sanz, 2017-06-26 This book thoroughly covers the fundamentals of the QFT robust control as well as practical control solutions for unstable time delay non minimum phase or distributed parameter systems plants with large model uncertainty high performance specifications nonlinear components multi input multi output characteristics or

asymmetric topologies The reader will discover practical applications through a collection of fifty successful real world case studies and projects in which the author has been involved during the last twenty five years including commercial wind turbines wastewater treatment plants power systems satellites with flexible appendages spacecraft large radio telescopes and industrial manufacturing systems Furthermore the book presents problems and projects with the popular QFT Control Toolbox QFTCT for MATLAB which was developed by the author

Robust Control Design: An Optimal Control

Approach Feng Lin, 2007-09-27 Comprehensive and accessible guide to the three main approaches to robust control design and its applications Optimal control is a mathematical field that is concerned with control policies that can be deduced using optimization algorithms The optimal control approach to robust control design differs from conventional direct approaches to robust control that are more commonly discussed by firstly translating the robust control problem into its optimal control counterpart and then solving the optimal control problem Robust Control Design An Optimal Control Approach offers a complete presentation of this approach to robust control design presenting modern control theory in an concise manner The other two major approaches to robust control design the H_∞ approach and the Kharitonov approach are also covered and described in the simplest terms possible in order to provide a complete overview of the area It includes up to date research and offers both theoretical and practical applications that include flexible structures robotics and automotive and aircraft control Robust Control Design An Optimal Control Approach will be of interest to those needing an introductory textbook on robust control theory design and applications as well as graduate and postgraduate students involved in systems and control research Practitioners will also find the applications presented useful when solving practical problems in the engineering field

Robust Systems Theory and Applications

Ricardo S. Sánchez-Peña, Mario Sznajder, 1998-08-17 Designed as a university textbook this text on robust systems theory includes problems with every chapter a solutions manual and Matlab files containing worked examples

Robust Control Theory Bruce A. Francis, Pramod P. Khargonekar, 1995

Robust control originates with the need to cope with systems with modeling uncertainty There have been several mathematical techniques developed for robust control system analysis The articles in this volume cover all of the major research directions in the field

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