Robust And Adaptive Control With Aerospace Applications Advanced Textbooks In Control And Signal Processing

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Stable Adaptive Control and Estimation for Nonlinear Systems
Adaptive Control of Robot Manipulators
Robust and Adaptive Model Predictive Control of Nonlinear Systems
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Adaptive Control Tutorial

Springer Science & Business Media

This graduate-level text focuses on the stability of adaptive systems, and offers a thorough understanding of the global stability properties essential to designing adaptive systems. Its self-contained, unified presentation of well-known results establishes the close connections between seemingly independent developments in the field. Prerequisites include a knowledge of linear algebra and differential equations, as well as a familiarity with basic concepts in linear systems theory. The first chapter sets the tone for the entire book, introducing basic concepts and tracing the evolution of the field from the 1960s through the 1980s. The first seven chapters are accessible to beginners, and the final four chapters are geared toward more advanced, research-oriented students. Problems ranging in complexity from relatively easy to quite difficult

appear throughout the text. Topics include results in stability theory that emphasize incidents directly relevant to the study of adaptive systems; the stability properties of adaptive observers and controllers; the important concept of persistent excitation; the use of error models in systems analysis; areas of intense research activity; and five detailed case studies of systems in which adaptive control has proved successful

Stable Adaptive Control and Estimation for Nonlinear Systems

Springer Science & Business Media

The authors here provide a detailed treatment of the design of robust adaptive controllers for nonlinear systems with uncertainties. They employ a new tool based on the ideas of system immersion and manifold invariance. New algorithms are delivered for the construction of robust asymptotically -stabilizing and adaptive control laws for nonlinear systems. The methods proposed lead to modular schemes that are easier to tune than their counterparts obtained from Lyapunov redesign.

Adaptive Control of Robot Manipulators

Springer

Nature Suitable for advanced undergraduates and graduate students, this overview introduces theoretical and practical aspects of adaptive control, with emphasis on deterministic and stochastic viewpoints. 1995 edition.

Robust and Adaptive Model Predictive Control of Nonlinear Systems

Springer Nature Perspectives in Control comprises twenty-one essays by leading experts in the field of control. Most of these were presented as plenary lectures at the colloquium erspectives in Control held at Paris, June 1998, and organised by the GdR-Automatique to mark the occasion of the sixtieth birthday of its founder, Ioan Dori Landau. The book provides a unique opportunity to report the views of the world-renowned authorities on some of the directions in which control disciplines might evolve in various areas at the threshold of the twenty-first century. The variety of essays, which includes advanced methodological contributions and overview tutorials as well as more philosophical reflections, contributes to the richness of the book. Many aspects of the field are discussed , including: - adaptive control; - passivity concepts; -

nonlinear control; - system identification; - supervisory control; - diagnosis; - emerging applied fields such as mechatronics, air traffic control, power plants, and educational devices. Many of the pioneering aspects of Professor Landau's work are covered. The book will be of interest to scientists as a guide to challenging research subjects, and of value to applied researchers as a survey of the current state of the art and potential of the field. Adaptive Internal Model Control Courier Corporation 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. *Perspectives in Control* John Wiley & Sons Nonlinear Control Design presents a self-contained introduction to nonlinear feedback control design

for continuous time, finite-dimensional uncertain systems. It deals with nonlinear systems affected by uncertainties such as unknown constant parameters, time-varying disturbances, and uncertain nonlinearities. Both state feedback and output feedback are addressed. Differential geometric techniques are used to identify classes of nonlinear systems considered and to design feedback algorithms. Adaptive versions of these controls are developed in the presence of unknown parameters while robust versions are designed in the presence of time-varying disturbances. These control algorithms are applied to significant physical control problems from electric motor drives, robotics, aerospace, power systems and are illustrated through worked examples. The text is illustrated throughout with over 100 exercises, more than 75 worked examples and 12 physical examples.

Cable-Driven Parallel Robots

Springer Science & Business Media

Exploring connections between adaptive control theory and practice, this book treats the techniques of linear quadratic optimal

control and estimation (Kalman filtering), recursive identification, linear systems theory and robust arguments. *Robust Control Design with MATLAB®* Courier Corporation This book presents the results of the second workshop on Neural Adaptive Control Technology, NACT II, held on September 9-10, 1996, in Berlin. The workshop was organised in connection with a three-year European-Union-funded Basic Research Project in the ESPRIT framework, called NACT, a collaboration between Daimler-Benz (Germany) and the University of Glasgow (Scotland).The NACT project, which began on 1 April 1994, is a study of the fundamental properties of neural-network-based adaptive control systems. Where possible, links with traditional adaptive control systems are exploited. A major aim is to develop a systematic engineering procedure for designing neural controllers for nonlinear dynamic systems. The techniques developed are being evaluated on concrete industrial problems from within the Daimler-Benz group of companies.The aim of the workshop was to bring together selected

invited specialists in the fields of adaptive control, nonlinear systems and neural networks. The first workshop (NACT I) took place in Glasgow in May 1995 and was mainly devoted to theoretical issues of neural adaptive control. Besides monitoring further development of theory, the NACT II workshop was focused on industrial applications and software tools. This context dictated the focus of the book and guided the editors in the choice of the papers and their subsequent reshaping into substantive book chapters. Thus, with the project having progressed into its applications stage, emphasis is put on the transfer of theory of neural adaptive engineering into industrial practice. The contributors are therefore both renowned academics and practitioners from major industrial users of neurocontrol.

Adaptive Control

Springer Science & Business Media

This volume presents a theoretical framework and control methodology for a class of complex dynamical systems characterised by high state space dimension, multiple inputs and outputs, significant

nonlinearity, parametric uncertainty, and unmodeled dynamics. A unique feature of the authors' approach is the combination of rigorous concepts and methods of nonlinear control (invariant and attracting submanifolds, Lyapunov functions, exact linearisation, passification) with approximate decomposition results based on singular perturbations and decentralisation. Some results published previously in the Russian literature and not well known in the West are brought to light. Basic concepts of modern nonlinear control and motivating examples are given. Audience: This book will be useful for researchers, engineers, university lecturers and postgraduate students specialising in the fields of applied mathematics and engineering, such as automatic control, robotics, and control of vibrations. *Nonlinear Control Design* Springer This book focuses on the applications of robust and adaptive control approaches to practical systems. The proposed control systems hold two important features: (1) The system is robust with the variation in plant parameters and disturbances (2) The

system adapts to parametric uncertainties even in the unknown plant structure by self-training and self-estimating the unknown factors. The various kinds of robust adaptive controls represented in this book are composed of sliding mode control, model-reference adaptive control, gain-scheduling, H-infinity, model-predictive control, fuzzy logic, neural networks, machine learning, and so on. The control objects are very abundant, from cranes, aircrafts, and wind turbines to automobile, medical and sport machines, combustion engines, and electrical machines.

Optimal Adaptive Control and Differential Games by Reinforcement Learning Principles

Springer

This book offers a unique compendium of the authors´ own research on the use of theoretical stability analysis, showing how to take advantage of local stability design and ultimate boundedness for practical robot control. It addresses researchers and postgraduate students dealing with control theory, particularly with nonlinear systems. Thanks to the numerous worked examples, it could also be used as a textbook in postgraduate courses.

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Robust Control with Limited Knowledge on Systems Dynamics World Scientific Robust and Adaptive Control shows the reader how to produce consistent and accurate controllers that operate in the presence of uncertainties and unforeseen events. Driven by aerospace applications the focus of the book is primarily on continuous-dynamical systems. The text is a three-part treatment, beginning with robust and optimal linear control methods and moving on to a self-contained presentation of the design and analysis of model reference adaptive control (MRAC) for nonlinear uncertain dynamical systems. Recent extensions and modifications to MRAC design are included, as are guidelines for combining robust optimal and MRAC controllers. Features of the text include: · case studies that demonstrate the benefits of robust and adaptive control for piloted, autonomous and experimental aerial platforms; · detailed background material for each chapter to motivate theoretical developments ; · realistic examples and simulation data illustrating key features of the methods described; and

· problem solutions for instructors and MATLAB® code provided electronically. The theoretical content and practical applications reported address real-life aerospace problems, being based on numerous transitions of control-theoretic results into operational systems and airborne vehicles that are drawn from the authors' extensive professional experience with The Boeing Company. The systems covered are challenging, often open-loop unstable, with uncertainties in their dynamics, and thus requiring both persistently reliable control and the ability to track commands either from a pilot or a guidance computer. Readers are assumed to have a basic understanding of root locus, Bode diagrams, and Nyquist plots, as well as linear algebra, ordinary differential equations, and the use of state-space methods in analysis and modeling of dynamical systems. Robust and Adaptive Control is intended to methodically teach senior undergraduate and graduate students how to construct stable and predictable control algorithms for realistic industrial applications. Practicing engineers and academic

researchers will also find the book of great instructional value.

Robust Adaptive Dynamic Programming

Springer Science & Business Media

This textbook provides readers with a good working knowledge of adaptive control theory through applications. It is intended for students beginning masters or doctoral courses, and control practitioners wishing to get up to speed in the subject expeditiously. Readers are taught a wide variety of adaptive control techniques starting with simple methods and extending step-by-step to more complex ones. Stability proofs are provided for all adaptive control techniques without obfuscating reader understanding with excessive mathematics. The book begins with standard model-reference adaptive control (MRAC) for first-order, second-order, and multi-input, multi-output systems. Treatment of least-squares parameter estimation and its extension to MRAC follow, helping readers to gain a different perspective on MRAC. Function approximation with orthogonal polynomials and neural networks, and MRAC using neural

networks are also covered. Robustness issues connected with MRAC are discussed, helping the student to appreciate potential pitfalls of the technique. This appreciation is encouraged by drawing parallels between various aspects of robustness and linear time-invariant systems wherever relevant. Following on from the robustness problems is material covering robust adaptive control including standard methods and detailed exposition of recent advances, in particular, the author's work on optimal control modification. Interesting properties of the new method are illustrated in the design of adaptive systems to meet stability margins. This method has been successfully flight-tested on research aircraft, one of various flight-control applications detailed towards the end of the book along with a hybrid adaptive flight control architecture that combines direct MRAC with least-squares indirect adaptive control. In addition to the applications, understanding is encouraged by the use of end-of-chapter exercises and associated MATLAB® files. Readers will need no more than the standard mathematics

for basic control theory such as differential equations and matrix algebra; the book covers the foundations of MRAC and the necessary mathematical preliminaries. *Advanced Control Systems* IET This book introduces an unified function approximation approach to the control of uncertain robot manipulators containing general uncertainties. It works for free space tracking control as well as compliant motion control. It is applicable to the rigid robot and the flexible joint robot. Even with actuator dynamics, the unified approach is still feasible. All these features make the book stand out from other existing publications. *Trends in Nonlinear and Adaptive Control* Wiley-Interscience Shows readers how to exploit the capabilities of the MATLAB® Robust Control and Control Systems Toolboxes to the fullest using practical robust control examples. Model-Reference Adaptive Control John Wiley & Sons Zusammenfassung: Robust and Adaptive Control (second edition) shows readers how to produce consistent and accurate controllers that operate in the presence of uncertainties and unforeseen events. Driven by aerospace applications,

the focus of the book is primarily on continuous-time dynamical systems. The two-part text begins with robust and optimal linear control methods and moves on to a self-contained presentation of the design and analysis of model reference adaptive control for nonlinear uncertain dynamical systems. Features of the second edition include: sufficient conditions for closed-loop stability under output feedback observer-based loop-transfer recovery (OBLTR) with adaptive augmentation; OBLTR applications to aerospace systems; case studies that demonstrate the benefits of robust and adaptive control for piloted, autonomous and experimental aerial platforms; realistic examples and simulation data illustrating key features of the methods described; and problem solutions for instructors and MATLAB® code provided electronically. The theory and practical applications address real-life aerospace problems, being based on numerous transitions of control-theoretic results into operational systems and airborne vehicles drawn from the authors' extensive professional experience with The Boeing

Company. The systems covered are challenging--often open-loop unstable with uncertainties in their dynamics--and thus require both persistently reliable control and the ability to track commands either from a pilot or a guidance computer. Readers should have a basic understanding of root locus, Bode diagrams, and Nyquist plots, as well as linear algebra, ordinary differential equations, and the use of state-space methods in analysis and modeling of dynamical systems. The second edition contains a background summary of linear systems and control systems and an introduction to state observers and output feedback control, helping to make it self-contained. Robust and Adaptive Control teaches senior undergraduate and graduate students how to construct stable and predictable control algorithms for realistic industrial applications. Practicing engineers and academic researchers will also find the book of great instructional value

Adaptive Optimal Control

Springer

Adaptive control is no longer just an important theoretical field of study, but is also providing

solutions to real-world problems. Adaptive techniques will transform the world of control. The leading world practitioners of adaptive control have contributed to this handbook which is the most important work yet in this field. Not only are techniques described in theory, but detailed control algorithms are given, making this a practical cookbook of adaptive control for both control professionals and practising engineers.The book presents the most advanced techniques and algorithms of adaptive control. These include various robust techniques, performance enhancement techniques, techniques with less a-priori knowledge, nonlinear adaptive control techniques and intelligent adaptive techniques. Each technique described has been developed to provide a practical solution to a real-life problem. This volume will therefore not only advance the field of adaptive control as an area of study, but will also show how the potential of this technology can be realised and offer significant benefits. - Practical cookbook of adaptive control - Contains important research

Adaptive Robust Control

Systems Elsevier Synthesis of Feedback Systems presents the feedback theory which exists in various feedback problems. This book provides techniques for the analysis and solution of these problems. The text begins with an introduction to feedback theory and exposition of problems of plant identification, representation, and analysis. Subsequent chapters are devoted to the application of the feedback point of view to any system; the principal useful properties of feedback; the feedback control system synthesis techniques; and the class of two degree-of-freedom feedback configurations and synthesis procedures appropriate for such configurations. The final chapter considers how to translate specifications from their typical original formulation, to the language appropriate for detailed design. The book is intended for engineers and graduate students of engineering design.

Adaptive and Learning Systems Courier Corporation Designed to meet the needs of a wide audience without sacrificing mathematical depth and rigor, Adaptive Control Tutorial presents the design, analysis, and application of a wide variety of algorithms that can be

used to manage dynamical systems with unknown parameters. Its tutorial-style presentation of the fundamental techniques and algorithms in adaptive control make it suitable as a textbook. Adaptive Control Tutorial is designed to serve the needs of three distinct groups of readers: engineers and students interested in learning how to design, simulate, and implement parameter estimators and adaptive control schemes without having to fully understand the analytical and technical proofs; graduate students who, in addition to attaining the aforementioned objectives, also want to understand the analysis of simple schemes and get an idea of the steps involved in more complex proofs; and advanced students and researchers who want to study and understand the details of long and technical proofs with an eye toward pursuing research in adaptive control or related topics. The authors achieve these multiple objectives by enriching the book with examples demonstrating the design procedures and basic analysis steps and by detailing their proofs in both an appendix and electronically available supplementar

y material; online examples are also available. A solution manual for instructors can be obtained by contacting SIAM or the authors. Preface; Acknowledgements; List of Acronyms; Chapter 1: Introduction; Chapter 2: Parametric Models; Chapter 3: Parameter Identification: Continuous Time; Chapter 4: Parameter Identification: Discrete Time; Chapter 5: Continuous-Time Model Reference Adaptive Control; Chapter 6: Continuous-Time Adaptive Pole Placement Control; Chapter 7: Adaptive Control for Discrete-Time Systems; Chapter 8: Adaptive Control of Nonlinear Systems; Appendix; Bibliography; Index

Nonlinear and Adaptive Control with Applications IET

This coherent introduction to the theory and methods of robust control system design clarifies and unifies the presentation of significant derivations and proofs. The book contains a thorough treatment of important material of uncertainties and robust control otherwise scattered throughout the literature.