Nonlinear Observers And Applications 1st Edition

This book is a tribute to Prof. Alberto Isidori on the occasion of his 65th birthday. Prof. Isidori's proli?c, pioneering and high-impact research activity has spanned over 35 years. Throughout his career, Prof. Isidori has developed ground-breaking results, has initiated researchdirections and has contributed towardsthe foundationofnonlinear controltheory.In addition,his dedication to explain intricate issues and di?cult concepts in a simple and rigorous way and to motivate young researchers has been instrumental to the intellectual growth of the nonlinear control community worldwide. The volume collects 27 contributions written by a total of 52 researchers. The principal author of each contribution has been selected among the - searchers who have worked with Prof. Isidori, have in?uenced his research activity, or have had the privilege and honour of being his PhD students. The contributions address a signi?cant number of control topics, including th- retical issues, advanced applications, emerging control directions and tutorial works. The diversity of the areas covered, the number of contributors and their international standing provide evidence of the impact of Prof. Isidori in the control and systems theory communities. The book has been divided into six parts: System Analysis, Optimization Methods, Feedback Design, Regulation, Geometric Methods and Asymptotic Analysis, re?ecting important control areas which have been strongly in- enced and, in some cases, pioneered by Prof. Isidori.

This book develops the understanding and skills needed to be able to tackle original control problems. The general approach to a given control problem is to try the simplest tentative solution first and, when this is insufficient, to explain why and use a more sophisticated alternative to remedy the deficiency and achieve satisfactory performance. This pattern of working gives readers a full understanding of different controllers and teaches them to make an informed choice between traditional controllers and more advanced modern alternatives in meeting the needs of a particular plant. Attention is focused on the time domain, covering model-based linear and nonlinear forms of control together with robust control based on sliding modes and the use of state observers such as disturbance estimation. Feedback Control is self-contained, paying much attention to explanations of underlying concepts, with detailed mathematical derivations being employed where necessary. Ample use is made of diagrams to aid these conceptual explanations and the subject matter is enlivened by continual use of examples and problems derived from real control applications. Readers' learning is further enhanced by experimenting with the fully-commented MATLAB®/Simulink® simulation environment made accessible at insert URL here to produce simulations relevant to all of the topics covered in the text. A solutions manual for use by instructors adopting the book can also be downloaded from insert URL here. Feedback Control is suitable as a main textbook for graduate and final-year undergraduate courses containing control modules; knowledge of ordinary linear differential equations, Laplace transforms, transfer functions, poles and zeros, root locus and elementary frequency response analysis, and elementary feedback control is required. It is also a useful reference source on control design methods for engineers practicing in industry and for academic control researchers.

This book gathers papers presented during the 4th International Conference on Electrical Engineering and Control Applications. It covers new control system models, troubleshooting tips and complex system requirements, such as increased speed, precision and remote capabilities. Additionally, the papers discuss not only the engineering aspects of signal processing and various practical issues in the broad field of information transmission, but also novel technologies for communication networks and modern antenna design. This book is intended for researchers, engineers and advanced postgraduate students in the fields of control and electrical engineering, computer science and signal

processing, as well as mechanical and chemical engineering.

The technology of hydrodynamic modeling and marine craft motion control systems has progressed greatly in recent years. This timely survey includes the latest tools for analysis and design of advanced guidance, navigation and control systems and presents new material on underwater vehicles and surface vessels. Each section presents numerous case studies and applications, providing a practical understanding of how model-based motion control systems are designed. Key features include: a three-part structure covering Modeling of Marine Craft; Guidance, Navigation and Control Systems; and Appendices, providing all the supporting theory in a single resource kinematics, kinetics, hydrostatics, seakeeping and maneuvering theory, and simulation models for marine craft and environmental forces guidance systems, sensor fusion and integrated navigation systems, inertial measurement units, Kalman filtering and nonlinear observer design for marine craft state-of-the-art methods for feedback control more advanced methods using nonlinear theory, enabling the user to compare linear design techniques before a final implementation is made. linear and nonlinear stability theory, and numerical methods companion website that hosts links to lecture notes and download information for the Marine Systems Simulator (MSS) which is an open source Matlab/Simulink® toolbox for marine systems. The MSS toolbox includes hydrodynamic models and motion control systems for ships, underwater vehicles and floating structures With an appropriate balance between mathematical theory and practical applications, academic and industrial researchers working in marine and control engineering aspects of manned and unmanned maritime vehicles will benefit from this comprehensive handbook. It is also suitable for final year undergraduates and postgraduates, lecturers, development officers, and practitioners in the areas of rigid-body modeling, hydrodynamics, simulation of marine craft, control and estimation theory, decision-support systems and sensor fusion. www.wiley.com/go/fossen_marine

The high reliability required in industrial processes has created the necessity of detecting abnormal conditions, called faults, while processes are operating. The term fault generically refers to any type of process degradation, or degradation in equipment performance because of changes in the process's physical characteristics, process inputs or environmental conditions. This book is about the fundamentals of fault detection and diagnosis in a variety of nonlinear systems which are represented by ordinary differential equations. The fault detection problem is approached from a differential algebraic viewpoint, using residual generators based upon high-gain nonlinear auxiliary systems (‘observers’). A prominent role is played by the type of mathematical tools that will be used, requiring knowledge of differential algebra and differential equations. Specific theorems tailored to the needs of the problem-solving procedures are developed and proved. Applications to real-world problems, both with constant and time-varying faults, are made throughout the book and include electromechanical positioning systems, the Continuous Stirred Tank Reactor (CSTR), bioreactor models and belt drive systems, to name but a few.

These proceedings present selected research papers from CISC’16, held in Xiamen, China. The topics include Multi-agent system, Evolutionary Computation, Artificial Intelligence, Complex systems, Computation intelligence and soft computing, Intelligent control, Advanced control technology, Robotics and applications, Intelligent information processing, Iterative learning control, Machine Learning, and etc. Engineers and researchers from academia, industry, and government can get an insight view of the solutions combining ideas from multiple disciplines in the field of intelligent systems.

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In the recent years, fractional-order systems have been studied by many researchers in the engineering field. It was found that many systems can be described more accurately by fractional differential equations than by integer-order models. Advanced Synchronization Control and

Bifurcation of Chaotic Fractional-Order Systems is a scholarly publication that explores new developments related to novel chaotic fractional-order systems, control schemes, and their applications. Featuring coverage on a wide range of topics including chaos synchronization, nonlinear control, and cryptography, this publication is geared toward engineers, IT professionals, researchers, and upper-level graduate students seeking current research on chaotic fractional-order systems and their applications in engineering and computer science.

This book is a tribute to Professor Laurent Praly and follows on from a workshop celebrating the occasion of his 60th birthday. It presents new and unified visions of the numerous problems that Laurent Praly has worked on in his prolific career: adaptive control, output feedback and observers, stability and stabilization. His main contributions are the central topic of this book. The book collects contributions written by prominent international experts in the control community, addressing a rich variety of topics: emerging ideas, advanced applications, and theoretical concepts. Organized in three sections, the first section covers the field of adaptive control, where Laurent Praly started his career. The second section focuses on stabilization and output feedback, which is also the topic of the second half of his career. Lastly, the third section presents the emerging research that will form Laurent Praly's scientific legacy.

Nonlinear Observers and ApplicationsSpringer

Observer synthesis for discrete-time nonlinear systems with special applications to parameter estimation is analyzed. Two new types of observers are developed. The first new observer is an adaptation of the Friedland continuous-time parameter estimator to discrete-time systems. The second observer is an adaptation of the continuous-time Gauthier observer to discrete-time systems. By adapting these observers to discrete-time continuous-time parameter estimation problems which were formerly intractable become tractable. In addition to the two newly developed observers, two observers already described in the literature are analyzed and deficiencies with respect to noise rejection are demonstrated. improved versions of these observers are proposed and their performance demonstrated. The issues of discrete-time observability, discrete-time system inversion, and optimal probing are also addressed.

This book focuses on unhealthy cyber-physical systems. Consisting of 14 chapters, it discusses recognizing the beginning of the fault, diagnosing the appearance of the fault, and stopping the system or switching to a special control mode known as fault-tolerant control. Each chapter includes the background, motivation, quantitative development (equations), and case studies/illustration/tutorial (simulations, experiences, curves, tables, etc.). Readers can easily tailor the techniques presented to accommodate their ad hoc applications.

This volume constitutes the proceedings of the 19th Asia Simulation Conference, AsiaSim 2019, held in Singapore, Singapore, in October 2019. The 19 revised full papers and 5 short papers presented in this volume were carefully reviewed and selected from 36 submissions. The papers are organized in topical sections on simulation and modeling methodology; numerical and Monte Carlo simulation; simulation applications: blockchain, deep learning and cloud; simulation and visualization; simulation applications; short papers.

Poland, - mania,Singapore,Slovakia,Spain, Sweden, Switzerland, Taiwan,UK,and USA.

Nonlinear Systems is divided into three volumes. The first deals with modeling and estimation, the second with stability and stabilization and the third with control. This three-volume set provides the most comprehensive and detailed reference available on nonlinear systems. Written by a group of leading experts in the field, drawn from industry, government and academic institutions, it provides a solid theoretical basis on nonlinear control methods as well as practical examples and advice for engineers, teachers and researchers working with nonlinear systems. Each book focuses on the applicability of the concepts introduced and keeps the level of mathematics to a minimum. Simulations and industrial examples drawn from aerospace as well as mechanical, electrical and chemical engineering are given throughout.

This volume presents a well balanced combination of state-of-the-art theoretical results in the field of nonlinear controller and observer design, combined with industrial applications stemming from mechatronics, electrical, (bio–) chemical engineering, and fluid dynamics. The unique combination of results of finite as well as infinite–dimensional systems makes this book a remarkable contribution addressing postgraduates, researchers, and engineers both at universities and in industry. The contributions to this book were presented at the Symposium on Nonlinear Control and Observer Design: From Theory to Applications (SYNCOD), held September 15–16, 2005, at the University of Stuttgart, Germany. The conference and this book are dedicated to the 65th birthday of Prof. Dr.–Ing. Dr.h.c. Michael Zeitz to honor his life – long research and contributions on the fields of nonlinear control and observer design.

Chaos is an interesting nonlinear phenomena that occurs in wide variety of fields. A significant amount of research was devoted to understanding chaos and its properties. After that, researchers focused on searching for possible application areas for chaos to utilize its properties. The need to increase the security of a communication system is considered as a perfect match for chaos and its several properties, yielding chaotic communication. In this thesis, chaotic communication is approached from a control theory perspective. Specifically, three nonlinear observers are designed to extract message encrypted in a chaotic communication signal. The design and stability analysis is presented for the first observer, and the other observers are presented as modifications to the first one. Extensive numerical simulations are performed to demonstrate the viability of the proposed observers. Robustness of the observers to noise, additive disturbances, and parametric mismatch, and security of the observers are demonstrated numerically.

Gathering 20 chapters contributed by respected experts, this book reports on the latest advances in and applications of sliding mode control in science and engineering. The respective chapters address applications of sliding mode control in the broad areas of chaos theory, robotics, electrical engineering, physics, chemical engineering, memristors, mechanical engineering, environmental engineering, finance, and biology. Special emphasis has been given to papers that offer practical solutions, and which examine design and modeling involving new types of sliding mode control such as higher order sliding mode control, terminal sliding mode control, super-twisting sliding mode control, and integral sliding mode control. This book serves as a unique reference guide to sliding mode control and its recent applications for graduate students and researchers with a basic knowledge of electrical and control systems engineering.

This book is about nonlinear observability. It provides a modern theory of observability based on a new paradigm borrowed from theoretical physics and the mathematical foundation of that paradigm. In the case of observability, this framework takes into account the group of invariance that is inherent to the concept of observability, allowing the reader to reach an intuitive derivation of significant results in the literature of control theory. The book provides a complete theory of observability and, consequently, the analytical solution of some open problems in control theory. Notably, it presents the first general analytic solution of the nonlinear unknown input observability (nonlinear UIO), a very complex open problem studied in the 1960s. Based on this solution, the book provides examples with important applications for neuroscience, including a deep study of the integration of multiple sensory cues from the visual and vestibular systems for self-motion perception. Observability: A New Theory Based on the Group of Invariance

is the only book focused solely on observability. It provides readers with many applications, mostly in robotics and autonomous navigation, as well as complex examples in the framework of vision-aided inertial navigation for aerial vehicles. For these applications, it also includes all the derivations needed to separate the observable part of the system from the unobservable, an analysis with practical importance for obtaining the basic equations for implementing any estimation scheme or for achieving a closed-form solution to the problem. This book is intended for researchers in robotics and automation, both in academia and in industry. Researchers in other engineering disciplines, such as information theory and mechanics, will also find the book useful.

Proceedings of the European Control Conference 1995, Rome, Italy 5-8 September 1995

The purpose of this fantastically useful book is to lay out an overview on possible tools for state reconstruction in nonlinear systems. Here, basic observability notions and observer structures are recalled, together with ingredients for advanced designs on this basis. The problem of state reconstruction in dynamical systems, known as observer problem, is crucial for controlling or even merely monitoring processes. For linear systems, the theory has been well established for several years, so this book attempts to tackle the problem for non-linear systems.

The ever-increasing need for higher efficiency, smaller size, and lower cost make the analysis, understanding, and design of energy conversion systems extremely important, interesting, and even imperative. One of the most neglected features in the study of such systems is the effect of the inherent nonlinearities on the stability of the system. Due to these nonlinearities, these devices may exhibit undesirable and complex dynamics, which are the focus of many researchers. Even though a lot of research has taken place in this area during the last 20 years, it is still an active research topic for mainstream power engineers. This research has demonstrated that these systems can become unstable with a direct result in increased losses, extra subharmonics, and even uncontrollability/unobservability. The detailed study of these systems can help in the design of smaller, lighter, and less expensive converters that are particularly important in emerging areas of research like electric vehicles, smart grids, renewable energy sources, and others. The aim of this Special Issue is to cover control and nonlinear aspects of instabilities in different energy conversion systems: theoretical, analysis modelling, and practical solutions for such emerging applications. In this Special Issue, we present novel research works in different areas of the control and nonlinear dynamics of energy conversion systems.

This book provides recent theoretical developments in and practical applications of fault diagnosis and fault tolerant control for complex dynamical systems, including uncertain systems, linear and nonlinear systems. Combining adaptive control technique with other control methodologies, it investigates the problems of fault diagnosis and fault tolerant control for uncertain dynamic systems with or without time delay. As such, the book provides readers a solid understanding of fault diagnosis and fault tolerant control based on adaptive control technology. Given its depth and breadth, it is well suited for undergraduate and graduate courses on linear system theory, nonlinear system theory, fault diagnosis and fault tolerant control techniques. Further, it can be used as a reference source for academic research on fault diagnosis and fault tolerant control, and for postgraduates in the field of control theory and engineering.

Due to its abilities to compensate disturbances and uncertainties, disturbance observer based control (DOBC) is regarded as one of the most promising approaches for disturbance-attenuation. One of the first books on DOBC, Disturbance Observer Based Control: Methods and Applications presents novel theory results as well as best practices for applica

Many problems in decision making, monitoring, fault detection, and control require the knowledge of state variables and time-varying parameters that are not directly measured by sensors. In such situations, observers, or estimators, can be employed that use the measured input and output signals along with a dynamic model of the system in order to estimate the unknown states or parameters. An essential requirement in designing an observer is to guarantee the convergence of the estimates to the true values or at least to a small neighborhood around the true values. However, for nonlinear, large-scale, or time-varying systems, the design and tuning of an observer is generally complicated and involves large computational costs. This book provides a range of methods and tools to design observers for nonlinear systems represented by a special type of a dynamic nonlinear model -- the Takagi--Sugeno (TS) fuzzy model. The TS model is a convex combination of affine linear models, which facilitates its stability analysis and observer design by using effective algorithms based on Lyapunov functions and linear matrix inequalities. Takagi--Sugeno models are known to be universal approximators and, in addition, a broad class of nonlinear systems can be exactly represented as a TS system. Three particular structures of large-scale TS models are considered: cascaded systems, distributed systems, and systems affected by unknown disturbances. The reader will find in-depth theoretic analysis accompanied by illustrative examples and simulations of real-world systems. Stability analysis of TS fuzzy systems is addressed in detail. The intended audience are graduate students and researchers both from academia and industry. For newcomers to the field, the book provides a concise introduction dynamic TS fuzzy models along with two methods to construct TS models for a given nonlinear system

Due to the increasing security and reliability demand of actual industrial process control systems, the study on fault diagnosis and fault tolerant control of dynamic systems has received considerable attention. Fault accommodation (FA) is one of effective methods that can be used to enhance system stability and reliability, so it has been widely and in-depth investigated and become a hot topic in recent years. Fault detection is used to monitor whether a fault occurs, which is the first step in FA. On the basis of fault detection, fault estimation (FE) is utilized to determine online the magnitude of the fault, which is a very important step because the additional controller is designed using the fault estimate. Compared with fault detection, the design difficulties of FE would increase a lot, so research on FE and accommodation is very challenging. Although there have been advancements reported on FE and accommodation for dynamic systems, the common methods at the present stage have design difficulties, which limit applications of respective design approaches. Therefore, the problems of FE and accommodation are needed to be further studied. This book considers the theory and technology of FE and accommodation for dynamic systems, and establishes a systemic and comprehensive framework of FE and accommodation for continuous/discrete-time systems.

Chaos and nonlinear dynamics initially developed as a new emergent field with its foundation in physics and applied mathematics.

The highly generic, interdisciplinary quality of the insights gained in the last few decades has spawned myriad applications in almost all branches of science and technology—and even well beyond. Wherever quantitative modeling and analysis of complex, nonlinear phenomena is required, chaos theory and its methods can play a key role. This volume concentrates on reviewing the most relevant contemporary applications of chaotic nonlinear systems as they apply to the various cutting-edge branches of engineering. The book covers the theory as applied to robotics, electronic and communication engineering (for example chaos synchronization and cryptography) as well as to civil and mechanical engineering, where its use in damage monitoring and control is explored). Featuring contributions from active and leading research groups, this collection is ideal both as a reference and as a ‘recipe book’ full of tried and tested, successful engineering applications

Provides complete coverage of both the Lyapunov and Input-Output stability theories, ina readable, concise manner. * Supplies an introduction to the popular backstepping approach to nonlinear control design * Gives a thorough discussion of the concept of input-to-state stability * Includes a discussion of the fundamentals of feedback linearization and related results. * Details complete coverage of the fundamentals of dissipative system's theory and its application in the so-called L2gain control prooblem, for the first time in an introductory level textbook. * Contains a thorough discussion of nonlinear observers, a very important problem, not commonly encountered in textbooksat this level. *An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department.

This thesis is divided into two main parts. The contribution of the first part is to design a continuous-time Piecewise-Affine (PWA) observer for a class of nonlinear systems. It is shown that the state estimation error is ultimately bounded. The bound on the state estimation error depends on the PWA approximation error. Moreover, it is shown that the state estimation error is still convergent and ultimately bounded when the output of the system is only available at sampling instants. The proof of convergence is presented in two parts: conditions dependent on the sampling time and conditions independent of the sampling time. In addition, ultimate boundedness of the state estimation error is proven in the presence of norm bounded measurement noise. It is shown that the bound on the state estimation error is dependent on the sampling time, PWA approximation error and the bound on the norm of the noise. The proposed approach for observer design leads to a convex optimization which can be solved efficiently using available software packages. The contribution of the second part is to implement the proposed PWA observer on a real setup of a wheeled mobile robot (WMR) available at the Hybrid Control Systems (HYCONS) Laboratory of Concordia University. Although some researchers have applied different types of observers to experimental applications, practical implementation of PWA observers has not been given much attention by researchers. In this thesis for the first time a PWA observer is applied to the WMR. The WMR is an example of a nonlinear system with a sampled output in the presence of measurement noise. The results of the experimental implementation validate the proposed theoretical results in the first part.

"This book introduces and explains Higher Order Neural Networks (HONNs) to people working in the fields of computer science and computer engineering, and how to use HONNS in these areas"--Provided by publisher.

This book provides readers a good understanding on how to achieve Fault Tolerant Control goal of Hybrid Systems. It presents important theoretical results as well as their applications.

This book studies how autonomous aerial robots physically interact with the surrounding environment. Intended to promote the advancement of aerial physical interaction, it analyzes a particular class of aerial robots: tethered aerial vehicles. By examining specific systems, while still considering the challenges of the general problem, it will help readers acquire the knowledge and expertise needed for the subsequent development of more general methods applicable to aerial physical interaction. The formal analysis covers topics ranging from control, state estimation, and motion planning, to experimental validation. Addressing both theoretical and technical aspects, the book is intended for a broad academic and industrial readership, including undergraduate students, researchers and engineers. It can be used as a teaching reference, or as the basis for product development.

Due to the growing use of web applications and communication devices, the use of data has increased throughout various industries. It is necessary to develop new techniques for managing data in order to ensure adequate usage. Deep learning, a subset of artificial intelligence and machine learning, has been recognized in various real-world applications such as computer vision, image processing, and pattern recognition. The deep learning approach has opened new opportunities that can make such real-life applications and tasks easier and more efficient. Deep Learning and Neural Networks: Concepts, Methodologies, Tools, and Applications is a vital reference source that trends in data analytics and potential technologies that will facilitate insight in various domains of science, industry, business, and consumer applications. It also explores the latest concepts, algorithms, and techniques of deep learning and data mining and analysis. Highlighting a range of topics such as natural language processing, predictive analytics, and deep neural networks, this multi-volume book is ideally designed for computer engineers, software developers, IT professionals, academicians, researchers, and upper-level students seeking current research on the latest trends in the field of deep learning.

The scope of the Workshop was Challenge to New Cyberships. When designing a marine system it is important that the cybernetic control system is seaworthy, safe, robust, intelligent and adaptive to strong sea disturbances and its changes. The Workshop was a forum for discussing the latest achievements and trends within the following fields: Marine Control Systems; Ship Manoeuvring Model; Navigation Systems; Traffic Guidance and Control Systems; Main Engine and Machinery Control Systems; Safety and Fault Control Systems; Machinery Surveillance, Condition Monitoring and Quality Control Systems; Training and Vehicle Simulation Systems.

Although parallel robots are known to offer many advantages with respect to accuracy, dynamics, and stiffness, major breakthroughs in industrial applications have not yet taken place. This is due to a knowledge gap preventing fast and precise execution of industrial handling and assembly tasks. This book focuses on the design, modeling, and control of innovative parallel structures as well as the integration of novel machine elements. Special attention is paid to the integration of active components into lightweight links and passive joints. In addition, new control concepts are introduced to minimize structural vibrations. Although

the optimization of robot systems itself allows a reduction of cycle times, these can be further decreased by improved path planning, robot programming, and automated assembly planning concepts described by 25 contributions within this book. The content of this volume is subdivided into four main parts dealing with Modeling and Design, System Implementation, Control and Programming as well as Adaptronics and Components. This book is aimed at researchers and postgraduates working in the field of parallel robots as well as practicing engineers dealing with industrial robot development and robotic applications.

Papers in this collection partly represent the set of talks that were presented at Texas Tech University on the occasion of Daya's memorial workshop in the year 2007. Daya had a varied interest in the field of Dynamics and Control Theory and the papers bring out the essence of his involvement in these activities. He also had a large number of collaborators and this collection represent a good fraction of them. The papers included here cover his interest in control theory. Also included are papers from application areas that we believe are of strong interest to him.

The book presents selected, extended and peer reviewed papers from the International Multiconference on System, Automation and Control held Leipzig in 2018. These are complemented with solicited contributions by international experts. Main topics are automatic control, robotics, synthesis of automation systems. Application examples range from man-machine interaction, mechatronics, on to biological and economical models.