Fuzzy Control Synthesis And Analysis

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Fuzzy Modeling and Control: Theory and Applications Fernando Matia 2014-08-14 Much work on fuzzy control, covering research, development and applications, has been developed in Europe since the 90's. Nevertheless, the existing books in the field are compilations of articles without interconnection or logical structure or they express the personal point of view of the author. This book compiles the developments of researchers with demonstrated experience in the field of fuzzy control following a logic structure and a unified the style. The first chapters of the book are dedicated to the introduction of the main fuzzy logic techniques, where the following chapters focus on concrete applications. This book is supported by the EUSFLAT and CEA-IFAC societies, which include a large number of researchers in the field of fuzzy logic and control. The central topic of the book, Fuzzy Control, is one of the main research and development lines covered by these associations.

Recent Advances in Intelligent Control Systems Wen Yu 2009-05-27 "Recent Advances in Intelligent Control Systems" gathers contributions from workers around the world and presents them in four categories according to the style of control employed: fuzzy control; neural control; fuzzy neural control; and intelligent control. The contributions illustrate the interdisciplinary antecedents of intelligent control and contrast its results with those of more traditional control methods. A variety of design examples, drawn primarily from robotics and mechatronics but also representing process and production engineering, large civil structures, network flows, and others, provide instances of the application of computational intelligence for control. Presenting state-of-the-art research, this collection will be of benefit to researchers in automatic control, automation, computer science (especially artificial intelligence) and mechatronics while graduate students and practicing control engineers working with intelligent systems will find it a good source of study material.

Fuzzy Logic-based Material Selection And Synthesis Babani Mustafa B 2019-03-04 This unique compendium presents a comprehensive and self-contained theory of material development under imperfect information and its applications. The book describes new approaches to synthesis and selection of materials with desirable characteristics. Such approaches provide the ability of systematic and computationally effective analysis in order to predict composition, structure and related properties of new materials. The volume will be a useful advanced textbook for graduate students. It is also suitable for academicians and practitioners who wish to have fundamental models in new material synthesis and selection.

Fuzzy Control Synthesis And Analysis Edited by Shehu S. Farinwata Ford Motor Company, Research Laboratory, Dearborn, Michigan, USA Dimitar Filev Ford Motor Company, AMTDC, Redford, Michigan, USA Reza Langari Texas A & M University, College Station, Texas, USA Fuzzy techniques are used to cope with imprecision in the basic elements of a process under control. Written by an international team of researchers this edited volume covers the modeling, analysis and synthesis of fuzzy control systems. Features include: Comprehensive coverage of fuzzy dynamical systems, robustness, stability and sensitivity -- giving the reader a good grasp of the fundamentals of fuzzy control? Focus on the analytical structures of new fuzzy modeling approaches based on the Takagi-Sugeno-Kang (TSK) or Takagi-Sugeno (TS) model? Applications of fuzzy control to aircraft systems, rocket engines and automotive engines? Problems and examples illustrating how fuzzy approaches may be applied to the modeling, analysis and synthesis of closed-loop systems Design and control engineers will value the advanced control techniques and new design and analysis tools presented. Postgraduates studying fuzzy control will find this book a useful reference on synthesis, systems analysis and advanced nonlinear control methods.

Synthesis and Stability Analysis of Self-learning Game-theoretic Fuzzy Logic Controllers Dennis M. Briggs 1994 Fuzzy Control Systems Design and Analysis Kazuo Tanaka 2004-04-07 A comprehensive treatment of model-based fuzzy controlsystems This volume offers full coverage of the systematic framework for the stability and design of nonlinear fuzzy control systems. Building on the Takagi-Sugeno fuzzy model, authors Tanaka and Wang address a number of important issues in fuzzy control systems, including stability analysis, systematic design procedures, incorporation of performance specifications, numerical implementations, and practical applications. Issues that have not been fully treated in existing texts, such as stability analysis, systematic design, and performance analysis, are crucial to the validity and applicability of fuzzy control methodology. Fuzzy Control Systems Design and Analysis addresses these issues in the framework of parallel distributed compensation, a controller structure devised in accordance with the fuzzy model. This balanced treatment features an overview of fuzzy control, modeling, and stability analysis, as well as a section on the use of linear matrix inequalities (LMI) as an approach to fuzzy design. It also covers advanced topics in model-based fuzzy control systems, including modeling and control of chaotic systems. Later sections offer practical examples in the form of detailed theoretical and experimental studies of fuzzy control in robotics and a discussion of future directions in the field. Fuzzy Control Systems Design and Analysis offers an advanced treatment of fuzzy control that makes a useful reference for researchers and a reliable text for advanced graduate students in the field.

Intelligent Systems Yung C. Shin 2017-12-19 Providing a thorough introduction to the field of soft computing techniques, Intelligent Systems: Modeling, Optimization, and Control covers every major technique in artificial intelligence in a clear and practical style. This book highlights current research and applications, addresses issues encountered in the development of applied systems, and describes a wide range of intelligent systems techniques, including neural networks, fuzzy logic, evolutionary strategy, and genetic algorithms. The book demonstrates concepts through simulation examples and practical experimental results. Case studies are also presented from each field to facilitate understanding.

Recent Advances in Robust Control Andreas Müller 2011-11-07 Robust control has been a topic of active research in the last three decades culminating in H₂/Hₐ/µ design methods followed by research on parametric robustness, initially motivated by Kharitonov's theorem, the extension to non-linear time delay systems, and other more recent methods. The two volumes of Recent Advances in Robust Control give a selective overview of recent theoretical developments and present selected application examples. The volumes comprise 39 contributions covering various theoretical aspects as well as different application areas. The first volume covers selected problems in the theory of robust control and its application to robotic and electromechanical systems. The second volume is dedicated to special topics in robust control and problem specific solutions. Recent Advances in Robust Control will be a valuable reference for those interested in the recent theoretical advances and for researchers working in the broad field of robotics and mechatronics.

Adaptive Fuzzy Systems and Control Li-Xin Wang 1994 This volume develops a variety of adaptive fuzzy systems and applies them to a variety of engineering problems. It summarizes the state-of-the-art methods for automatic tuning of the parameters and structures of fuzzy logic systems.

Modern Fuzzy Control Systems and Its Applications S. Ramakrishnan 2017-08-30 Control systems play an important role in engineering. Fuzzy logic is the natural choice for designing control applications and is the most popular and appropriate for the control of home and industrial appliances. Academic and industrial experts are constantly researching and proposing innovative and effective fuzzy control systems. This book is an edited volume and has 21 innovative
chapters arranged into five sections covering applications of fuzzy control systems in energy and power systems, navigation systems, imaging, and industrial engineering. Overall, this book provides a rich set of modern fuzzy control systems and their applications and will be a useful resource for the graduate students, researchers, and practicing engineers in the field of electrical engineering.

Control Systems, Robotics and Automation – Volume XVII

Heinz D. Unbehauen 2009-10-11 This Encyclopedia of Control Systems, Robotics, and Automation is a component of the global Encyclopedia of Life Support Systems EOLSS, which is an integrated compendium of twenty one Encyclopedias. This 22-volume set contains 240 chapters, each of size 5000-30000 words, with perspectives, applications and extensive illustrations. It is the only publication of its kind carrying state-of-the-art knowledge in the fields of Control Systems, Robotics, and Automation and is aimed, by virtue of the several applications, at the following five major target audience: Practitioners, Research Personnel and Policy Analysts, Managers, and Decision Makers and NGOs.

Granular, Soft and Fuzzy Approaches for Intelligent Systems

Janusz Kacprzyk 2016-11-14 This book offers a comprehensive report on the state-of-the-art in the broadly-intended field of “intelligent systems”. After introducing key theoretical issues, it describes a number of promising models for data and system analysis, decision making, and control. It discusses important theories, including possibility theory, the Dempster-Shafer theory, the theory of approximate reasoning, as well as computing with novel applications in various areas, such as information aggregation and fusion, linguistic data summarization, participatory learning, systems modeling, and many others. By presenting the methods in their application contexts, the book shows how granular computing, soft computing and fuzzy logic techniques can provide novel, efficient solutions to real-world problems. It is dedicated to Professor Ronald R. Yager for his great scientific and scholarly achievements, and for his long-lasting service to the fuzzy logic, and the artificial and computational intelligence communities. It has been motivated by the authors’ appreciation of his original thinking and groundbreaking ideas, with a special thought to his valuable research on the computerized implementation of various aspects of human cognition for decision-making and problem-solving.

Soft Computing Luigi Fortuna 2012-12-06 The book presents a clear understanding of a new type of computation system, the Cellular Neural Network (CNN), which has been successfully applied to the solution of many heavy computation problems, mainly in the fields of image processing and complex partial differential equations. The text describes how CNN will improve the soft-computation toolbox, and examines the many applications of soft computing to complex systems.

Control and Estimation of Piecewise Affine Systems

Jun Xu 2014-04-21 As a powerful tool to study nonlinear systems and hybrid systems, piecewise affine (PWA) systems have been widely applied to mechanical systems. Control and Estimation of Piecewise Affine Systems presents several research findings relating to the control and estimation of PWA systems in one unified view. Chapters in this title discuss stability results of PWA systems, using piecewise quadratic Lyapunov functions and piecewise homogeneous polynomial Lyapunov functions. Explicit necessary and sufficient conditions for the controllability and reachability of a class of PWA systems are considered along with controller and estimator design methods for PWA systems using linear matrix inequality (LMI) and bilinear matrix inequality (BMI) techniques. A PWA approach to a class of Takagi-Sugeno fuzzy system is discussed in depth. The book uses numerous numerical examples, such as discrete systems and linear cascaded systems, to illustrate the advantages of the proposed methods. Provides new insights on properties of PWA systems, including stability, stabilizability, reachability and controllability. Presents a unified framework for analysis and synthesis of both continuous-time and discrete-time PWA systems. Presents novel approaches for stability analysis and control design based on the promising SOS techniques.

Control Synthesis and Stability Analysis of a Fuzzy Sugeno Model System

Eugene David Schmitt 1997 Dynamic Fuzzy Logic and Its Applications Fanzhang Li 2008 Dynamic fuzzy problem are problems that are universally focused by academicians. Many academicians and some other experts have used fuzzy logic to developed theories and solve static problems in so called subjective and objective worlds. This book includes 12 chapters. Chapter 1 is about basic conceptions of Dynamic Fuzzy Sets (DFS), Chapter 2 introduces Dynamic Fuzzy (DF) decomposition theorem. Chapter 3 is about L form of DFS module structure. Chapter 4 is about representation theorem of DFS. Chapter 5 introduces extension theorem of DFS. Chapter 6 is about DF measure theory. In chapter 7 it is Dynamic Fuzzy Logic (DFL). Chapter 8 is about reasoning methods of DFL. Chapter 9 is about bases of DFL. Chapter 10 introduces multi-agent learning model based on DFL. Chapter 11 is about intelligent computing model based on DFL. The last Chapter introduces application of DFL in machine learning.

Introduction to Fuzzy Sets, Fuzzy Logic, and Fuzzy Control Systems

Guarrong Chen 2000-11-27 In the early 1970s, fuzzy systems and fuzzy control theories added a new dimension to control systems engineering. From its beginnings as mostly heuristic and somewhat ad hoc, more recent and rigorous approaches to fuzzy control theory have helped make it an integral part of modern control theory and produced many exciting results. Yesterday’s “art” Fuzzy Control and Identification John H. Lilly 2011-03-10 This book gives an introduction to basic fuzzy logic and Mamdani and Takagi-Sugeno fuzzy systems. The text shows how these can be used to control complex nonlinear systems, while also suggesting several approaches to modeling of complex engineering systems with unknown models. Finally, fuzzy modeling and control methods are combined in a book, to create adaptive fuzzy controllers, ending with examples of an obstacle-avoidance controller for an autonomous vehicle using modus ponendo tollens logic.

Artificial Intelligence Illuminated Ben Coppin 2004 Artificial Intelligence Illuminated presents an overview of the background and history of artificial intelligence, its important applications, and potential for the future. The book covers a range of AI techniques, algorithms, and methodologies, including game playing, intelligent agents, machine learning, genetic algorithms, and Artificial Life. Material is presented in a lively and accessible manner and the author focuses on explaining how AI techniques relate to and are derived from natural systems, such as the human brain and evolution, and explaining how the artificial equivalents are used in the real world. Each chapter includes student exercises and review questions, and a detailed glossary at the end of the book defines important terms and concepts highlighted throughout the text.

Analysis and Synthesis for Interval Type-2 Fuzzy-Model-Based Systems

Hong Li 2016-02-29 This book develops a set of reference methods capable of modeling uncertainties existing in membership functions, and analyzing and synthesizing the interval type-2 fuzzy systems with desired performances. It also provides numerous simulation results for various examples, which fill certain gaps in this area of research and may serve as benchmark solutions for the readers. Interval type-2 T-S fuzzy models provide a convenient and flexible method for analysis and synthesis of complex nonlinear systems with uncertainties.

A Framework for Analysis and Synthesis of Fuzzy Linguistic Control Systems

Gholamreza Langari 1993 Stability Analysis and Nonlinear Observer Design using Takagi- Sugeno Fuzzy Models Zsófia Lendek 2010-11-26 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 an extremely 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 of dynamic TS fuzzy models along with two methods to construct TS models.

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for a given nonlinear system

Foundations of Fuzzy Control Jan Jantzen 2013-07-17 Foundations of Fuzzy Control: A Practical Approach, 2ndEdition has been significantly revised and updated, with twonew chapters on Gain Scheduling Control and Neuro-Fuzzy Modelling. It focuses on the PID (Proportional, Integral, Derivative) typecontroller which is the most widely used in industry and systematically analyses several fuzzy PID control systems and adaptive control mechanisms. This new edition covers the basics of fuzzy control and builds asolid foundation for the design of fuzzy controllers, by creating linkstos established linear and nonlinear control theory.

Advanced topics are also introduced and in particular, common sense geometries emphasized. Key features Setso out practical worked through problems, examples and casestudies to illustrate each type of control system Accompanied by a website hosting downloadable MATLAB programs Accompanied by an online course on Fuzzy Control which is taught by the present author and students enrolled at the companion website Foundations of Fuzzy Control: A Practical Approach, 2nd Edition is an invaluable resource for researchers, practitioners, and students in engineering. It is especially relevant for engineers working with automatic control, mechatronics, electrical, or chemical systems.

Fuzzy Control, Estimation and Diagnosis Magdi S. Mahmoud 2017-06-15 This textbook explains the principles of fuzzy systems in some depth together with information useful in realizing them within computational processes. The various algorithms and example problem solutions are well explained. This book is recommended for researchers and graduate study. In addition to its worked examples, the book also uses end-of-chapter exercises as an instructional aid with a downloadable solutions manual available to instructors. The content of the book is developed and extended from material taught for four years in the author’s classes. The text provides a broad overview of fuzzy control, estimation and fault diagnosis. It ranges over various classes of target system and modes of control and then turns to filtering, stabilization, and fault detection and diagnosis. Applications, simulation tools and an appendix on algebraic inequalities complete a unified approach to the analysis of single and interconnected fuzzy systems. Fuzzy Control, Estimation and Fault Detection is a guide for final-year undergraduate and graduate students of electrical and mechanical engineering, computer science and information technology, and will also be instructive for professionals in the information technology sector.

Design Optimization of Active and Passive Structural Control Systems Lagaros, Nikos D. 2012-08-31 A typical engineering task during the development of any system is, among others, to improve its performance in terms of cost and response. Improvements can be achieved either by simply using design rules based on the experience or in an automated way by using optimization methods that lead to optimum designs. Design Optimization of Active and Passive Structural Control Systems includes Earthquake Engineering and Tuned Mass Damper research topics into a volume taking advantage of the connecting link between them, which is optimization. This is a publication addressing the design optimization of active and passive control systems. This title is perfect for engineers, professionals, professors, and students alike, providing cutting edge research and applications.

Autonomous and Intelligent Systems Mohamed Kamel 2011-06-16 This book constitutes the refereed proceedings of the Second International Conference on Autonomous and Intelligent Systems, AIS 2011, held in Burnaby, BC, Canada, in June 2011, colocated with the International Conference on Image Analysis and Recognition, IACIAR 2011. The 40 revised full papers presented were carefully reviewed and selected from 62 submissions. The papers are organized in topical sections on autonomous and intelligent systems, intelligent and advanced control systems, intelligent sensing and data analysis, human-machine interaction, and intelligent circuit analysis and signal processing.

Intelligent Control, Filtering and Model Reduction Analysis for Fuzzy- Model-Based Systems Xiaolong Su 2021-08-17 This book aims to introduce the state-of-the-art research of stability/performance analysis and optimal synthesis methods for fuzzy-model-based systems. A series of problems are solved with new approaches of design, analysis and synthesis of fuzzy systems, including stabilization control and stability analysis, dynamic output feedback control, detection filter design, and reduced-order model approximation. Some efficient techniques, such as Lyapunov stability theory, linear matrix inequality, reciprocally convex approach, and cone complementary linearization method, are utilized in the approaches. This book is a comprehensive reference for researchers and practitioners working on intelligent control, model reduction, and fault detection of fuzzy systems, and is also a useful source of information for senior undergraduates and graduates in these areas. The readers will benefit from some new concepts and methodologies with theoretical and practical significance in system analysis and control synthesis.

Fifty Years of Fuzzy Logic and Its Applications Dan E. Tamir 2015-05-23 This book presents a comprehensive report on the evolution of Fuzzy Logic since its formulation in Lotfi Zadeh’s seminal paper on “fuzzy sets,” published in 1965. In addition, it features a stimulating sampling from the broad field of research and development inspired by Zadeh’s paper. The chapters, written by pioneers and prominent scholars in the field, show how fuzzy sets have been successfully applied to artificial intelligence, control theory, inference, and reasoning. The book also reports on theoretical issues; features recent applications of Fuzzy Logic in the fields of neural networks, clustering, data mining and software testing; and highlights an important paradigm shift caused by Fuzzy Logic in the area of control. The editor is grateful to the editors as an academic celebration of the fifty years’ anniversary of the 1965 paper, this work is a must-have for students and researchers willing to get an inspiring picture of the potentialities, limitations, achievements and accomplishments of Fuzzy Logic-based systems.

Design of Interpretable Fuzzy Systems Krzysztof Cpałka 2017-01-31 This book shows that the term “interpretability” goes far beyond the concept of readability of a fuzzy set and fuzzy rules. It focuses on novel and precise operators of aggregation, inference, and defuzzification leading to flexible Mamdani-type and logical-type systems that can achieve the required accuracy using fewer labelling rules. Individual chapters describe various aspects of interpretability, including appropriate selection of the structure of a fuzzy system, focusing on improving the interpretability of fuzzy systems designed using both gradient-learning and evolutionary algorithms. It also demonstrates how to eliminate various system components, such as inputs, rules and fuzzy sets, whose reduction does not adversely affect system accuracy. It illustrates the performance of the developed algorithms and methods with commonly used benchmarks. The book provides valuable tools for possible applications in many fields including expert systems, automatic control and robotics.

Analysis and Synthesis of Fuzzy Control Systems Gang Feng 2018-09-03 Fuzzy logic control (FLC) has proven to be a popular control methodology for many complex systems in industry, and is often used with great success as an alternative to conventional control techniques. However, because it is fundamentally model free, conventional FLC suffers from a lack of tools for systematic stability analysis and controller design. To address this problem, many model-based fuzzy control approaches have been developed, with the fuzzy dynamic model or the Takagi and Sugeno (T-S) fuzzy model-based approaches receiving the greatest attention. Analysis and Synthesis of Fuzzy Control Systems: A Model-Based Approach offers a unique reference devoted to the systematic analysis and synthesis of model-based fuzzy control systems. After giving a brief review of the varieties of FLC, including the T-S fuzzy model-based control, it fully explains the fundamental concepts of fuzzy sets, fuzzy logic, and fuzzy systems. This enables the book to be self-contained and provides a basis for later chapters, which cover: T-S fuzzy modeling and identification via nonlinear models or data Stability analysis of T-S fuzzy systems Stabilization controller synthesis as well as robust H™ and observer and output feedback controller synthesis Robust controller synthesis of uncertain T-S fuzzy systems Time-delay T-S fuzzy systems Fuzzy model predictive control Robust fuzzy filtering Adaptive control of T-S fuzzy systems A reference for scientists and engineers in systems and control and second-year graduate students exploring fuzzy logic control. It readily demonstrates that conventional control technology and fuzzy logic control can be elegantly combined and further developed so that disadvantages of conventional FLC can be avoided and the horizon of conventional control technology greatly extended. Many chapters feature application simulation examples and practical numerical examples based on MATLAB®.

Fuzzy Controller Design Zdenko Kovacic 2018-10-08 Fuzzy control methods are critical for meeting the demands of complex nonlinear systems. They bestow robust, adaptive, and self-correcting character to complex systems that demand high stability and functionality beyond the capability of traditional methods. A thorough treatise on the theory of fuzzy logic control is out of place on the design bench. That is why Fuzzy Controller Design: Theory and Applications offers laboratory- and industry-tested algorithms, techniques, and formulations of real-world problems for immediate implementation. With surgical precision, the authors carefully select the fundamental elements of fuzzy logic control theory necessary
to formulate effective and efficient designs. The book supplies a springboard of knowledge, punctuated with examples worked out in MATLAB®/SIMULINK®, from which newcomers to the field can dive directly into applications. It systematically covers the design of hybrid, adaptive, and self-learning fuzzy control structures along with strategies for fuzzy controller design suitable for on-line and off-line operation. Examples occupy an entire chapter, with a section devoted to the simulation of an electro-hydraulic servo system. The final chapter explores industrial applications with emphasis on techniques for fuzzy controller implementation and different implementation platforms for various applications. With proven methods based on more than a decade of experience, Fuzzy Controller Design: Theory and Applications is a concise guide to the methodology, design steps, and formulations for effective control solutions.

Polynomial Fuzzy Model-Based Control Systems Hak-Keung Lam 2016-07-18 This book presents recent research on the stability analysis of polynomial-fuzzy-model-based control systems where the concept of partially/imperfectly matched premises and membership-function-dependent analysis are considered. The membership-function-dependent analysis offers a new research direction for fuzzy-model-based control systems by taking into account the characteristic and information of the membership functions in the stability analysis. The book presents on a research level the most recent and advanced research results, promotes the research of polynomial-fuzzy-model-based control systems, and provides theoretical support and point a research direction to postgraduate students and fellow researchers. Each chapter provides numerical examples to verify the analysis results, demonstrate the effectiveness of the proposed polynomial fuzzy control schemes, and explain the design procedure. The book is comprehensively written enclosing detailed derivation steps and mathematical derivations also for readers without extensive knowledge on the topics including students with control background who are interested in polynomial fuzzy model-based control systems. New Approaches to Fuzzy Modeling and Control Michael Margioli 2000 Fuzzy logic has found applications in an incredibly wide range of areas in the relatively wide range of areas in the relatively short time since its conception. It was invented by Lotfi Zadeh, a leading systems expert, so it is perhaps not surprising that system theory is one of the areas in which fuzzy logic has made a profound impact. Fuzzy logic combined with the paradigm of computing with words allows the use and manipulation of human knowledge and reasoning in the modeling and control of dynamical systems. This monograph presents new approaches to the construction of fuzzy models and to the design of fuzzy controllers. The emphasis is on developing methods that allow systematic design on the one hand and mathematical analysis of the resulting system on the other. In particular, the methods described allow rigorous analysis of the stability and robustness of the systems, which are crucial issues in control theory. The first theme of the book is a new approach to the system design and analysis of fuzzy controllers, given linguistic information concerning the plant and the control objective. The new approach, fuzzy Lyapunov synthesis, is a computing-with-words version of the well-known (classical) Lyapunov synthesis method. The second theme of the book is to show that fuzzy controllers are in fact solutions to a nonlinear optimal control problem. The authors formulate a novel nonlinear optimal control problem, consisting of a new state-space model -- referred to as the hyperbolic state-space model -- and a new cost functional and show that its solution is a fuzzy controller. This leads to a new framework for fuzzy modeling and control that combines the advantages of the fuzzyworld, such as linguistic models, with the powerful tools of traditional control theory, such as guaranteed stability and robustness. Fuzzy Systems Hung T. Nguyen 2012-12-06 The analysis and control of complex systems have been the main motivation for the emergence of fuzzy set theory since its inception. It is also a major research field where many applications, especially industrial ones, have made fuzzy logic famous. This unique handbook is devoted to an extensive, organized, and up-to-date presentation of fuzzy systems engineering methods. The book includes detailed material and extensive bibliographies, written by leading experts in the field, on topics such as: Use of fuzzy logic in various control systems. Fuzzy rule-based modeling and its universal approximation properties. Learning and tuning techniques for fuzzy models, using neural networks and genetic algorithms. Fuzzy control methods, including issues such as stability analysis and design techniques, as well as the relationship with traditional linear control. Fuzzy sets relation to the study of chaotic systems, and the fuzzy extension of set-valued approaches to systems modeling through the use of differential inclusions. Fuzzy Systems: Modeling and Control is part of The Handbooks of Fuzzy Sets Series. This series provides a complete picture of contemporary fuzzy set theory and its applications. This volume is a key reference for systems engineers and scientists seeking a guide to the vast amount of literature in fuzzy logic modeling and control. Stability Analysis of Fuzzy-Model-Based Control Systems Hak-Keung Lam 2011-01-28 In this book, the state-of-the-art fuzzy-model-based (FMB) based control approaches are covered. A comprehensive review about the stability analysis of type-1 and type-2 FMB control systems using the Lyapunov-based approach is given, presenting a clear picture to researchers who would like to work on this field. A wide variety of continuous-time nonlinear control systems such as state-feedback, switching, time-delay and sampled-data FMB control systems, are covered. In short, this book summarizes the recent contributions of the authors on the stability analysis of the FMB control systems. It discusses advanced stability analysis issues for various types of FMB control systems, and founds a concrete theoretical basis to support the investigation of FMB control systems at the research level. The analysis results of this book offer various mathematical approaches to designing stable and well-performed FMB control systems. Furthermore, the results widen the applicability of the FMB control approach and help put the fuzzy controller in practice. A wide range of advanced analytical and mathematical analysis techniques will be employed to investigate the system stability and performance of FMB-based control systems in a rigorous manner. Detailed analysis and derivation steps are given to enhance the readability, enabling those who are unfamiliar with the FMB control systems to follow the materials easily. Simulation examples, with figures and plots of system responses, are given to demonstrate the effectiveness of the proposed FMB control approaches. Fuzzy Control Systems with Time-Delay and Stochastic Perturbation Ligang Wu 2014-10-17 This book presents up-to-date research developments and novel methodologies on fuzzy control systems. It presents solutions to a series of problems with new approaches for the analysis and synthesis of fuzzy time-delay systems and fuzzy stochastic systems, including stability analysis and stabilization, dynamic output feedback control, robust filter design, and model approximation. A set of newly developed techniques such as fuzzy Lyapunov function approach, delay-partitioning, reciprocally convex, cone complementary linearization approach are presented. Fuzzy Control Systems with Time-Delay and Stochastic Perturbation: Analysis and Synthesis is a comprehensive reference for researchers and practitioners working in control engineering, system sciences and applied mathematics, and is also a useful source of information for senior undergraduates and graduates in these areas. The readers will benefit from some new concepts, new models and new methodologies with practical significance in control engineering and signal processing.

Fuzzy Systems Ahmad Taher Azar 2010-12-01 While several books are available today that address the mathematical and philosophical foundations of fuzzy logic, none, unfortunately, provides the practicing knowledge engineer, system analyst, and project manager with specific, practical information about fuzzy system modeling. Those few books that include applications and case studies concentrate almost exclusively on engineering problems: pendulum balancing, truck backeruppers, cement kilns, antilock braking systems, image pattern recognition, and digital signal processing. Yet the application of fuzzy logic to engineering problems represents only a fraction of its real potential. As a method of encoding and using human knowledge in a form that is very close to the way experts think about difficult, complex problems, fuzzy systems provide the facilities needed to break through the conceptual bottlenecks associated with traditional decision support and expert systems. Additionally, fuzzy systems provide a rich and robust method of building systems that include multiple conflicting, cooperating, and collaborating experts (a capability that generally eludes not only symbolic expert system users but analysts who have turned to such related technologies as neural networks and genetic algorithms). Yet the application of fuzzy logic in the areas of decision support, medical systems, database analysis and mining has been largely ignored by both the commercial vendors of decision support products and the knowledge engineers who use them.

Fuzzy If-Then Rules in Computational Intelligence Da Ruan 2012-12-06 During the last three decades, interest has increased significantly in the representation and manipulation of imprecision and uncertainty. Perhaps the most important technique in this area concerns fuzzy logic or the logic of fuzziness initiated by L. A. Zadeh in 1965. Since then, fuzzy logic has been incorporated into many areas of fundamental science and into the
applied sciences. More importantly, it has been successful in the areas of expert systems and fuzzy control. The main body of this book consists of so-called IF-THEN rules, on which experts express their knowledge with respect to a certain domain of expertise. Fuzzy IF-THEN Rules in Computational Intelligence: Theory and Applications brings together contributions from leading global specialists who work in the domain of representation and processing of IF-THEN rules. This work gives special attention to fuzzy IF-THEN rules as they are being applied in computational intelligence. Included are theoretical developments and applications related to IF-THEN problems of propositional calculus, fuzzy predicate calculus, implementations of the generalized Modus Ponens, approximate reasoning, data mining and data transformation, techniques for complexity reduction, fuzzy linguistic modeling, large-scale application of fuzzy control, intelligent robotic control, and numerous other systems and practical applications. This book is an essential resource for engineers, mathematicians, and computer scientists working in fuzzy sets, soft computing, and of course, computational intelligence.

Type-2 Fuzzy Logic in Control of Nonsmooth Systems Oscar Castillo 2018-11-02 This book presents the synthesis and analysis of fuzzy controllers and its application to a class of mechanical systems. It mainly focuses on the use of type-2 fuzzy controllers to account for disturbances known as hard or nonsmooth nonlinearities. The book, which summarizes the authors' research on type-2 fuzzy logic and control of mechanical systems, presents models, simulation and experiments towards the control of servomotors with dead-zone and Coulomb friction, and the control of both wheeled mobile robots and a biped robot. Closed-loop systems are analyzed in the framework of smooth and nonsmooth Lyapunov functions.

Advances in Computational Intelligence