Plamen P. Angelov

Evolving
Rule-Based Models

A Tool for Design
of Flexible Adaptive Systems

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  Evolving Rule-Based Models Plamen P. Angelov,2002-02-26 The idea about this book has evolved during the process of its preparation as some of the results have been achieved in parallel with its writing One reason for this is that in this area of research results are very quickly updated Another is possibly that a strong unchallenged theoretical basis in this field still does not fully exist From other hand the rate of innovation competition and demand from different branches of industry from biotech industry to civil and building engineering from market forecasting to civil aviation from robotics to emerging e commerce is increasingly pressing for more customised solutions based on learning consumers behaviour A highly interdisciplinary and rapidly innovating field is forming which focus is the design of intelligent self adapting systems and machines It is on the crossroads of control theory artificial and computational intelligence different engineering disciplines borrowing heavily from the biology and life sciences It is often called intelligent control soft computing or intelligent technology Some other branches have appeared recently like intelligent agents which migrated from robotics to different engineering fields data fusion knowledge extraction etc which are inherently related to this field The core is the attempts to enhance the abilities of the classical control theory in order to have more adequate flexible and adaptive models and control algorithms   **Evolving Rule-Based Models** Plamen P. Angelov,2013-03-20 The idea about this book has evolved during the process of its preparation as some of the results have been achieved in parallel with its writing One reason for this is that in this area of research results are very quickly updated Another is possibly that a strong unchallenged theoretical basis in this field still does not fully exist From other hand the rate of innovation competition and demand from different branches of industry from biotech industry to civil and building engineering from market forecasting to civil aviation from robotics to emerging e commerce is increasingly pressing for more customised solutions based on learning consumers behaviour A highly interdisciplinary and rapidly innovating field is forming which focus is the design of intelligent self adapting systems and machines It is on the crossroads of control theory artificial and computational intelligence different engineering disciplines borrowing heavily from the biology and life sciences It is often called intelligent control soft computing or intelligent technology Some other branches have appeared recently like intelligent agents which migrated from robotics to different engineering fields data fusion knowledge extraction etc which are inherently related to this field The core is the attempts to enhance the abilities of the classical control theory in order to have more adequate flexible and adaptive models and control algorithms   **Springer Handbook of Computational Intelligence** Janusz Kacprzyk,Witold Pedrycz,2015-05-28 The Springer Handbook for Computational Intelligence is the first book covering the basics the state of the art and important applications of the dynamic and rapidly expanding discipline of computational intelligence This comprehensive handbook makes readers familiar with a broad spectrum of approaches to solve various problems in science and technology Possible approaches include for example those being inspired by biology living organisms and animate

systems Content is organized in seven parts foundations fuzzy logic rough sets evolutionary computation neural networks swarm intelligence and hybrid computational intelligence systems Each Part is supervised by its own Part Editor s so that high quality content as well as completeness are assured **Handbook On Computational Intelligence (In 2 Volumes)** Plamen Parvanov Angelov,2016-03-18 With the Internet the proliferation of Big Data and autonomous systems mankind has entered into an era of digital obesity In this century computational intelligence such as thinking machines have been brought forth to process complex human problems in a wide scope of areas from social sciences economics and biology medicine and social networks to cyber security The Handbook of Computational Intelligence in two volumes prompts readers to look at these problems from a non traditional angle It takes a step by step approach supported by case studies to explore the issues that have arisen in the process The Handbook covers many classic paradigms as well as recent achievements and future promising developments to solve some of these very complex problems Volume one explores the subjects of fuzzy logic and systems artificial neural networks and learning systems Volume two delves into evolutionary computation hybrid systems as well as the applications of computational intelligence in decision making the process industry robotics and autonomous systems This work is a one stop shop for beginners as well as an inspirational source for more advanced researchers It is a useful resource for lecturers and learners alike **Computational Intelligence - Volume I** Hisao Ishibuchi,2015-12-30 Computational intelligence is a component of Encyclopedia of Technology Information and Systems Management Resources in the global Encyclopedia of Life Support Systems EOLSS which is an integrated compendium of twenty one Encyclopedias Computational intelligence is a rapidly growing research field including a wide variety of problem solving techniques inspired by nature Traditionally computational intelligence consists of three major research areas Neural Networks Fuzzy Systems and Evolutionary Computation Neural networks are mathematical models inspired by brains Neural networks have massively parallel network structures with many neurons and weighted connections Whereas each neuron has a simple input output relation a neural network with many neurons can realize a highly non linear complicated mapping Connection weights between neurons can be adjusted in an automated manner by a learning algorithm to realize a non linear mapping required in a particular application task Fuzzy systems are mathematical models proposed to handle inherent fuzziness in natural language For example it is very difficult to mathematically define the meaning of cold in everyday conversations such as It is cold today and Can I have cold water The meaning of cold may be different in a different situation Even in the same situation a different person may have a different meaning Fuzzy systems offer a mathematical mechanism to handle inherent fuzziness in natural language As a result fuzzy systems have been successfully applied to real world problems by extracting linguistic knowledge from human experts in the form of fuzzy IF THEN rules Evolutionary computation includes various population based search algorithms inspired by evolution in nature Those algorithms usually have the following three mechanisms fitness evaluation to measure the quality of each solution selection to choose good solutions from the current population and

variation operators to generate offspring from parents Evolutionary computation has high applicability to a wide range of optimization problems with different characteristics since it does not need any explicit mathematical formulations of objective functions For example simulation based fitness evaluation is often used in evolutionary design Subjective fitness evaluation by a human user is also often used in evolutionary art and music These volumes are aimed at the following five major target audiences University and College students Educators Professional practitioners Research personnel and Policy analysts managers and decision makers **Nature-Inspired Optimization Algorithms for Fuzzy Controlled Servo Systems** Radu-Emil Precup,Radu-Codrut David,2019-04-23 Nature inspired Optimization Algorithms for Fuzzy Controlled Servo Systems explains fuzzy control in servo systems in a way that doesn t require any solid mathematical prerequisite Analysis and design methodologies are covered along with specific applications to servo systems and representative case studies The theoretical approaches presented throughout the book are validated by the illustration of digital simulation and real time experimental results This book is a great resource for a wide variety of readers including graduate students engineers designers practitioners and researchers and everyone who faces challenging control problems **Autonomous Learning Systems** Plamen Angelov,2012-11-06 Autonomous Learning Systems is the result of over a decade of focused research and studies in this emerging area which spans a number of well known and well established disciplines that include machine learning system identification data mining fuzzy logic neural networks neuro fuzzy systems control theory and pattern recognition The evolution of these systems has been both industry driven with an increasing demand from sectors such as defence and security aerospace and advanced process industries bio medicine and intelligent transportation as well as research driven there is a strong trend of innovation of all of the above well established research disciplines that is linked to their on line and real time application their adaptability and flexibility Providing an introduction to the key technologies detailed technical explanations of the methodology and an illustration of the practical relevance of the approach with a wide range of applications this book addresses the challenges of autonomous learning systems with a systematic approach that lays the foundations for a fast growing area of research that will underpin a range of technological applications vital to both industry and society Key features Presents the subject systematically from explaining the fundamentals to illustrating the proposed approach with numerous applications Covers a wide range of applications in fields including unmanned vehicles robotics oil refineries chemical industry evolving user behaviour and activity recognition Reviews traditional fields including clustering classification control fault detection and anomaly detection filtering and estimation through the prism of evolving and autonomously learning mechanisms Accompanied by a website hosting additional material including the software toolbox and lecture notes Autonomous Learning Systems provides a one stop shop on the subject for academics students researchers and practicing engineers It is also a valuable reference for Government agencies and software developers **Empirical Approach to Machine Learning** Plamen P. Angelov,Xiaowei Gu,2018-10-17 This book provides a one stop source for all

readers who are interested in a new empirical approach to machine learning that unlike traditional methods successfully addresses the demands of today s data driven world After an introduction to the fundamentals the book discusses in depth anomaly detection data partitioning and clustering as well as classification and predictors It describes classifiers of zero and first order and the new highly efficient and transparent deep rule based classifiers particularly highlighting their applications to image processing Local optimality and stability conditions for the methods presented are formally derived and stated while the software is also provided as supplemental open source material The book will greatly benefit postgraduate students researchers and practitioners dealing with advanced data processing applied mathematicians software developers of agent oriented systems and developers of embedded and real time systems Itcan also be used as a textbook for postgraduate coursework for this purpose a standalone set of lecture notes and corresponding lab session notes are available on the same website as the code Dimitar Filev Henry Ford Technical Fellow Ford Motor Company USA and Member of the National Academy of Engineering USA The book Empirical Approach to Machine Learning opens new horizons to automated and efficient data processing Paul J Werbos Inventor of the back propagation method USA I owe great thanks to Professor Plamen Angelov for making this important material available to the community just as I see great practical needs for it in the new area of making real sense of high speed data from the brain Chin Teng Lin Distinguished Professor at University of Technology Sydney Australia This new book will set up a milestone for the modern intelligent systems Edward Tunstel President of IEEE Systems Man Cybernetics Society USA Empirical Approach to Machine Learning provides an insightful and visionary boost of progress in the evolution of computational learning capabilities yielding interpretable and transparent implementations **Granular, Fuzzy, and Soft Computing** Tsau-Young Lin,Churn-Jung Liau,Janusz Kacprzyk,2023-03-29 The first edition of the Encyclopedia of Complexity and Systems Science ECSS 2009 presented a comprehensive overview of granular computing GrC broadly divided into several categories Granular computing from rough set theory Granular Computing in Database Theory Granular Computing in Social Networks Granular Computing and Fuzzy Set Theory Grid Cloud Computing as well as general issues in granular computing In 2011 the formal theory of GrC was established providing an adequate infrastructure to support revolutionary new approaches to computer data science including the challenges presented by so called big data For this volume of ECSS Second Edition many entries have been updated to capture these new developments together with new chapters on such topics as data clustering outliers in data mining qualitative fuzzy sets and information flow analysis for security applications Granulations can be seen as a natural and ancient methodology deeply rooted in the human mind Many daily things are routinely granulated into sub things The topography of earth is granulated into hills plateaus etc space and time are granulated into infinitesimal granules and a circle is granulated into polygons of infinitesimal sides Such granules led to the invention of calculus topology and non standard analysis Formalization of general granulation was difficult but as shown in this volume great progress has been made in combing discrete and continuous

mathematics under one roof for a broad range of applications in data science   *Computational Intelligence for Knowledge-Based System Design* Eyke Hüllermeier,Rudolf Kruse,Frank Hoffmann,2010-06-30 The book constitutes the refereed proceedings of the 13th International Conference on Information Processing and Management of Uncertainty in Knowledge Based Systems IPMU 2010 held in Dortmund Germany from June 28 July 2 2010 The 77 revised full papers were carefully reviewed and selected from 320 submissions and reflect the richness of research in the field of Computational Intelligence and represent developments on topics as machine learning data mining pattern recognition uncertainty handling aggregation and fusion of information as well as logic and knowledge processing   **Applications and Science in Soft Computing** Ahmad Lotfi,Jonathan M. Garibaldi,2013-06-29 Soft computing techniques have reached a significant level of recognition and ceptance from both the academic and industrial communities The papers collected in this volume illustrate the depth of the current theoretical research trends and the breadth of the application areas in which soft computing methods are making c tributions This volume consists of forty six selected papers presented at the Fourth Inter tional Conference on Recent Advances in Soft Computing which was held in N th th tingham United Kingdom on 12 and 13 December 2002 at Nottingham Trent University This volume is organized in five parts The first four parts address mainly the f damental and theoretical advances in soft computing namely Artificial Neural Networks Evolutionary Computing Fuzzy Systems and Hybrid Systems The fifth part of this volume presents papers that deal with practical issues and ind trial applications of soft computing techniques We would like to express our sincere gratitude to all the authors who submitted contributions for inclusion We are also indebted to Janusz Kacprzyk for his vices related to this volume We hope you find the volume an interesting refl tion of current theoretical and application based soft computing research   **Advances in Computational Intelligence Systems** Plamen Angelov,Alexander Gegov,Chrisina Jayne,Qiang Shen,2016-09-06 The book is a timely report on advanced methods and applications of computational intelligence systems It covers a long list of interconnected research areas such as fuzzy systems neural networks evolutionary computation evolving systems and machine learning The individual chapters are based on peer reviewed contributions presented at the 16th Annual UK Workshop on Computational Intelligence held on September 7 9 2016 in Lancaster UK The book puts a special emphasis on novels methods and reports on their use in a wide range of applications areas thus providing both academics and professionals with a comprehensive and timely overview of new trends in computational intelligence   **Emerging Paradigms in Machine Learning** Sheela Ramanna,Lakhmi C Jain,Robert J. Howlett,2012-07-31 This book presents fundamental topics and algorithms that form the core of machine learning ML research as well as emerging paradigms in intelligent system design The multidisciplinary nature of machine learning makes it a very fascinating and popular area for research The book is aiming at students practitioners and researchers and captures the diversity and richness of the field of machine learning and intelligent systems Several chapters are devoted to computational learning models such as granular

computing rough sets and fuzzy sets An account of applications of well known learning methods in biometrics computational stylistics multi agent systems spam classification including an extremely well written survey on Bayesian networks shed light on the strengths and weaknesses of the methods Practical studies yielding insight into challenging problems such as learning from incomplete and imbalanced data pattern recognition of stochastic episodic events and on line mining of non stationary data streams are a key part of this book **Fuzzy System Identification and Adaptive Control** Ruiyun Qi,Gang Tao,Bin Jiang,2019-06-11 This book provides readers with a systematic and unified framework for identification and adaptive control of Takagi Sugeno T S fuzzy systems Its design techniques help readers applying these powerful tools to solve challenging nonlinear control problems The book embodies a systematic study of fuzzy system identification and control problems using T S fuzzy system tools for both function approximation and feedback control of nonlinear systems Alongside this framework the book also introduces basic concepts of fuzzy sets logic and inference system discusses important properties of T S fuzzy systems develops offline and online identification algorithms for T S fuzzy systems investigates the various controller structures and corresponding design conditions for adaptive control of continuous time T S fuzzy systems develops adaptive control algorithms for discrete time input output formT S fuzzy systems with much relaxed design conditions and discrete time state space T S fuzzy systems and designs stable parameter adaptation algorithms for both linearly and nonlinearly parameterized T S fuzzy systems The authors address adaptive fault compensation problems for T S fuzzy systems subject to actuator faults They cover a broad spectrum of related technical topics and to develop a substantial set of adaptive nonlinear system control tools Fuzzy System Identification and Adaptive Control helps engineers in the mechanical electrical and aerospace fields to solve complex control design problems The book can be used as a reference for researchers and academics in nonlinear intelligent adaptive and fault tolerant control *Soft Computing: State of the Art Theory and Novel Applications* Ronald R Yager,Ali M. Abbasov,Marek Z. Reformat,Shahnaz N Shahbazova,2012-10-31 This book is a tribute to Lotfi A Zadeh the father of fuzzy logic on the occasion of his 90th Birthday The book gathers original scientific contributions written by top scientists and presenting the latest theories applications and new trends in the fascinating and challenging field of soft computing Predictive Maintenance in Dynamic Systems Edwin Lughofer,Moamar Sayed-Mouchaweh,2019-02-28 This book provides a complete picture of several decision support tools for predictive maintenance These include embedding early anomaly fault detection diagnosis and reasoning remaining useful life prediction fault prognostics quality prediction and self reaction as well as optimization control and self healing techniques It shows recent applications of these techniques within various types of industrial production utilities equipment plants smart devices etc systems addressing several challenges in Industry 4 0 and different tasks dealing with Big Data Streams Internet of Things specific infrastructures and tools high system dynamics and non stationary environments Applications discussed include production and manufacturing systems renewable energy production and management maritime systems power

plants and turbines conditioning systems compressor valves induction motors flight simulators railway infrastructures mobile robots cyber security and Internet ofThings The contributors go beyond state of the art by placing a specific focus on dynamic systems where it is of utmost importance to update system and maintenance models on the fly to maintain their predictive power   Fuzzy Logic and Mathematics Radim Belohlavek,Joseph W. Dauben,George J. Klir,2017-05-03 The term fuzzy logic as it is understood in this book stands for all aspects of representing and manipulating knowledge based on the rejection of the most fundamental principle of classical logic the principle of bivalence According to this principle each declarative sentence is required to be either true or false In fuzzy logic these classical truth values are not abandoned However additional intermediate truth values between true and false are allowed which are interpreted as degrees of truth This opens a new way of thinking thinking in terms of degrees rather than absolutes For example it leads to the definition of a new kind of sets referred to as fuzzy sets in which membership is a matter of degree The book examines the genesis and development of fuzzy logic It surveys the prehistory of fuzzy logic and inspects circumstances that eventually lead to the emergence of fuzzy logic The book explores in detail the development of propositional predicate and other calculi that admit degrees of truth which are known as fuzzy logic in the narrow sense Fuzzy logic in the broad sense whose primary aim is to utilize degrees of truth for emulating common sense human reasoning in natural language is scrutinized as well The book also examines principles for developing mathematics based on fuzzy logic and provides overviews of areas in which this has been done most effectively It also presents a detailed survey of established and prospective applications of fuzzy logic in various areas of human affairs and provides an assessment of the significance of fuzzy logic as a new paradigm

   Sequential Intelligent Dynamic System Modeling and Control Hai-Jun Rong,Zhao-Xu Yang,2024-07-05 The book offers novel research results of sequential intelligent dynamic system modeling and control in a unified framework from theory proposals to real applications It covers an in depth study of various learning algorithms for the permanent adaptation of intelligent model parameters as well as of structural parts of the model The comprehensive researches on sequential fuzzy and neural controller design schemes for some complex real applications are included This is particularly suited for readers who are interested to learn practical solutions for controlling nonlinear systems that are uncertain and varied at any time In addition the organization of the book from addressing fundamental concepts and presenting novel intelligent models to solving real applications is one of the major features of the book which makes it a valuable resource for both beginners and researchers wanting to further their understanding and study about realtime online intelligent modeling and control ofnonlinear dynamic systems The book can benefit researchers engineers and graduate students in the fields of control engineering artificial intelligence computational intelligence intelligent control nonlinear system modeling and control etc

   Proceedings of the 8th International Conference on Computer Recognition Systems CORES 2013 Robert Burduk,Konrad Jackowski,Marek Kurzynski,Michał Wozniak,Andrzej Zolnierek,2013-05-23 The computer recognition systems are nowadays

one of the most promising directions in artificial intelligence This book is the most comprehensive study of this field It contains a collection of 86 carefully selected articles contributed by experts of pattern recognition It reports on current research with respect to both methodology and applications In particular it includes the following sections Biometrics Data Stream Classification and Big Data Analytics Features learning and classifiers Image processing and computer vision Medical applications Miscellaneous applications Pattern recognition and image processing in robotics Speech and word recognition This book is a great reference tool for scientists who deal with the problems of designing computer pattern recognition systems Its target readers can be the as well researchers as students of computer science artificial intelligence or robotics

Intelligent Assistive Robots Samer Mohammed,Juan C. Moreno,Kyoungchul Kong,Yacine Amirat,2015-03-26 This book deals with the growing challenges of using assistive robots in our everyday activities along with providing intelligent assistive services The presented applications concern mainly healthcare and wellness such as helping elderly people assisting dependent persons habitat monitoring in smart environments well being security etc These applications reveal also new challenges regarding control theory mechanical design mechatronics portability acceptability scalability security etc

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