A Hybrid Fuzzy Logic And Extreme Learning Machine For

This thoroughly refereed and well organized collection of papers is largely based on papers originally presented at the IJCAI'95 Workshop on Fuzzy Logic in AI, held in Montreal, Canada, in August 1995. Additionally, a few papers were invited in order to round off the scope and competent coverage of relevant topics. The 20 revised full papers included are organized in sections on hybrid and novel architectures, machine learning and data mining, image processing and computer vision, and theoretical developments. Focusing on the most pressing problems of AI, the volume supports the view that fuzzy systems combined with traditional AI leads the move towards the next generation of intelligent systems.

This book describes new methods for building intelligent systems using type-2 fuzzy logic and soft computing (SC) techniques. The authors extend the use of fuzzy logic to a higher order, which is called type-2 fuzzy logic. Combining type-2 fuzzy logic with traditional SC techniques, we can build powerful hybrid intelligent systems that can use the advantages that each technique offers. This book is intended to be a major reference tool and can be used as a textbook.

Fuzzy Logic for Embedded Systems Applications, by a recognized expert in the field, covers all the basic theory relevant to electronics design, with particular emphasis on embedded systems, and shows how the techniques can be applied to shorten design cycles and handle logic problems that are tough to solve using conventional linear techniques. All the latest advances in the field aree discussed and practical circuit design examples presented. Fuzzy logic has been found to be particularly suitable for many embedded control applications. The intuitive nature of the fuzzy-based system design saves engineers time and reduces costs by shortening product development cycles and making system maintenance and adjustments easier. Yet despite its wide acceptance—and perhaps because of its name—it is still misunderstood and feared by many engineers. There is a need for embedded systems designers—both hardware and software—to get up to speed on the principles and applications of fuzzy logic in order to ascertain when and how to use them appropriately. Fuzzy Logic for Embedded Systems Applications provides practical guidelines for designing electronic circuits and devices for embedded systems using fuzzy-based logic. It covers both theory and applications with design examples. * Unified approach to fuzzy electronics from an engineering point of view * Easy to follow with plenty of examples * Review and evaluation of free resources

Fuzzy logic techniques have had extraordinary growth in various engineering systems. The developments in engineering sciences have caused apprehension in modern years due to high-tech industrial processes with ever-increasing levels of complexity. Advanced Fuzzy Logic Approaches in Engineering Science provides innovative insights into a comprehensive range of soft fuzzy logic techniques applied in various fields of engineering problems like fuzzy sets theory, adaptive neuro fuzzy inference system, and hybrid fuzzy logic genetic algorithms belief networks in industrial and engineering settings. The content within this publication represents the work of particle swarms, fuzzy computing, and rough sets. It is a vital reference source for engineers, research scientists, academicians, and graduate-level students seeking coverage on topics centered on the applications of fuzzy logic in high-tech industrial processes.

This book introduces new concepts and theories of Fuzzy Logic Control for the application and development of robotics and intelligent machines. The book consists of nineteen chapters categorized into 1) Robotics and Electrical Machines 2) Intelligent Control Systems with various applications, and 3) New Fuzzy Logic Concepts and Theories. The intended readers of this book are engineers, researchers, and graduate students interested in fuzzy logic control systems.

This book provides comprehensive introduction to a consortium of technologies underlying soft computing, an evolving branch of computational intelligence. The constituent technologies discussed comprise neural networks, fuzzy logic, genetic algorithms, and a number of hybrid systems which include classes such as neuro-fuzzy, fuzzy-genetic, and neuro-genetic systems. The hybridization of the technologies is demonstrated on architectures such as Fuzzy-Back-propagation Networks (NN-FL), Simplified Fuzzy ARTMAP (NN-FL), and Fuzzy Associative Memories. The book also gives an exhaustive discussion of FL-GA hybridization. Every architecture has been discussed in detail through illustrative examples and applications. The algorithms have been presented in pseudo-code with a step-by-step illustration of the same in problems. The applications, demonstrative of the potential of the architectures, have been chosen from diverse disciplines of science and engineering. This book with a wealth of information that is clearly presented and illustrated by many examples and applications is designed for use as a text for courses in soft computing at both the senior undergraduate and first-year post-graduate engineering levels. It should also be of interest to researchers and technologists desirous of applying soft computing technologies to their respective fields of work.

We describe in this book, recent developments on fuzzy logic, neural networks and optimization algorithms, as well as their hybrid combinations, and their application in areas such as, intelligent control and robotics, pattern recognition, medical diagnosis, time series prediction and optimization of complex problems. The book contains a collection of papers focused on hybrid intelligent systems based on soft computing. There are some papers with the main theme of type-1 and type-2 fuzzy logic, which basically consists of papers that propose new concepts and algorithms based on type-1 and type-2 fuzzy logic and their applications. There also some papers that presents theory and practice of meta-heuristics in different areas of application. Another group of papers describe diverse applications of fuzzy logic, neural networks and hybrid intelligent systems in medical applications. There are also some papers that present theory and practice of neural networks in different areas of application. In addition, there are papers that present theory and practice of optimization and evolutionary algorithms in different areas of application. Finally, there are some papers describing applications of fuzzy logic, neural networks and meta-heuristics in pattern recognition problems.

What is fuzzy logic?--a system of concepts and methods for exploring modes of reasoning that are approximate rather than exact. While the engineering community has appreciated the advances in understanding using fuzzy logic for quite some time, fuzzy logic's impact in non-engineering disciplines is only now being recognized. The authors of Fuzzy Logic in Geology attend to this growing interest in the subject and introduce the use of fuzzy set theory in a style geoscientists can understand. This is followed by individual chapters on topics relevant to earth scientists: sediment modeling, fracture detection, reservoir characterization, clustering in geophysical data analysis, ground water movement, and time series analysis. George Klir is the Distinguished Professor of Systems Science and Director of the Center for Intelligent Systems, Fellow of the IEEE and IFSA, editor of nine volumes, editorial board member of 18 journals, and author or co-author of 16 books Foreword by the inventor of fuzzy logic-- Professor Lotfi Zadeh

Fuzzy Logic in Action: Applications in Epidemiology and Beyond, co-authored by Eduardo Massad, Neli Ortega, Laécio Barros, and Cláudio Struchiner is a remarkable achievement. The book brings a major paradigm shift to medical sciences exploring the

use of fuzzy sets in epidemiology and medical diagnosis arena. The volume addresses the most significant topics in the broad areas of epidemiology, mathematical modeling and uncertainty, embodying them within the framework of fuzzy set and dynamic systems theory. Written by leading contributors to the area of epidemiology, medical informatics and mathematics, the book combines a very lucid and authoritative exposition of the fundamentals of fuzzy sets with an insightful use of the fundamentals in the area of epidemiology and diagnosis. The content is clearly illustrated by numerous illustrative examples and several real world applications. Based on their profound knowledge of epidemiology and mathematical modeling, and on their keen understanding of the role played by uncertainty and fuzzy sets, the authors provide insights into the connections between biological phenomena and dynamic systems as a mean to predict, diagnose, and prescribe actions. An example is the use of Bellman-Zadeh fuzzy decision making approach to develop a vaccination strategy to manage measles epidemics in São Paulo. The book offers a comprehensive, systematic, fully updated and self- contained treatise of fuzzy sets in epidemiology and diagnosis. Its content covers material of vital interest to students, researchers and practitioners and is suitable both as a textbook and as a reference. The authors present new results of their own in most of the chapters. In doing so, they reflect the trend to view fuzzy sets, probability theory and statistics as an association of complementary and synergetic modeling methodologies.
In this book, a new approach for diagnosis and risk evaluation of ar-terial hypertension is introduced. The new approach was implement-ed as a hybrid intelligent system combining modular neural net-works and fuzzy systems. The different responses of the hybrid system are combined using fuzzy logic. Finally, two genetic algo-rithms are used to perform the optimization of the modular neural networks parameters and fuzzy inference system parameters. The experimental results obtained using the proposed method on real pa-tient data show that when the optimization is used, the results can be better than without optimization. This book is intended to be a refer-ence for scientists and physicians interested in applying soft compu-ting techniques, such as neural networks, fuzzy logic and genetic algorithms, in medical diagnosis, but also in general to classification and pattern recognition and similar problems.
It is really important to diagnose jaw tumor in its early stages to improve its prognosis. A differential diagnosis could be performed using X-ray images; therefore, accurate and fully automatic jaw lesions image segmentation is a challenging and essential task. The aim of this work was to develop a novel, fully automatic and effective method for jaw lesions in panoramic X-ray image segmentation.
The 1960s were perhaps a decade of confusion, when scientists faced d- culties in dealing with imprecise information and complex dynamics. A new set theory and then an in?nite-valued logic of Lot? A. Zadeh were so c- fusing that they were called fuzzy set theory and fuzzy logic; a deterministic system found by E. N. Lorenz to have random behaviours was so unusual that it was lately named a chaotic system. Just like irrational and imaginary numbers, negative energy, anti-matter, etc., fuzzy logic and chaos were gr- ually and eventually accepted by many, if not all, scientists and engineers as fundamental concepts, theories, as well as technologies. In particular, fuzzy systems technology has achieved its maturity with widespread applications in many industrial, commercial, and technical ?elds, ranging from control, automation, and arti?cial intelligence to image/signal processing,patternrecognition,andelectroniccommerce.Chaos,ontheother hand,wasconsideredoneofthethreemonumentaldiscoveriesofthetwentieth century together with the theory of relativity and quantum mechanics. As a very special nonlinear dynamical phenomenon, chaos has reached its current outstanding status from being merely a scienti?c curiosity in the mid-1960s to an applicable technology in the late 1990s. Finding the intrinsic relation between fuzzy logic and chaos theory is certainlyofsigni?cantinterestandofpotentialimportance.Thepast20years have indeed witnessed some serious explorations of the interactions between fuzzylogicandchaostheory,leadingtosuchresearchtopicsasfuzzymodeling of chaotic systems using Takagi–Sugeno models, linguistic descriptions of chaotic systems, fuzzy control of chaos, and a combination of fuzzy control technology and chaos theory for various engineering practices.
The world we live in is pervaded with uncertainty and imprecision. Is it likely to rain this afternoon? Should I take an umbrella with me? Will I be able to find parking near the campus? Should I go by bus? Such simple questions are a c- mon occurrence in our daily lives. Less simple examples: What is the probability that the price of oil will rise sharply in the near future? Should I buy Chevron stock? What are the chances that a bailout of GM, Ford and Chrysler will not s- ceed? What will be the consequences? Note that the examples in question involve both uncertainty and imprecision. In the real world, this is the norm rather than exception. There is a deep-seated tradition in science of employing probability theory, and only probability theory, to deal with uncertainty and imprecision. The mon- oly of probability theory came to an end when fuzzy logic made its debut. H- ever, this is by no means a widely accepted view. The belief persists, especially within the probability community, that probability theory is all that is needed to deal with uncertainty. To quote a prominent Bayesian, Professor Dennis Lindley, "The only satisfactory description of uncertainty is probability.
Ever since fuzzy logic was introduced by Lotfi Zadeh in the mid-sixties and genetic algorithms by John Holland in the early seventies, these two fields widely been subjects of academic research the world over. During the last few years, they have been experiencing extremely rapid growth in the industrial world, where they have been shown to be very effective in solving real-world problems. These two substantial fields, together with neurocomputing techniques, are recognized as major parts of soft computing: a set of computing technologies already riding the waves of the next century to produce the human-centered intelligent systems of tomorrow; the collection of papers presented in this book shows the way. The book also contains an extensive bibliography on fuzzy logic and genetic algorithms.
This book constitutes the refereed proceedings of the 9th International Workshop on Fuzzy Logic and Applications, WILF 2011 held in Trani, Italy in August 2011. The 34 revised full papers presented were carefully reviewed and selected from 50 submissions. The papers are organized in topical sections on advances in theory of fuzzy sets, advances in fuzzy systems, advances in classification and clustering; and applications.
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 necessary to break through the computational 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.

This volume includes most of the recent results obtained by Italian researchers in fuzzy logic. It collects selected papers from the 1997 Italian Workshop on Fuzzy Logic — WILF '97 and some invited papers, covering the mathematical foundations of fuzzy logic, neuro-fuzzy systems, hardware implementation of fuzzy logic controllers, and gives an update on applications to control, physics, decision support systems and pattern analysis.

This book offers a timely overview of fuzzy and rough set theories and methods. Based on selected contributions presented at the International Symposium on Fuzzy and Rough Sets, ISFUROS 2017, held in Varadero, Cuba, on October 24-26, 2017, the book also covers related approaches, such as hybrid rough-fuzzy sets and hybrid fuzzy-rough sets and granular computing, as well as a number of applications, from big data analytics, to business intelligence, security, robotics, logistics, wireless sensor networks and many more. It is intended as a source of inspiration for PhD students and researchers in the field, fostering not only new ideas but also collaboration between young researchers and institutions and established ones.

This book provides state-of-the-art scientific and engineering research findings and developments in the area of mobile robotics and associated support technologies. The book contains peer reviewed articles presented at the CLAWAR 2012 conference. Robots are no longer confined to industrial and manufacturing environments. A great deal of interest is invested in the use of robots outside the factory environment. The CLAWAR conference series, established as a high profile international event, acts as a platform for dissemination of research and development findings and supports such a trend to address the current interest in mobile robotics to meet the needs of mankind in various sectors of the society. These include personal care, public health, services in the domestic, public and industrial environments. The editors of the book have extensive research experience and publications in the area of robotics in general and in mobile robotics specifically, and their experience is reflected in editing the contents of the book.

This book addresses the latest research and applications of fuzzy management methods for business decisions. It showcases a broad set of applications and discusses topics such as measures for the quality of analytics outcomes in big data environments; how fuzzy management methods support the inclusion of human thinking and human behavior in decision making processes; how to generate better results with fuzzy management methods in cases of imprecise information; new personalization concepts enabled by fuzzy logic for the offering of customized products and services especially in the electronic market; and lastly the application of fuzzy analysis for executives using natural rather than computer language. The combination of research papers and case studies makes it a valuable resource both for researchers and practitioners in the digital economy.

Fuzzy Logic Hybrid Extensions of Neural and Optimization Algorithms: Theory and ApplicationsSpringer Nature

To say that Fuzzy Logic in Medicine, or FLM for short, is an important addi tion to the literature of fuzzy logic and its applications, is an understatement. Edited by two prominent informaticians, Professors S. Barro and R. Marin, it is one of the first books in its field. Between its covers, FLM presents authoritative expositions of a wide spectrum of medical and biological ap plications of fuzzy logic, ranging from image classification and diagnostics to anaesthesia control and risk assessment of heart diseases. As the editors note in the preface, recognition of the relevance of fuzzy set theory and fuzzy logic to biological and medical systems has a long history. In this context, particularly worthy of note is the pioneering work of Profes sor Klaus Peter Adlassnig of the University of Vienna School of Medicine. However, it is only within the past decade that we began to see an accelerat ing growth in the visibility and importance of publications falling under the rubric of fuzzy logic in medicine and biology -a leading example of which is the Journal of the Biomedical Fuzzy Systems Association in Japan. Why did it take so long for this to happen? First, a bit of history.

This volume constitutes the proceedings of two collocated international conferences: EUSFLAT-2017 – the 10th edition of the flagship Conference of the European Society for Fuzzy Logic and Technology held in Warsaw, Poland, on September 11–15, 2017, and IWIFSGN'2017 – The Sixteenth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets, held in Warsaw on September 13–15, 2017. The conferences were organized by the Systems Research Institute, Polish Academy of Sciences, Department IV of Engineering Sciences, Polish Academy of Sciences, and the Polish Operational and Systems Research Society in collaboration with the European Society for Fuzzy Logic and Technology (EUSFLAT), the Bulgarian Academy of Sciences and various European universities. The aim of the EUSFLAT-2017 was t o bring together theoreticians and practitioners working on fuzzy logic, fuzzy systems, soft computing and related areas and to provide a platform for exchanging ideas and discussing the latest trends and ideas, while the aim of IWIFSGN'2017 was to discuss new developments in extensions of the concept of a fuzzy set, such as an intuitionistic fuzzy set, as well as other concepts, like that of a generalized net. The papers included, written by leading international experts, as well as the special sessions and panel discussions contribute to the development the field, strengthen collaborations and intensify networking.

Intelligent Hybrid Systems: Fuzzy Logic, Neural Networks, and Genetic Algorithms is an organized edited collection of contributed chapters covering basic principles, methodologies, and applications of fuzzy systems, neural networks and genetic algorithms. All chapters are original contributions by leading researchers written exclusively for this volume. This book reviews important concepts and models, and focuses on specific methodologies common to fuzzy systems, neural networks and evolutionary computation. The emphasis is on development of cooperative models of hybrid systems. Included are applications related to intelligent data analysis, process analysis, intelligent adaptive information systems, systems identification, nonlinear systems, power and water system design, and many others. Intelligent Hybrid Systems: Fuzzy Logic, Neural Networks, and Genetic Algorithms provides researchers and engineers with up-to-date coverage of new results, methodologies and applications for building intelligent systems capable of solving large-scale problems.

A number of academic and industrial researches incontrol systems have exposed the inherent weaknessesof PID control which are; rigidity, prohibitivecomputational complexity and non-applicability forintelligent and complex systems. Consequently, agroup of researchers have proposed fuzzy logiccontrol as a better alternative to PID control. Thisnotion has spawned numerous debates amongresearchers, experts and professionals in the fieldof control systems. As a result, this bookinvestigates and compares the performance oftraditional control techniques with fuzzy logiccontrol which will be optimized and made adaptive tothe variations of the sensor input. It will also beproven that fuzzy logic control is far more superiorin performance to the existing traditional controltechniques. These objectives were achieved throughthe use of MATLAB and SIMULINK to simulate, tweak andfine-tune the different cases for the response andtheir respective performance metrics. Interestinglyas expected, the results of the simulations showsthat fuzzy logic control, optimized or not, is betterthan the traditional control techniques, especially, PID control

A simple nonlinear model of a DC shunt motor is considered for speed control using fuzzy logic control. Concentrates on controlling the speed both in the presence and in the absence of a torque disturbance.

This book attempts to present some current research progress and results on the interplay of fuzzy logic and chaos theory. More specifically, this book includes a collection of some state-of-theart surveys, tutorials, and application examples written by some

experts working in the interdisciplinary fields overlapping fuzzy logic and chaos theory. The content of the book covers fuzzy definition of chaos, fuzzy modeling and control of chaotic systems using both Mamdani and Takagi-Sugeno models, fuzzy model identification using genetic algorithms and neural network schemes, bifurcation phenomena and self-referencing in fuzzy systems, complex fuzzy systems and their collective behaviours, as well as some applications of combining fuzzy logic and chaotic dynamics, such as fuzzy-chaos hybrid controllers for nonlinear dynamic systems, and fuzzy-model-based chaotic cryptosystems. This book can serve as a handy reference for researchers working in interdisciplines related, among others, to both fuzzy logic and chaos theory.

At the beginning of the new millennium, fuzzy logic opens a new challenging perspective in information processing. This perspective emerges out of the ideas of the founder of fuzzy logic - Lotfi Zadeh, to develop 'soft' tools for direct computing with human perceptions. The enigmatic nature of human perceptions manifests in their unique capacity to generalize, extract patterns and capture both the essence and the integrity of the events and phenomena in human life. This capacity goes together with an intrinsic imprecision of the perception-based information. According to Zadeh, it is because of the imprecision of the human imprecision that they do not lend themselves to meaning representation through the use of precise methods based on predicate logic. This is the principal reason why existing scientific theories do not have the capability to operate on perception-based information. We are at the eve of the emergence of a theory with such a capability. Its applicative effectiveness has been already demonstrated through the industrial implementation of the soft computing - a powerful intelligent technology centred in fuzzy logic. At the focus of the papers included in this book is the knowledge and experience of the researchers in relation both to the engineering applications of soft computing and to its social and philosophical implications at the dawn of the third millennium. The papers clearly demonstrate that Fuzzy Logic revolutionizes general approaches for solving applied problems and reveals deep connections between them and their solutions.

We describe in this book, new methods and applications of hybrid intelligent systems using soft computing techniques. Soft Computing (SC) consists of several intelligent computing paradigms, including fuzzy logic, neural networks, and evolutionary al-rithms, which can be used to produce powerful hybrid intelligent systems. The book is organized in five main parts, which contain a group of papers around a similar subject. The first part consists of papers with the main theme of intelligent control, which are basically papers that use hybrid systems to solve particular problems of control. The second part contains papers with the main theme of pattern recognition, which are basically papers using soft computing techniques for achieving pattern recognition in different applications. The third part contains papers with the themes of intelligent agents and social systems, which are papers that apply the ideas of agents and social behavior to solve real-world problems. The fourth part contains papers that deal with the hardware implementation of intelligent systems for solving particular problems. The fifth part contains papers that deal with modeling, simulation and optimization for real-world applications.

This book is a guide for students, researchers, and practitioners to the latest developments in fuzzy hybrid computing in construction engineering and management. It discusses basic theory related to fuzzy logic and fuzzy hybrid computing, their application in a range of practical construction problems, and emerging and future research trends.

This edited book presents the state-of-the-art of applying fuzzy logic to managerial decision-making processes in areas such as fuzzy-based portfolio management, recommender systems, performance assessment and risk analysis, among others. Presenting the latest research, with a strong focus on applications and case studies, it is a valuable resource for researchers, practitioners, project leaders and managers wanting to apply or improve their fuzzy-based skills.

Fuzzy Logic and Soft Computing contains contributions from world-leading experts from both the academic and industrial communities. The first part of the volume consists of invited papers by international authors describing possibilistic logic in decision analysis, fuzzy dynamic programming in optimization, linguistic modifiers for word computation, and theoretical treatments and applications of fuzzy reasoning. The second part is composed of eleven contributions from Chinese authors focusing on some of the key issues in the fields: stable adaptive fuzzy control systems, partial evaluations and fuzzy reasoning, fuzzy wavelet neural networks, analysis and applications of genetic algorithms, partial repeatability, rough set reduction for data enriching, limits of agents in process calculus, medium logic and its evolution, and factor spaces canes. These contributions are not only theoretically sound and well-formulated, but are also coupled with applicability implications and/or implementation treatments. The domains of applications realized or implied are: decision analysis, word computation, databases and knowledge discovery, power systems, control systems, and multi-destinational routing. Furthermore, the articles contain materials that are an outgrowth of recently conducted research, addressing fundamental and important issues of fuzzy logic and soft computing.

The primary purpose of this book is to present information about selected topics on the interactions and applications of fuzzy + neural. Most of the discussion centers around our own research in these areas. Fuzzy + neural can mean many things: (1) approximations between fuzzy systems and neu ral nets (Chapter 4); (2) building hybrid neural nets to equal fuzzy systems (Chapter 5); (3) using neura.l nets to solve fuzzy problems (Chapter 6); (4) approximations between fuzzy neural nets and other fuzzy systems (Chap ter 8); (5) constructing hybrid fuzzy neural nets for certain fuzzy systems (Chapters 9, 10); or (6) computing with words (Chapter 11). This book is not intend to be used primarily as a text book for a course in fuzzy + neural because we have not included problems at the end of each chapter, we have omitted most proofs (given in the references), and we have given very few references. We wanted to keep the mathematical prerequisites to a minimum so all longer, involved, proofs were omitted. Elementary dif ferential calculus is the only prerequisite needed since we do mention partial derivatives once or twice.

This book comprises papers on diverse aspects of fuzzy logic, neural networks, and nature-inspired optimization meta-heuristics and their application in various areas such as intelligent control and robotics, pattern recognition, medical diagnosis, time series prediction and optimization of complex problems. The book is organized into seven main parts, each with a collection of papers on a similar subject. The first part presents new concepts and algorithms based on type-2 fuzzy logic for dynamic parameter adaptation in meta-heuristics. The second part discusses network theory and applications, and includes papers describing applications of neural networks in diverse areas, such as time series prediction and pattern recognition. The third part addresses the theory and practice of meta-heuristics in different areas of application, while the fourth part describes diverse fuzzy logic applications in the control area, which can be considered as intelligent controllers. The next two parts explore applications in areas, such as time series prediction, and pattern recognition and new optimization and evolutionary algorithms and their applications respectively. Lastly, the seventh part addresses the design and application of different hybrid intelligent systems.

Uncertainty has been of concern to engineers, managers and . scientists for many centuries. In management sciences there have existed definitions of uncertainty in a rather narrow sense since the beginning of this century. In engineering and uncertainty has for a long time been

considered as in sciences, however, synonymous with random, stochastic, statistic, or probabilistic. Only since the early sixties views on uncertainty have ~ecome more heterogeneous and more tools to model uncertainty than statistics have been proposed by several scientists. The problem of modeling uncertainty adequately has become more important the more complex systems have become, the faster the scientific and engineering world develops, and the more important, but also more difficult, forecasting of future states of systems have become. The first question one should probably ask is whether uncertainty is a phenomenon, a feature of real world systems, a state of mind or a label for a situation in which a human being wants to make statements about phenomena, i. e. , reality, models, and theories, respectively. One cart also ask whether uncertainty is an objective fact or just a subjective impression which is closely related to individual persons. Whether uncertainty is an objective feature of physical real systems seems to be a philosophical question. This shall not be answered in this volume.

Fuzzy Logic: State of the Art covers a wide range of both theory and applications of fuzzy sets, ranging from mathematical basics, through artificial intelligence, computer management and systems science to engineering applications. Fuzzy Logic will be of interest to researchers working in fuzzy set theory and its applications.

This book is an excellent starting point for any curriculum in fuzzy systems fields such as computer science, mathematics, business/economics and engineering. It covers the basics leading to: fuzzy clustering, fuzzy pattern recognition, fuzzy database, fuzzy image processing, soft computing, fuzzy applications in operations research, fuzzy decision making, fuzzy rule based systems, fuzzy systems modeling, fuzzy mathematics. It is not a book designed for researchers - it is where you really learn the "basics" needed for any of the above-mentioned applications. It includes many figures and problem sets at the end of sections.