

Multiobjective Optimization Interactive And Evolutionary Approaches Lecture Notes In Computer Science Theoretical Computer Science And General Issues

Many kinds of practical problems such as engineering design, industrial management and financial investment have multiple objectives conflicting with each other. Those problems can be formulated as multiobjective optimization. In multiobjective optimization, there does not necessarily a unique solution which minimizes (or maximizes) all objective functions. We usually face to the situation in which if we want to improve some of objectives, we have to give up other objectives. Finally, we pay much attention on how much to improve some of objectives and instead how much to give up others. This is called "trade-off." Note that making trade-off is a problem of value judgment of decision makers. One of main themes of multiobjective optimization is how to incorporate value judgment of decision makers into decision support systems. There are two major issues in value judgment (1) multiplicity of value judgment and (2) dynamics of value judgment. The multiplicity of value judgment is treated as trade-off analysis in multiobjective optimization. On the other hand, dynamics of value judgment is difficult to treat. However, it is natural that decision makers change their value judgment even in decision making process, because they obtain new information during the process. Therefore, decision support systems are to be robust against the change of value judgment of decision makers. To this aim, interactive programming methods which search a solution while eliciting partial information on value judgment of decision makers have been developed. Those methods are required to perform flexibly for decision makers' attitude.

This book contains state-of-the-art contributions in the field of evolutionary and deterministic methods for design, optimization and control in engineering and sciences. Specialists have written each of the 34 chapters as extended versions of selected papers presented at the International Conference on Evolutionary and Deterministic Methods for Design, Optimization and Control with Applications to Industrial and Societal Problems (EUROGEN 2013). The conference was one of the Thematic Conferences of the European Community on Computational Methods in Applied Sciences (ECCOMAS). Topics treated in the various chapters are classified in the following sections: theoretical and numerical methods and tools for optimization (theoretical methods and tools; numerical methods and tools) and engineering design and societal applications (turbo machinery; structures, materials and civil engineering; aeronautics and astronautics; societal applications; electrical and electronics applications), focused particularly on intelligent systems for multidisciplinary design optimization (mdo) problems based on multi-hybridized software, adjoint-based and one-shot methods, uncertainty quantification and optimization, multidisciplinary design optimization, applications of game theory to industrial optimization problems, applications in structural and civil engineering optimum design and surrogate models

based optimization methods in aerodynamic design.

Optimization in Science and Engineering is dedicated in honor of the 60th birthday of Distinguished Professor Panos M. Pardalos. Pardalos's past and ongoing work has made a significant impact on several theoretical and applied areas in modern optimization. As tribute to the diversity of Dr. Pardalos's work in Optimization, this book comprises a collection of contributions from experts in various fields of this rich and diverse area of science. Topics highlight recent developments and include: Deterministic global optimization Variational inequalities and equilibrium problems Approximation and complexity in numerical optimization Non-smooth optimization Statistical models and data mining Applications of optimization in medicine, energy systems, and complex network analysis This volume will be of great interest to graduate students, researchers, and practitioners, in the fields of optimization and engineering.

In modern science and engineering, laboratory experiments are replaced by high fidelity and computationally expensive simulations. Using such simulations reduces costs and shortens development times but introduces new challenges to design optimization process. Examples of such challenges include limited computational resource for simulation runs, complicated response surface of the simulation inputs-outputs, and etc. Under such difficulties, classical optimization and analysis methods may perform poorly. This motivates the application of computational intelligence methods such as evolutionary algorithms, neural networks and fuzzy logic, which often perform well in such settings. This is the first book to introduce the emerging field of computational intelligence in expensive optimization problems. Topics covered include: dedicated implementations of evolutionary algorithms, neural networks and fuzzy logic. reduction of expensive evaluations (modelling, variable-fidelity, fitness inheritance), frameworks for optimization (model management, complexity control, model selection), parallelization of algorithms (implementation issues on clusters, grids, parallel machines), incorporation of expert systems and human-system interface, single and multiobjective algorithms, data mining and statistical analysis, analysis of real-world cases (such as multidisciplinary design optimization). The edited book provides both theoretical treatments and real-world insights gained by experience, all contributed by leading researchers in the respective fields. As such, it is a comprehensive reference for researchers, practitioners, and advanced-level students interested in both the theory and practice of using computational intelligence for expensive optimization problems.

Catalytic Reactors presents several key aspects of reactor design in Chemical and Process Engineering. Starting with the fundamental science across a broad interdisciplinary field, this graduate level textbook offers a concise overview on reactor and process design for students, scientists and practitioners new to the field. This book aims to collate into a comprehensive and well-informed work of leading researchers from north America, western Europe and south-east Asia. The editor and international experts discuss state-of-the-art applications of multifunctional reactors, biocatalytic

membrane reactors, micro-flow reactors, industrial catalytic reactors, micro trickle bed reactors and multiphase catalytic reactors. The use of catalytic reactor technology is essential for the economic viability of the chemical manufacturing industry. The importance of Chemical and Process Engineering and efficient design of reactors are another focus of the book. Especially the combination of advantages from both catalysis and chemical reaction technology for optimization and intensification as essential factors in the future development of reactors and processes are discussed. Furthermore, options that can drastically influence reaction processes, e.g. choice of catalysts, alternative reaction pathways, mass and heat transfer effects, flow regimes and inherent design of catalytic reactors are reviewed in detail. Focuses on the state-of-the-art applications of catalytic reactors and optimization in the design and operation of industrial catalytic reactors Insights into transfer of knowledge from laboratory science to industry For students and researchers in Chemical and Mechanical Engineering, Chemistry, Industrial Catalysis and practising Engineers

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This book presents a comprehensive documentation of the scientific outcome of 14 satellite events held at the 13th International Conference on Model-Driven Engineering, Languages and Systems, MODELS 2010, held in Oslo, Norway, in October 2010. Besides the 21 revised best papers selected from 12 topically focused workshops, the post-proceedings also covers the doctoral symposium and the educators symposium; each of the 14 satellite events covered is introduced by a summary of the respective organizers. All relevant current aspects in model-based systems design and analysis are addressed. This book is the companion of the MODELS 2010 main conference proceedings LNCS 6394/6395.

This book introduces students on Multiple Criteria Decision Aiding and Making courses to practical, real-world cases.

Each case study introduces a problem or situation together with a method, and a description and explanation of a computer application. In this sense each chapter is based on four pillars: the problem, the model building, the methods and their implementation. The book presents and elaborates a rich and comprehensive set of practical problems comprising multiple criteria, including numerous approaches for their solution, for decision support or decision aid. It complements traditional textbooks and lecture material by employing case studies to promote a deeper understanding of the investigated concepts and help students apply these methods to other areas.

Offering a global snapshot of parallel and distributed computational intelligence today, this volume covers ongoing issues as well as recent exploratory work. Topics discussed include GPUs, Clusters, Grids, volunteer computing, p2p networks and more.

Decision making is an omnipresent, most crucial activity of the human being, and also of virtually all artificial broadly perceived "intelligent" systems that try to mimic human behavior, reasoning and choice processes. It is quite obvious that such a relevance of decision making had triggered vast research effort on its very essence, and attempts to develop tools and techniques which would make it possible to somehow mimic human decision making related acts, even to automate decision making processes that had been so far reserved for the human

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beings. The roots of those attempts at a scientific analysis can be traced to the ancient times but – clearly – they have gained momentum in the recent 50 or 100 years following a general boom in science. Depending on the field of science, decision making can be viewed in different ways. The most general view can be that decision making boils down to some cognitive, mental process(es) that lead to the selection of an option or a course of action among several alternatives. Then, looking in a deeper way, from a psychological perspective this process proceeds in the context of a set of needs, preferences, rational choice of an individual, a group of individuals, or even an organization. From a cognitive perspective, the decision making process proceeds in the context of various interactions with the environment.

This book constitutes the thoroughly refereed proceedings of the Clausthal-Göttingen International Workshop on Simulation Science, held in Göttingen, Germany, in April 2017. The 16 full papers presented were carefully reviewed and selected from 40 submissions. The papers are organized in topical sections on simulation and optimization in networks, simulation of materials, distributed simulations.

Although several books or monographs on multiobjective optimization under uncertainty have been published, there seems to be no book which starts with an introductory chapter of linear programming and is designed to incorporate both fuzziness and randomness into multiobjective programming in a unified way. In this book, five major topics, linear programming, multiobjective programming, fuzzy programming, stochastic programming, and fuzzy stochastic programming, are presented in a comprehensive manner. Especially, the last four topics together comprise the main characteristics of this book, and special stress is placed on interactive decision making aspects of multiobjective programming for human-centered systems in most realistic situations under fuzziness and/or randomness. Organization of each chapter is briefly summarized as follows: Chapter 2 is a concise and condensed description of the theory of linear programming and its algorithms. Chapter 3 discusses fundamental notions and methods of multiobjective linear programming and concludes with interactive multiobjective linear programming. In Chapter 4, starting with clear explanations of fuzzy linear programming and fuzzy multiobjective linear programming, interactive fuzzy multiobjective linear programming is presented. Chapter 5 gives detailed explanations of fundamental notions and methods of stochastic programming including two-stage programming and chance constrained programming. Chapter 6 develops several interactive fuzzy programming approaches to multiobjective stochastic programming problems. Applications to purchase and transportation planning for food retailing are considered in Chapter 7. The book is self-contained because of the three appendices and answers to problems. Appendix A contains a brief summary of the topics from linear algebra. Pertinent results from nonlinear programming are summarized in Appendix B. Appendix C is a clear explanation of the Excel Solver, one of the easiest ways to solve optimization problems, through the use of simple examples of linear and nonlinear programming.

Containing twenty six contributions by experts from all over the world, this book presents both research and review material describing the evolution and recent developments of various pattern recognition methodologies, ranging from statistical, linguistic, fuzzy-set-theoretic, neural, evolutionary computing and rough-set-theoretic to hybrid soft computing, with significant real-life applications. Pattern Recognition and Big Data provides state-of-the-art classical and modern approaches to pattern recognition and mining, with extensive real life applications. The book describes efficient soft and robust machine learning algorithms and granular computing techniques for data mining and knowledge discovery; and the issues associated with handling Big Data. Application domains considered include bioinformatics, cognitive machines (or machine mind developments), biometrics, computer vision, the e-nose, remote sensing and social network analysis.

Multiobjective optimization deals with solving problems having not only one, but multiple, often conflicting, criteria. Based on the International Seminar on Practical Approaches to Multiobjective Optimization, held in Dagstuhl Castle, Germany, in December 2006, this book gives an

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account of the status of research and applications in this field.

A unified view of metaheuristics This book provides a complete background on metaheuristics and shows readers how to design and implement efficient algorithms to solve complex optimization problems across a diverse range of applications, from networking and bioinformatics to engineering design, routing, and scheduling. It presents the main design questions for all families of metaheuristics and clearly illustrates how to implement the algorithms under a software framework to reuse both the design and code. Throughout the book, the key search components of metaheuristics are considered as a toolbox for: Designing efficient metaheuristics (e.g. local search, tabu search, simulated annealing, evolutionary algorithms, particle swarm optimization, scatter search, ant colonies, bee colonies, artificial immune systems) for optimization problems Designing efficient metaheuristics for multi-objective optimization problems Designing hybrid, parallel, and distributed metaheuristics Implementing metaheuristics on sequential and parallel machines Using many case studies and treating design and implementation independently, this book gives readers the skills necessary to solve large-scale optimization problems quickly and efficiently. It is a valuable reference for practicing engineers and researchers from diverse areas dealing with optimization or machine learning; and graduate students in computer science, operations research, control, engineering, business and management, and applied mathematics.

This book constitutes the refereed proceedings of the Third Australasian Conference on Artificial Life and Computational Intelligence, ACALCI 2017, held in Geelong, VIC, Australia, in January/February 2017. The 32 papers presented in this volume were carefully reviewed and selected from 47 submissions. They were organized in topical sections named: artificial life and computational intelligence and optimization algorithms and applications.

The interdisciplinary field of smart digital systems is crucial to modern computer science, encompassing artificial intelligence, information systems and engineering. For over a decade the mission of KES International has been to provide publication opportunities for all those who work in knowledge intensive subjects. The conferences they run worldwide are aimed at facilitating the dissemination, transfer, sharing and brokerage of knowledge in a number of leading edge technologies. This book presents some 80 papers selected after peer review for inclusion in three KES conferences, held as part of the Smart Digital Futures 2014 (SDF-14) multi-theme conference in Chania, Greece, in June 2014. The three conferences are: Intelligent Decision Technologies (KES-IDT-14), Intelligence Interactive Multimedia Systems and Services (KES-IIMSS-14), and Smart Technology-based Education and Training (KES-STET-14). The book will be of interest to all those whose work involves the development and application of intelligent digital systems.

Nature has long provided the inspiration for a variety of scientific discoveries in engineering, biomedicine, and computing, though only recently have these elements of nature been used directly in computational systems. Natural Computing for Simulation and Knowledge Discovery investigates the latest developments in nature-influenced technologies. Within its pages, readers will find an in-depth analysis of such advances as cryptographic solutions based on cell division, the

creation and manipulation of biological computers, and particle swarm optimization techniques. Scientists, practitioners, and students in fields such as computing, mathematics, and molecular science will make use of this essential reference to explore current trends in natural computation and advance nature-inspired technologies to the next generation. This book constitutes the refereed proceedings of the 14th International Conference on Parallel Problem Solving from Nature, PPSN 2016, held in Edinburgh, UK, in September 2016. The total of 93 revised full papers were carefully reviewed and selected from 224 submissions. The meeting began with four workshops which offered an ideal opportunity to explore specific topics in intelligent transportation Workshop, landscape-aware heuristic search, natural computing in scheduling and timetabling, and advances in multi-modal optimization. PPSN XIV also included sixteen free tutorials to give us all the opportunity to learn about new aspects: gray box optimization in theory; theory of evolutionary computation; graph-based and cartesian genetic programming; theory of parallel evolutionary algorithms; promoting diversity in evolutionary optimization: why and how; evolutionary multi-objective optimization; intelligent systems for smart cities; advances on multi-modal optimization; evolutionary computation in cryptography; evolutionary robotics - a practical guide to experiment with real hardware; evolutionary algorithms and hyper-heuristics; a bridge between optimization over manifolds and evolutionary computation; implementing evolutionary algorithms in the cloud; the attainment function approach to performance evaluation in EMO; runtime analysis of evolutionary algorithms: basic introduction; meta-model assisted (evolutionary) optimization. The papers are organized in topical sections on adaption, self-adaption and parameter tuning; differential evolution and swarm intelligence; dynamic, uncertain and constrained environments; genetic programming; multi-objective, many-objective and multi-level optimization; parallel algorithms and hardware issues; real-world applications and modeling; theory; diversity and landscape analysis.

This book presents the proceedings of the 7th International Conference on Frontiers of Intelligent Computing: Theory and Applications (FICTA 2018), held at Duy Tan University, Da Nang, Vietnam. The event brought together researchers, scientists, engineers, and practitioners to exchange new ideas and experiences in the domain of intelligent computing theories with prospective applications in various engineering disciplines. These proceedings are divided into two volumes. Covering broad areas of information and decision sciences, with papers exploring both the theoretical and practical aspects of data-intensive computing, data mining, evolutionary computation, knowledge management and networks, sensor networks, signal processing, wireless networks, protocols and architectures, this volume is a valuable resource for postgraduate students in various engineering disciplines.

The present book includes extended and revised versions of a set of selected papers from the 1st International Conference on Simulation and Modeling Methodologies, Technologies and Applications (SIMULTECH 2011) which was

sponsored by the Institute for Systems and Technologies of Information, Control and Communication (INSTICC) and held in Noordwijkerhout, The Netherlands. SIMULTECH 2011 was technically co-sponsored by the Society for Modeling & Simulation International (SCS), GDR I3, Lionphant Simulation and Simulation Team and held in cooperation with ACM Special Interest Group on Simulation and Modeling (ACM SIGSIM) and the AIS Special Interest Group of Modeling and Simulation (AIS SIGMAS).

Pour assurer une production de biens de qualité, de manière fiable et dans des délais maîtrisés, les organisations ont besoin d'outils d'exécution optimale de tâches tels que l'ordonnancement. Le succès des méthodologies de résolution des problèmes d'ordonnancement de production basées sur les métaheuristiques s'explique par leur capacité à fournir des solutions proches de l'optimum, dans des temps raisonnables. Cet ouvrage se consacre, dans un premier temps, aux métaheuristiques appliquées aux problèmes d'ordonnancement multicritère, qui sont des cas particuliers des problèmes d'optimisation combinatoire multicritère, généralement NP-difficiles. Puis, il s'intéresse aux préoccupations d'ordonnancement dans le secteur du transport qui suscitent également de multiples problèmes d'optimisation. Deux grands domaines d'application se distinguent, celui des systèmes de transport et celui des ressources de transport intervenant dans un atelier.

Following a brief introduction and general review on the development of multi-objective optimization applications in chemical engineering since 2000, the book gives a description of selected multi-objective techniques and then goes on to discuss chemical engineering applications. These applications are from diverse areas within chemical engineering, and are presented in detail. Several exercises are included at the end of many chapters.

These proceedings gather contributions presented at the 2nd International Conference on Applied Operational Research (ICAOR 2010) in Turku, Finland, August 25-27, 2010, published in the series Lecture Notes in Management Science (LNMS). The conference covers all aspects of Operational Research and Management Science (OR/MS) with a particular emphasis on applications.

Multi-criterion optimization refers to optimization problems with two or more objectives expressing conflicting goals that are formulated within a mathematical programming framework. The problems addressed may involve linear or nonlinear objective functions and/or constraints, continuous or discrete variables, and may or may not be affected by uncertainty in the data. This branch of multiple criteria decision making (MCDM) finds application in numerous domains: engineering design, health, transportation, telecommunications, bioinformatics, etc. The concept of a unique optimal solution does not apply as soon as multiple objectives are optimized simultaneously. The models and methods introduced in multi-criterion optimization deal with the concept of a set of efficient (also called Pareto optimal) solutions. Efficient solutions imply trade-offs between the different criteria. The computation of the efficient solution set may be hard when the size of the problem is large, when the problem is computationally complex, when the data are not crisp. It is then often impossible to guarantee the computation of exact

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solutions. In that case, approximate solutions, i. e. , sub-optimal solutions computed with limited and controlled resources, such as available time, are of interest. This is the domain of multi-objective metaheuristics, of which evolutionary multi-criterion optimization (EMO) is definitely the most prominent representative. The success of EMO is due to the simplicity of its concepts and the generality of its methods, and is clearly expressed by the many impressive success stories reported in the literature. Research activities in EMO have boomed since the mid-1990s. Three generations of work are identifiable throughout the years.

This volume presents up-to-date material on the state of the art in evolutionary and deterministic methods for design, optimization and control with applications to industrial and societal problems from Europe, Asia, and America. EUROGEN 2015 was the 11th of a series of International Conferences devoted to bringing together specialists from universities, research institutions and industries developing or applying evolutionary and deterministic methods in design optimization, with emphasis on solving industrial and societal problems. The conference was organised around a number of parallel symposia, regular sessions, and keynote lectures focused on surrogate-based optimization in aerodynamic design, adjoint methods for steady & unsteady optimization, multi-disciplinary design optimization, holistic optimization in marine design, game strategies combined with evolutionary computation, optimization under uncertainty, topology optimization, optimal planning, shape optimization, and production scheduling.

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.

This book describes recent advances on hybrid intelligent systems using soft computing techniques for diverse areas of application, such as intelligent control and robotics, pattern recognition, time series prediction and optimization complex problems. Soft Computing (SC) consists of several intelligent computing paradigms, including fuzzy logic, neural networks and bio-inspired optimization algorithms, 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 type-2 fuzzy logic, which basically consists of papers that propose new models and applications for type-2 fuzzy systems. The second part contains papers with the main theme of bio-inspired optimization algorithms, which are basically papers using nature-inspired techniques to achieve optimization of complex optimization problems in diverse areas of application. The third part contains papers that deal with new models and applications of neural networks in real world problems. The fourth part contains papers with the theme of intelligent optimization methods, which basically consider the proposal of new methods of optimization to solve complex real world optimization problems. The fifth part contains papers with the theme of evolutionary methods and intelligent computing, which are papers considering soft computing methods for applications related to diverse areas, such as natural language processing, recommending systems and optimization.

FLINS, originally an acronym for Fuzzy Logic and Intelligent Technologies in Nuclear Science, is now extended to Computational Intelligence for applied research. The contributions to the 10th of FLINS conference cover state-of-the-art research, development, and technology for computational intelligence systems, both from the foundations and the applications points-of-view.

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This book provides a comprehensive overview of music data analysis, from introductory material to advanced concepts. It covers various applications including transcription and segmentation as well as chord and harmony, instrument and tempo recognition. It also discusses the implementation aspects of music data analysis such as architecture, user interface and hardware. It is ideal for use in university classes with an interest in music data analysis. It also could be used in computer science and statistics as well as musicology.

Computer-aided process engineering (CAPE) plays a key design and operations role in the process industries, from the molecular scale through managing complex manufacturing sites. The research interests cover a wide range of interdisciplinary problems related to the current needs of society and industry. ESCAPE 23 brings together researchers and practitioners of computer-aided process engineering interested in modeling, simulation and optimization, synthesis and design, automation and control, and education. The proceedings present and evaluate emerging as well as established research methods and concepts, as well as industrial case studies. Contributions from the international community using computer-based methods in process engineering Reviews the latest developments in process systems engineering Emphasis on industrial and societal challenges

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.

The three volume set LNCS 7062, LNCS 7063, and LNCS 7064 constitutes the proceedings of the 18th International Conference on Neural Information Processing, ICONIP 2011, held in Shanghai, China, in November 2011. The 262

regular session papers presented were carefully reviewed and selected from numerous submissions. The papers of part I are organized in topical sections on perception, emotion and development, bioinformatics, biologically inspired vision and recognition, bio-medical data analysis, brain signal processing, brain-computer interfaces, brain-like systems, brain-realistic models for learning, memory and embodied cognition, Clifford algebraic neural networks, combining multiple learners, computational advances in bioinformatics, and computational-intelligent human computer interaction. The second volume is structured in topical sections on cybersecurity and data mining workshop, data mining and knowledge discovery, evolutionary design and optimisation, graphical models, human-originated data analysis and implementation, information retrieval, integrating multiple nature-inspired approaches, Kernel methods and support vector machines, and learning and memory. The third volume contains all the contributions connected with multi-agent systems, natural language processing and intelligent Web information processing, neural encoding and decoding, neural network models, neuromorphic hardware and implementations, object recognition, visual perception modelling, and advances in computational intelligence methods based pattern recognition.

Optimization is now essential in the design, planning and operation of chemical and related processes. Although process optimization for multiple objectives was studied in the 1970s and 1980s, it has attracted active research in the last 15 years, spurred by the new and effective techniques for multi-objective optimization (MOO). To capture this renewed interest, this monograph presents recent research in MOO techniques and applications in chemical engineering.

Following a brief introduction and review of MOO applications in chemical engineering since 2000, the book presents selected MOO techniques and many chemical engineering applications in detail. In this second edition, several chapters from the first edition have been updated, one chapter is completely revised and three new chapters have been added. One of the new chapters describes three MS Excel programs useful for MOO of application problems. All the chapters will be of interest to researchers in MOO and/or chemical engineering. Several exercises are included at the end of many chapters, for use by both practicing engineers and students.

The book presents papers from the 6th International Conference on Big Data and Cloud Computing Challenges (ICBCC 2019), held at the University of Missouri, Kansas City, USA, on September 9 and 10, 2019 and organized in collaboration with VIT Chennai. The book includes high-quality, original research on various aspects of big data and cloud computing, offering perspectives from the industrial and research communities on how to address the current challenges in the field. As such it is a valuable reference resource for researchers and practitioners in academia and industry.

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.

This book provides cutting-edge research results and application experiences from researchers and practitioners in multiple criteria decision making areas. It consists of three parts: MCDM Foundation and Theory, MCDM Methodology, and MCDM Applications. In Part I, it covers the historical MCDM development, the influence of MCDM on technology, society and policy, Pareto optimization, and analytical hierarchy process. In Part II, the book presents different MCDM algorithms based on techniques of robust estimating, evolutionary multiobjective optimization, Choquet integrals, and genetic search. In Part III, this book demonstrates a variety of MCDM applications, including project management, financial investment, credit risk analysis, railway transportation, online advertising, transport infrastructure, environmental pollution, chemical industry, and regional economy. The 17 papers of the book have been selected out of the 121 accepted papers at the 20th International Conference on Multiple Criteria Decision Making "New State of MCDM in 21st Century", held at Chengdu, China, in 2009. The 35 contributors of these papers stem from 10 countries.

e-Design is the first book to integrate discussion of computer design tools throughout the design process. Through this book, the reader will understand... Basic design principles and all-digital design paradigms. CAD/CAE/CAM tools available for various design related tasks. How to put an integrated system together to conduct All-Digital Design (ADD). Industrial practices in employing ADD and tools for product development. Provides a comprehensive and thorough coverage on essential elements for practicing all-digital design (ADD) Covers CAD/CAE methods throughout the design process, including solid modelling, performance simulation, reliability, manufacturing, cost estimates and rapid prototyping Discusses CAD/CAE/CAM/RP/CNC tools and data integration for support of the all-digital design process Reviews off-the-shelf tools for support of modelling, simulations, manufacturing, and product data management Provides tutorial type projects using ProENGINEER and SolidWorks for readers to exercise design examples and gain hands-on experience A series of running examples throughout the book illustrate the practical use of the ADD paradigm and tools This book covers the latest theories, applications and techniques in Biologically-Inspired Optimisation Methods. Many chapters derive from studies presented at workshops and international conferences on e-Science, Grid Computing and Evolutionary computation.

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