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Volume 1222

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Lakhmi C. Jain · Marius Mircea Balas ·
Shahnaz N. Shahbazova
Editors

Soft Computing Applications

Proceedings of the 8th International
Workshop Soft Computing Applications
(SOFA 2018), Vol. II

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ISSN 2194-5357

ISSN 2194-5365 (electronic)

Advances in Intelligent Systems and Computing

ISBN 978-3-030-52189-9

ISBN 978-3-030-52190-5 (eBook)

<https://doi.org/10.1007/978-3-030-52190-5>

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The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

These two volumes constitute the Proceedings of the 8th International Workshop on Soft Computing Applications, or SOFA 2018, held on September 13–15, 2018, in Arad, Romania. This edition was organized by Aurel Vlaicu University of Arad, Romania, in conjunction with Institute of Computer Science, Iasi Branch of the Romanian Academy, IEEE Romanian Section, Romanian Society of Control Engineering and Technical Informatics (SRAIT)-Arad Section, General Association of Engineers in Romania-Arad Section and BTM Resources Arad.

Soft computing concept was introduced by Lotfi Zadeh in 1991 and serves to highlight the emergence of computing methodologies in which the accent is on exploiting the tolerance for imprecision and uncertainty to achieve tractability, robustness and low solution cost. Soft computing facilitates the use of fuzzy logic, neurocomputing, evolutionary computing and probabilistic computing in combination, leading to the concept of hybrid intelligent systems.

Combining of such intelligent systems tools and a large number of applications can show the great potential of soft computing in all domains.

The volumes cover a broad spectrum of soft computing techniques, and theoretical and practical applications find solutions for industrial world, economic and medical problems.

The conference papers included in these proceedings, published post conference, were grouped into the following area of research:

- Soft computing and conventional techniques in power engineering methods and applications in electrical engineering
- Modeling, Algorithms. Optimization, reliability and applications
- Machine learning, NLP and applications
- Business process management
- Knowledge-based technologies for Web applications, cloud computing, security algorithms and computer networks, smart city
- Fuzzy applications, theory, expert systems, fuzzy and control
- Biomedical applications
- Image, text and signal processing

- Computational intelligence techniques, machine learning and optimization methods in recent applications
- Methods and applications in engineering and games
- Wireless sensor networks, cloud computing, IoT

In SOFA 2018, we had five eminent keynote speakers: Professor Michio Sugeno (Japan), Professor Oscar Castillo (Mexico), Academician Florin G. Filip (Romania), Professor Valeriu Beiu (Romania) and Professor Jeng-Shyang Pan (China). Their summary talks are included in this book.

We especially thank the honorary chair of SOFA 2018, Prof. Michio Sugeno, who encouraged and motivated us, like to all the other SOFA editions.

A special keynote was presented by Professor Shahnaz Shahbazova (Azerbaijan)–“In memoriam Lotfi A. Zadeh”, dedicated to the renowned founder of fuzzy set theory and in the same time the honorary chair of SOFA conferences, who passed away in September 2017. In fact, the whole conference was dedicated to the memory of Professor Zadeh. We all remembered in our presentations and discussions his great personality and how he influenced our lives.

We are thankful to all the authors who have submitted papers for keeping the quality of the SOFA 2018 conference at high levels. The editors of this book would like to acknowledge all the authors for their contributions and the reviewers. We have received an invaluable help from the members of the International Program Committee and the Chairs responsible for different aspects of the workshop. We also appreciate the role of special sessions' organizers. Thanks to all of them we had been able to collect many papers of interesting topics, and during the workshop, we had remarkably interesting presentations and stimulating discussions.

For their help with organizational issues of all SOFA editions, we express our thanks to TRIVENT Company, Mónika Jetzin and Teodora Artimon for having customized the Software Conference Manager, registration of conference participants and all local arrangements.

Our special thanks go to Janus Kacprzyk (Editor-in-Chief, Springer, *Advances in Intelligent Systems and Computing Series*) for the opportunity to organize this guest edited volume.

We are grateful to Springer, especially to Dr. Thomas Ditzinger (Senior Editor, *Applied Sciences & Engineering Springer-Verlag*), for the excellent collaboration, patience and help during the evolvement of this volume.

We hope that the volumes will provide useful information to professors, researchers and graduated students in the area of soft computing techniques and applications, and all will find this collection of papers inspiring, informative and useful. We also hope to see you at a future SOFA event.

Valentina Emilia Balas
Lakhmi C. Jain
Marius Mircea Balas
Shahnaz N. Shahbazova

Invited Speakers

DSS, Classifications, Trends and Enabling Modern Information and Communication Technologies

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Abstract. A decision support system (DSS) can be defined as an anthropocentric and evolving information system which is meant to implement the functions of a human support system that would otherwise be necessary to help the decision-maker to overcome his/her limits and constraints he/she may encounter when trying to solve complex and complicated decision problems that count (Filip, 2008). The purpose of the talk is to present the impact of modern Information and Communication Technologies (I&CT) on DSS domain with emphasis on the systems that support collaborative decision-making activities. Consequently, the talk is composed of three parts as it follows. In the first part, several basic aspects concerning decisions and decision makers are reviewed in the context of modern business models and process and management automation solutions, including Intelligent Process Automation (IPA), which is meant to liberate the human of “robot-type” operations. The evolution of models of human–automation device systems, from “either/or automation” to “shared and cooperative” control solutions (Flemisch et al. 2012), receives particular attention together with the explanation of causes for wrong decisions (Power, Mitra, 2016). The second part of the talk addresses several aspects concerning the DSS domain such as basic concepts, classifications and evolutions. Several classifications made in accordance with attributes such as purpose, dominant technology, number of users and real-time usage in crisis situations are presented. Collaborative systems (Nof, 2017; Filip et al., 2017) and “mixt knowledge” (Filip, 2008) solutions are described in detail. In the third part of the talk, several I&C technologies, such as big data (Shi, 2015), cloud and mobile computing, and cognitive systems (High, 2012; Tecuci et al. 2016), are presented as viewed from the perspective of their relevance to modern computer-supported collaborative decision making. Two application examples are presented with a view to illustrating the usage of big data, and cloud computing and service-oriented architectures, respectively. A list of concerns and open problems regarding the impact of new I&C technologies on human being’s personal and professional life is eventually evoked. Selected References Filip F.G. (2008) Decision support and control for large-scale systems. *Annual Reviews in Control*, 32(1), p. 62–70. Filip F G, Zamfirescu C B, Ciurea C (2017) *Computer*

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Florin Gheorghe Filip

Brief Bio Sketch: Florin Gheorghe Filip was born on July 25, 1947. He became corresponding member of the Romanian Academy (in 1991, when he was only 44 years old), and at 52 years old (1999) becomes full member in the highest cultural and scientific forum of Romania. For 10 years, during 2000–2010, he was Vice president of the Romanian Academy (the National Academy of Sciences) and in 2010, he was elected President of the 14th Section “Information Science and Technology” of the Academy (re-elected in 2015). He was the managing director of National Institute for R&D in Informatics-ICI (1991–1997). He has been a part-time researcher and member of the Scientific Council of INCE (the Nat. Institute for Economic Researches) of the Academy since 2004. His main scientific interests are optimization and control of complex systems, decision support systems, technology management and foresight, and IT applications in the cultural sector. He authored/coauthored over 300 papers published in international journals (*IFAC J Automatica*, *IFAC J Control Engineering Practice*, *Annual Reviews in Control*, *Computers in Industry*, *System Analysis Modeling Simulation*, *Large Scale Systems*, *Technological and Economical Development of Economy* and so on) and contributed volumes printed by international publishing houses (Pergamon Press, North Holland, Elsevier, Kluwer, Chapman & Hall, etc). He is also the author/coauthor of thirteen monographs (published by Editura Tehnica,

Bucuresti, Hermes-Lavoisier Paris, J. Wiley & Sons, London, Springer) and editor/coeditor of 25 volumes of contributions (published by Editura Academiei Romane, Elsevier Science, Institute of Physics, Melville, USA, IEEE Computer Society, Los Alamitos, USA). He was an IPC member of more than 50 international conferences held in Europe, USA, South America, Asia and Africa and gave plenary papers at scientific conferences held in Brazil, Chile, China, France, Germany, Lithuania, Poland, Portugal, Republic of Moldova, Spain, Sweden, Tunisia and UK. F.G Filip was the chairman of IFAC (International Federation of Automatic Control) Technical Committee “Large Scale Complex Systems” (1991–1997). He is Founder and Editor-in-Chief of Studies in Informatics and Control journal (1991), cofounder and Editor-in-Chief of International Journal of Computers Communications & Control (2006). He has received Doctor Honoris Causa title from “Lucian Blaga” University of Sibiu (2000), “Valahia” University, Targoviste (2007), “Ovidius” University, Constanta (2007), Ecole Centrale de Lille (France) (2007), Technical University “Traian Vuia.” Timisoara (2009), “Agora” University of Oradea (2012), Academy of Economic Studies, Bucharest (2014), University of Pitesti (2017), and “Petrol-Gaz” University of Ploiesti (2017). He is a honorary member of the Academy of Sciences of Republic of Moldova (2007) and Romanian Academy of Technical Sciences (2007). More details can be found at: http://www.academiaromana.ro/sectii/sectia14_informatica/sti_FFilip.htm and <http://univagora.ro/jour/index.php/ijccc/article/view/2960/1125>.

Distorted Statistics based on Choquet Calculus

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Abstract. In this study, we discuss statistics with distorted probabilities by applying Choquet calculus which we call “distorted statistics.” To deal with distorted statistics, we consider distorted probability space on the non-negative real line. A (non-additive) distorted probability is derived from an ordinary additive probability by the monotone transformation with a generator. First, we explore some properties of Choquet integrals of non-negative, continuous and differentiable functions with respect to distorted probabilities. Next, we calculate elementary statistics such as the distorted mean and variance of a random variable for exponential and Gamma distributions. In addition, we introduce the concept of density function for distorted exponential distribution. Further, we deal with Choquet calculus of real-valued functions on the real line and explore their basic properties. Then, we consider distorted probability space on the real line. We also calculate elementary distorted statistics for uniform and normal distributions. Finally, we compare distorted statistics with conventional skew statistics.



Michio Sugeno

Biography: After graduating from the Department of Physics, the University of Tokyo, he worked at a company for three years. Then, he served the Tokyo Institute of Technology as Research Associate, Associate Professor and Professor from 1965 to 2000. After retiring from the Tokyo Institute of Technology, he worked as Laboratory Head at the Brain Science Institute, RIKEN from 2000 to 2005 and then as Distinguished Visiting Professor at Doshisha University from 2005 to 2010. Finally, he worked as Emeritus Researcher at the European Centre for Soft Computing in Spain from 2010 to 2015. He is Emeritus Professor at the Tokyo Institute of Technology. He was

President of the Japan Society for Fuzzy Theory and Systems from 1991 to 1993, and also President of the International Fuzzy Systems Association from 1997 to 1999. He is the first recipient of the IEEE Pioneer Award in Fuzzy Systems with Zadeh in 2000. He also received the 2010 IEEE Frank Rosenblatt Award and Kampéde Fériét Award in 2012.

Overview of QUasi-Affine TRansformation Evolutionary (QUATRE) Algorithm

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Abstract. QUasi-Affine TRansformation Evolutionary (QUATRE) algorithm is a swarm-based algorithm and uses quasi-affine transformation approach for evolution. This talk discusses the relation between QUATRE algorithm and other kinds of swarm-based algorithms including particle swarm optimization (PSO) variants and differential evolution (DE) variants. Several QUATRE variants are described in this talk. Comparisons and contrasts are made among the proposed QUATRE algorithm, state-of-the-art PSO variants and DE variants under several test functions. Experimental results show that the usefulness of the QUATRE algorithm is not only on real-parameter optimization but also on large-scale optimization. Especially QUATRE algorithm can reduce the time complexity and has the excellent performance not only on uni-modal functions, but also on multi-modal functions even on higher-dimensional optimization problems.



Jeng-Shyang Pan

Biography: Jeng-Shyang Pan, Assistant President, Fujian University of Technology Professor, Harbin Institute of Technology Jeng-Shyang Pan, received the B.S. degree in Electronic Engineering from the National Taiwan University of Science and Technology in 1986, the M.S. degree in Communication Engineering from the National Chiao Tung University, Taiwan in 1988, and the PhD degree in Electrical Engineering from the University of Edinburgh, UK, in 1996. Currently, he is Assistant President and Dean of the College of Information Science and Engineering in Fujian University of Technology. He is also Professor in the Harbin Institute of Technology. He has published more than 600 papers in which 250 papers are indexed by SCI,

the H-Index is 41, and the total cited times are more than 7900. He is IET Fellow, UK, and has been Vice Chair of IEEE Tainan Section. He was awarded Gold Prize in the International Micro Mechanisms Contest held in Tokyo, Japan, in 2010. He was also awarded Gold Medal in the Pittsburgh Invention & New Product Exposition (INPEX) in 2010; Gold Medal in the International Exhibition of Geneva Inventions in 2011; and Gold Medal of the IENA, International “Ideas–Inventions–New products”, Nuremberg, Germany. He was offered Thousand Talent Program in China in 2010. He is on the editorial board of Journal of Information Hiding and Multimedia Signal Processing, and Chinese Journal of Electronics. His current research interests include soft computing, robot vision and big data mining.

Nature-Inspired Optimization of Type-2 Fuzzy Logic Controllers

Oscar Castillo

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Abstract. The design of type-2 fuzzy logic systems is a complex task, and in general, achieving an optimal configuration of structure and parameters is time-consuming and rarely found in practice. For this reason, the use of nature-inspired meta-heuristics offers a good hybrid solution to find near-optimal designs of type-2 fuzzy logic systems in real-world applications. Type-2 fuzzy control offers a real challenge because the problems in this area require very efficient and accurate solutions; in particular, this is the case for robotic applications. In this talk, we present a general scheme for optimizing type-2 fuzzy controllers with nature-inspired optimization techniques, like ant colony optimization, the chemical reaction algorithm, bee colony optimization and others.



Oscar Castillo

Biography: Oscar Castillo holds the Doctor in Science degree (Doctor Habilitatus) in Computer Science from the Polish Academy of Sciences (with the Dissertation “Soft Computing and Fractal Theory for Intelligent Manufacturing”). He is Professor of computer science in the Graduate Division, Tijuana Institute of Technology, Tijuana, Mexico. In addition, he is serving as Research Director of Computer Science and Head of the research group on Hybrid Fuzzy Intelligent Systems. Currently, he is President of HAFSA (Hispanic American Fuzzy Systems Association) and Past President of IFSA (International Fuzzy Systems Association). Prof. Castillo is also Chair of the Mexican Chapter of the Computational Intelligence Society (IEEE). He also belongs to the Technical Committee on Fuzzy Systems of IEEE and to the Task Force on “Extensions to Type-1 Fuzzy Systems.” He is

also a member of NAFIPS, IFSA and IEEE. He belongs to the Mexican Research System (SNI Level 3). His research interests are in type-2 fuzzy logic, fuzzy control, neuro-fuzzy and genetic-fuzzy hybrid approaches. He has published over 300 journal papers, 7 authored books, 30 edited books, 200 papers in conference proceedings and more than 300 chapters in edited books, in total more 740 publications according to Scopus and more than 840 according to Research Gate. He has been Guest Editor of several successful special issues in the past, like in the following journals: Applied Soft Computing, Intelligent Systems, Information Sciences, Non-Linear Studies, Fuzzy Sets and Systems, JAMRIS and Engineering Letters. He is currently Associate Editor of the Information Sciences Journal, Applied Soft Computing Journal, Granular Computing Journal and the IEEE Transactions on Fuzzy Systems. Finally, he has been elected IFSA Fellow and MICAII Fellow member last year. He has been recognized as Highly Cited Researcher in 2017 by Clarivate Analytics because of having multiple highly cited papers in Web of Science.

Seeing Is Believing

“It is very easy to answer many of these fundamental biological questions; you just look at the thing!” Richard P. Feynman, “There’s Plenty of Room at the Bottom,” Caltech, December 29, 1959

Valeriu Beiu

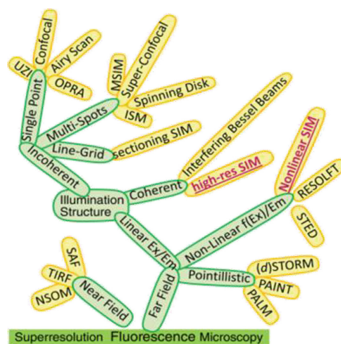
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Abstract. This presentation is geared toward the latest developments in imaging platforms that are able to tackle biological samples. Visualizing living cells, single molecules and even atoms are crucially important, but unfortunately excruciatingly difficult. Still, recent progress reveals that a wide variety of novel imaging techniques have reached maturity. We will recap here the principles behind techniques that allow imaging beyond the diffraction limit and highlight both historical and fresh advances in the field of neuroscience (as a result of such imaging technologies). As an example, single-particle tracking is one of several tools able to study single molecules inside cells and reveal the dynamics of biological processes (receptor trafficking, signaling and cargo transport).

Historically, the first venture outside classical optics was represented by X-ray and electron-based techniques. Out of these, electron microscopy allows higher resolution by far. In time, this has diverged into transmission electron microscopy (TEM), scanning electron microscopy (SEM), reflection electron microscopy (REM) and scanning transmission electron microscopy (STEM), while lately these have started to merge with digital holography (scanning transmission electron holography, atomic-resolution holography and low-energy electron holography). Electron microscopy allows resolutions down to 40pm, while it is not trivial to use such techniques on biological samples. The second departure from classical optics was represented by scanning probe techniques like atomic force microscope (AFM), scanning tunneling microscope (STM), photonic force microscope (PFM) and recurrence tracking microscope (RTM). All of these rely on the physical contact of a solid probe tip which scans the surface of an object (which is supposed to be quite flat). The third attempt has come full circle and is represented by super-resolution microscopy which won the Nobel Prize in 2014.

The presentation will start from basic principles, emphasizing the advantages and disadvantages of different bio-imaging techniques. The development of super-resolution microscopy techniques in the 1990's and 2000's (https://en.wikipedia.org/wiki/Super-resolution_microscopy) has allowed researchers

to image fluorescent molecules at unprecedentedly small scales. This significant boost was properly acknowledged by replacing the term “microscopy” with “nanoscopy” which was coined by Stefan Walter Hell in 2007. It distinguishes novel diffraction-unlimited techniques from conventional approaches, e.g., confocal or wide-field microscopy. An incomplete list includes (among others): binding-activated localization microscopy (BALM), cryogenic optical localization in 3D (COLD), fluctuation-assisted BALM (fBALM), fluorescence photo-activation localization microscopy (FPALM), ground-state depletion microscopy (GSDIM), Light sheet fluorescence microscopy (LSFM), photo-activated localization microscopy (PALM), structured illumination microscopy (SIM), including both linear and nonlinear, stimulated emission depletion (STED), stochastic optical reconstruction microscopy (STORM), single molecule localization microscopy (SMLM), scanning near-field microscopy (SNOM) and total internal reflection fluorescence (TIRF). Obviously, with such improvements in resolving power, new avenues for studying synapses and neurons more generally are being opened, and a few of the latest experiments that highlight unique capabilities will be enumerated, briefly reviewed and compared.



Valeriu Beiu

Biography: VALERIU BEIU (S'92–M'95–SM'96) received the MSc in computer engineering from the University “Politehnica” Bucharest in 1980, and the PhD summa cum laude in electrical engineering from the Katholieke Universiteit Leuven in 1994. Since graduating in 1980, he has been with the Research Institute for Computer Techniques, University “Politehnica” Bucharest, Katholieke Universiteit Leuven, King’s College London, Los Alamos National Laboratory, Rose Research, Washington State University, United Arab Emirates University, and currently is with “Aurel Vlaicu” University of Arad. His research interests have constantly been on biological-inspired nano-circuits and brain-inspired nano-architectures for VLSI-efficient designs

(ultra-low power and highly reliable), being funded at over US\$ 51M. On such topics, he gave over 200 invited talks, organized over 120 conferences, chaired over 60 sessions, has edited two books and has authored over 230 journal/conference articles (30 invited), as well as 8 chapters and 11 patents. Dr. Beiu has received five fellowships and seven best paper awards, and is a senior member of the IEEE as well as a member of: ACM, INNS, ENNS and MCFA. He was a member of the SRC-NNI Working Group on Novel Nano-architectures, the IEEE CS Task Force on Nano-architectures and the IEEE Emerging Technologies Group on Nanoscale Communications, and has been an Associate Editor of the IEEE Transactions on Neural Networks (2005–2008), of the IEEE Transactions for Very Large Scale Integration Systems (2011–2015) and of the Nano Communication Networks (2010–2015).

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