# Advances in Intelligent Systems and Computing

Volume 633

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Valentina Emilia Balas · Lakhmi C. Jain Marius Mircea Balas Editors

# Soft Computing Applications

Proceedings of the 7th International Workshop Soft Computing Applications (SOFA 2016), Volume 1



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 ISSN 2194-5357
 ISSN 2194-5365 (electronic)

 Advances in Intelligent Systems and Computing
 ISBN 978-3-319-62520-1
 ISBN 978-3-319-62521-8 (eBook)

 DOI 10.1007/978-3-319-62521-8
 ISBN 978-3-319-62521-8
 ISBN 978-3-319-62521-8 (eBook)

Library of Congress Control Number: 2017952376

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Printed on acid-free paper

This Springer imprint is published by Springer Nature The registered company is Springer International Publishing AG The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

## Preface

These two volumes constitute the Proceedings of the 7th International Workshop on Soft Computing Applications, or SOFA 2016, which will be held on August 24–26, 2016, in Arad, Romania. This edition was organized by Aurel Vlaicu University of Arad, Romania, University of Belgrade, Serbia, 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, 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:

- Methods and Applications in Electrical Engineering
- Knowledge-Based Technologies for Web Applications, Cloud Computing, Security Algorithms and Computer Networks
- Biomedical Applications
- Image, text and signal processing
- Machine Learning and Applications
- Business Process Management
- Fuzzy Applications, Theory and Fuzzy and Control
- Computational Intelligence in Education

- Soft Computing & Fuzzy Logic in Biometrics (SCFLB)
- Soft Computing Algorithms Applied in Economy, Industry and Communication Technology
- Modelling and Applications in Textiles
- Methods and Applications in Electrical Engineering

In SOFA 2016, we had six eminent keynote speakers: Professor Michio Sugeno (Japan), Professor Anna Esposito (Italy), Professor Mika Sato-Ilic (Japan), Professor Valeriu Beiu (Romania), Professor Salil Bose (USA), Professor Rajeeb Dey (India) and an interesting roundtable of Professor József Dombi (Hungary). Their summaries talks are included in this book.

We especially thank the Honorary Chair of SOFA 2016 Prof. Lotfi A. Zadeh who encouraged and motivated us, like to all the other SOFA editions.

We are thankful to all the authors that have submitted papers for keeping the quality of the SOFA 2016 conference at high levels. The editors of this book would like to acknowledge all the authors for their contributions and also 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 appreciate also 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 very 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 **Keynote Presentations** 

### **Introduction to Choquet Calculus**

Michio Sugeno Tokyo Institute of Technology, Japan

**Abstract.** In this talk, we give a brief introduction to a recent topic "Choquet calculus" where calculus consists of integrals and derivatives.

Modern integrals, namely Lebesgue integrals initiated by Lebesgue in 1902, are associated with the concept of "measures." Lebesgue measures are defined as additive set functions with certain conditions, and hence, Lebesgue integrals hold additivity by inheriting the property of measures. In the latter half of the twentieth century, a new concept of "measures without additivity" named fuzzy measures was proposed by Sugeno in 1974. Fuzzy measures (non-additive measures in general) are defined as monotone set functions and considered as a natural extension of Lebesgue measures leading to the concept of non-additive integrals with respect to non-additive measures, where we note that monotonicity contains additivity in it.

In 1953, Choquet studied the so-called Choquet functionals based on capacities, where capacities representing "potential energy" of a set were also monotone set functions but not captured as "measures" as in the sense of Lebesgue. Together with the appearance of fuzzy measures, Choquet functionals were finally re-formulated as non-additive integrals with respect to fuzzy measures by Höle in 1982. Since then, various non-additive integrals with respect to non-additive measures have been suggested. Among them, we focus on Choquet integrals which are the most general extension of Lebesgue integrals.

Once we obtain the concept of integrals, we become curious about their inverse operations. In the case of Lebesgue integrals, Radon and Nikodym gave Radon-Nikodym derivatives as inverse operations in 1913 and 1930, respectively. It is well-known that with the aid of Radon-Nikodym derivatives, Kolmogorov proved the existence of conditional probabilities in 1933 and thus initiated modern probability theory, where probabilities are nothing but Lebesgue measures. On the other hand in fuzzy measure theory, conditional fuzzy measures have been not well defined in the sense of Kolmogorov. Very recently, inverse operations of Choquet integrals were studied as "derivatives with respect to fuzzy measures" (Sugeno 2013).

In this talk, we deal with Choquet calculus (Sugeno 2015) based on Choquet integrals and derivatives. So far, most studies on Choquet integrals have been devoted to a discrete case. In Choquet calculus, we deal with continuous Choquet integrals and derivatives as well. First, we show how to calculate continuous Choquet integrals. To this aim, we consider distorted Lebesgue measures as a special class of fuzzy measures, and nonnegative and non-decreasing functions. The Laplace transformation is used as a basic tool for calculations. Distorted Lebesgue measures are obtained by monotone transformations of Lebesgue measures according to the idea of distorted probabilities suggested by Edwards in 1953. We remember that Kahneman was awarded Nobel Prize in Economics in 2002, where his cumulative prospect theory is based on "Choquet integrals with respect to distorted probabilities." Next, we define

derivatives of functions with respect to distorted Lebesgue measures, where the derivatives correspond to Radon-Nikodym derivatives in the case of Lebesgue integrals. We also discuss the identification of distorted Lebesgue measures which is a problem arising particularly in Choquet calculus. Then, we show some relations between Choquet calculus and fractional calculus which is recently getting very popular, for example, in control theory. Also, we consider differential equations with respect to distorted Lebesgue measures and give their solutions. Lastly, we present the concept of conditional distorted Lebesgue measures defined with the aid of Radon-Nikodym-like derivatives.

### **Biography**



Michio Sugeno was born in Yokohama, Japan, in 1940. After graduating from the Department of Physics, the University of Tokyo, he worked at Mitsubishi Atomic Power Industry. 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 Distinguished Visiting Professor at Doshisha University from 2005 to 2010 and then Emeritus Researcher at the European Centre for Soft

Computing, 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 Kampét de Feriét Award in 2012.

His research interests are Choquet calculus, fuzzy measure theory, nonlinear control, and preference theory, applications of systemic functional linguistics and language functions of the brain.

## **Emotional Facial Expressions: Communicative Displays or Psychological Universals?**

Anna Esposito Department of Psychology, and IIASS, Seconda Università di Napoli, Italy iiass.annaesp@tin.it; anna.esposito@unina2.it http://www.iiassvietri.it/anna.html

**Abstract.** Emotional feelings permeate our everyday experience, consciously or unconsciously, driving our daily activities and constraining our perception, actions, and reactions.

During daily interactions, our ability to decode emotional expressions plays a vital role in creating social linkages, producing cultural exchanges, influencing relationships, and communicating meanings.

Emotional information is transmitted through verbal (the semantic content of a message) and nonverbal (facial, vocal, gestural expressions, and more) communicative tools and relations and exchanges are highly affected by the way this information is coded/decoded by/from the addresser/addressee.

The accuracy above the chance in decoding facial emotional expressions suggested they can play the role of psychological universals. However, this idea is debated by data suggesting that they play the role of social messages dependent upon context and personal motives.

These open questions are discussed in this talk, at the light of experimental data obtained from several experiments aimed to assess the role of context on the decoding of emotional facial expressions. The reported data support more the idea that facial expressions of emotions are learned to efficiently and effectively express intentions and negotiate relations, even though particular emotional aspects show similarities across cultural boundaries.

Research devoted to the understanding of the perceptual and cognitive processes involved in the decoding of emotional states during interactional exchanges is particularly relevant in the field of Human-Human, Human-Computer Interaction and Robotics, for building and hardenind human relationships, and developing friendly, emotionally, and socially believable assistive technologies.

### **Biography**

Anna Esposito received her "Laurea Degree" summa cum laude in Information Technology and Computer Science from the Università di Salerno in 1989 with a thesis on: The Behavior and Learning of a Deterministic Neural Net (published on Complex System, vol 6(6), 507–517, 992). She received her PhD Degree in Applied Mathematics and Computer Science from the Università di Napoli,



"Federico II" in 1995. Her PhD thesis was on: Vowel Height and Consonantal Voicing Effects: Data from Italian (published on Phonetica, vol 59(4), 197–231, 2002) and was developed at Massachusetts Institute of Technology (MIT), Research Laboratory of Electronics (RLE), under the supervision of Professor Kenneth N Stevens.

She has been a Postdoc at the International Institute for Advanced Scientific Studies (IIASS), and Assistant Professor at the Department of Physics at the Università di Salerno (Italy), where she taught courses on cybernetics, neural networks, and speech processing (1996–

2000). She had a position as Research Professor (2000–2002) at the Department of Computer Science and Engineering at Wright State University (WSU), Dayton, OH, USA. She is currently associated with WSU as Research Affiliate.

Anna is currently working as an Associate Professor in Computer Science at the Department of Psychology, Seconda Università di Napoli (SUN). Her teaching responsibilities include cognitive and algorithmic issues of multimodal communication, human–machine interaction, cognitive economy, and decision making. She authored 160+ peer-reviewed publications in international journals, books, and conference proceedings. She edited/co-edited 21 books and conference proceedings with Italian, EU, and overseas colleagues.

Anna has been the Italian Management Committee Member of:

- COST 277: Nonlinear Speech Processing, http://www.cost.esf.org/domains\_ actions/ict/Actions/277 (2001–2005)
- COST MUMIA: Multilingual and Multifaceted Interactive information Access,
- www.cost.esf.org/domains\_actions/ict/Actions/IC1002 (2010–2014)
- COST TIMELY: Time in Mental Activity, www.timely-cost.eu (2010–2014)
- She has been the proposer and chair of COST 2102: Cross Modal Analysis of Verbal and Nonverbal Communication, http://www.cost.esf.org/domains\_actions/ict/Actions/2102 (2006–2010).

Since 2006, she is a Member of the European Network for the Advancement of Artificial Cognitive Systems, Interaction and Robotics (www.eucognition.org);

She is currently the Italian Management Committee Member of ISCH COST Action IS1406:

Enhancing children's oral language skills across Europe and beyond (http://www.cost.eu/COST\_Actions/isch/Actions/IS1406)

Anna's research activities are on the following three principal lines of investigations:

- 1998 to date: Cross-modal analysis of speech, gesture, facial and vocal expressions of emotions. Timing perception in language tasks.
- 1995 to date: Emotional and social believable Human-Computer Interaction (HCI).
- 1989 to date: Neural Networks: learning algorithm, models and applications.

### Soft Data Analysis Based on Cluster Scaling

Mika Sato-Ilic University of Tsukuba, Japan mika@risk.tsukuba.ac.jp

**Abstract.** There is a growing need to analyze today's vast and complex societal data; however, conventional data analysis that is dependent on statistical methods cannot deal with the frequently complex data types that make up this data. As early as 2000, the following six challenges were reported as important future challenges in the core area statistical research in the twenty-first century. The six challenges pointed out are (1) scales of data, (2) data reduction and compression, (3) machine learning and neural networks, (4) multivariate analysis for large p, small n (high dimension low sample size data), (5) Bayes and biased estimation, and (6) middle ground between proof and computational experiment.

Soft data analysis which is soft computing-based multivariate analysis is the core area in which to combine conventional statistical methods and machine learning or data mining methods, and has a strong capability to solve the statistical challenges in the twenty-first century. In soft data analysis, we have developed cluster-scaled models which use the obtained cluster as the latent scale for explaining data. While the original scale does not have the capacity to work as the scale for complex data, a scale that is extracted from the data itself will have the capability to deal with the vast and complex data.

This presentation outlines the problems and challenging issues of statistical data analysis caused by the new vast and complex data, how our cluster-scaled models are related with these issues, and how the models solve the problems with some applications.

### Biography



Prof. Mika Sato-Ilic currently holds the position of Professor in the Faculty of Engineering, Information and Systems, at the University of Tsukuba, Japan. She is the founding Editor in Chief of the International Journal of Knowledge Engineering and Soft Data Paradigms, Associate Editor of Neurocomputing, Associate Editor of Information Sciences, Regional Editor of International Journal on Intelligent Decision Technologies, and Associate Editor of the International Journal of Innovative Computing, Information and Control Express Letters, as well asserving on the editorial board of several other journals.In addition, she was a Council of the International Association for Statistical Computing (a Section of the International Statistical Institute), a Senior Member of the IEEE, where she held several positions including the Vice-Chair of the Fuzzy Systems Technical Committee of the IEEE Computational Intelligence Society. In addition, she has served on several IEEE committees including the administration committee, program co-chair, and special sessions co-chair. Her academic output includes four books, 10 chapters, and over 120 journal and conference papers. Her research interests include the development of methods for data mining, multidimensional data analysis, multimode multiway data theory, pattern classification, and computational intelligence techniques for which she has received several academic awards.

# Why the Brain Can and the Computer Can't Biology Versus Silicon

Valeriu Beiu Universitatea "Aurel Vlaicu" din Arad, Romania valeriu.beiu@uav.ro

**Abstract.** This presentation aims to follow on von Neumann's prescient "*The Computer and the Brain*" (Yale Univ. Press, 1958) and—relying on the latest discoveries—to explain how the Brain achieves ultra-low power and outstandingly high reliability (nano-)computing, while our silicon-based computers cannot. The tale will be reversed as starting from the brain, and in particular from very fresh experimental results, for information processing and communication.

We shall proceed from the gated ion channels which are the nano-switches of the brain. Understanding the ways, ion channels communicate will allow analyzing the statistical behaviors of arrays of gated ion channels. These will be followed by unexpected results showing that highly reliable communication using arrays of absolutely random devices is possible at amazingly small redundancy factors (<10). For computations, we will make the case for interweaving arrays of ion channels acting as distributed amplifiers, and for adapting the classical Kirchhoff current law to active (*i.e.*, "amplified") electrodiffusion. Afterward, we shall touch upon the ultra-low power/energy consumption, where we will stress the crucial role played by hydrated ions, the very fast ion channels, and the much slower ion pumps, as well as how these behave in extremely crammed spaces. Finally, moving only briefly to the next higher level, the computational power of columnar structures will be explored in the context of large fan-in cyclic circuits.

The information conveyed will expose the reasons why our current silicon-based approaches are falling short of doing what the brain is able to do, and also reveal a stringent need for new and more accurate computational models. As quite a few issues are still being investigated, we will conclude with a call-to-arms for both the computing and the VLSI/nano-communities.

### 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-/neural-inspired circuits and brain-inspired architectures (low-power, highly reliable, massively parallel), being funded at over US\$ 40M, and publishing over 250 papers (over 40 invited and more than 10 patents) as well as giving over 190 invited talks, organizing over 100 conferences and working (unfortunately very slowly) on two books: *Emerging Brain-Inspired Nano-Architectures* and *VLSI Complexity of Discrete Neural Networks*.

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) and of the *IEEE Transactions for Very Large Scale Integration Systems* (2011–2015), while being an Associate Editor of the *Nano Communication Networks* (since 2010).

### **Online Course: A Modern Trend of Teaching and Learning**

Salil Bose Fellow of the Royal Society of Biology, UK boses1940@gmail.com

**Abstract.** As academics, we have dual responsibilities—doing research and teaching. We know how difficult, if not impossible, it is to do the one to our fullest satisfaction without compromising with the other. My presentation is focused on teaching—how we can make teaching (more) effective and at the same time make more time and energy available for research. Thanks to modern Internet technology, a new online avenue of teaching and learning shows promising potential to reach these goals. Online pedagogical methodologies are now globally either complementing or replacing in-class teaching.

An **online course** is basically a course that is offered in part or wholly via the Internet. The most important infrastructural component of online course is the LMS (Learning Management System) software. The LMS is the online environment which enables the learning to happen. It is the platform, where the **teacher creates a course** and the students can interact with the course content in a dynamic manner. Online courses include means for the students to contact their professor and access most course materials, including online readings, videos, audio files, and other resources. This is also where students go to participate in discussion boards to exchange views with fellow classmates, and the instructor can monitor and comment on their discussion. Depending on the versatility of LMS, students can also e-mail and instantly message their classmates and instructors.

My objective is to describe how an LMS can be used to create a course. Currently, many learning management systems are available with varying capabilities, costs, and conveniences; research is ongoing in developing more with varying features. In this presentation, as a case study, I will describe one LMS, more specifically known as LCMS (learning content management system) with brand name Drona (http://drona.netimaginelearning.com/), which has several unique user-friendly features.

Animation is an elegant component of online courses especially to illustrate and explain complex functions and abstract concepts of a phenomenon. However, creating a "real-life" animation with sufficient details of structure and function is a highly skilled job. In this presentation, I will also show an animation of a biological molecular machine (DNA replication in eukaryotic cells) to demonstrate how the potential of online courses can be harnessed to illustrate highly complex biological phenomena in a dynamic and three-dimensional matter overcoming the barrier of distance.

### Biography



Salil Bose obtained his PhD from the University of Rochester, New York, in 1975. His thesis was on energy transduction in photosynthetic processes. After completing postdoctoral training in Brookhaven National Laboratories in Long Island and University in Illinois at Urbana-Campaign, he taught and conducted research on bioenergetics at two universities including Jawaharlal Nehru University, where he served as Professor and Chairman of the Center for Biotechnology. Prof Bose worked for eleven years as a Senior Scientist in National Institutes of Health (NIH) in USA doing research on fast kinetics of proton (H<sup>+</sup>) transduction in bacteriorhodopsin

photocycle, fast kinetics of electron transfer in cytochrome oxidase, and regulation of oxidative phosphorylation in mitochondria by monitoring electron transfer kinetics and changes in transmembrane electrical potential. Prof Bose has published over 100 research papers.

Professor Bose served Nanyang Technological University (NTU) in Singapore for thirteen years, initially as visiting professor and later as senior education consultant. He was involved in advising PhD students, and developing and teaching interdisciplinary courses at various levels—undergraduate to PhD. He initiated the development of online courses at NTU and conducted research in developing effective online assessment methodology. He also served the NTU School of Computer Science as an adjunct professor to teach systems biology to the master's students in bioinformatics.

For many years, Professor Bose has been working as the Editor in Chief of a Canadian journal, *International Journal of Biology* published by the Canadian Center of Science and Education (www.ccsenet.org) and as a member of the international advisory board of a British journal, *Journal of Biological Education* published by the Society of Biology (www.societyofbiology.org/).

Invited as a visiting scientist/professor, Professor Bose has contributed to research and teaching at many reputed institutions such as Kyungpook National University in South Korea, Washington University at St. Louis USA, Imperial College of Science & Technology London, Carnegie Institution of Washington at Stanford University, University of California at Berkeley, and Michigan State University at East Lansing, USA.

Professor Bose is an elected Fellow of the Royal Society of Biology, UK.

## **Complex Dynamical System: Analysis and Control via Linear Matrix Inequality (LMI) Techniques**

Rajeeb Dey National Institute of Technology Silchar, India rajeeb.iitkgp@gmail.com

**Abstract.** To analyze/predict the behavior of system at a future time is always a topic of interest not only in engineering or physics but also in every subject (like economics, pschycology, finance), and thus, it is a topic of research to systems and control community too. For understanding the behavior of a system, one needs to have a dynamical model, but modeling should be such that it must predict more realistic nature/behavior without many complications in the models too. More complex is the model more complex will be the mathematical framework for carrying out the analysis and further control synthesis of the system under study. Thus, there is always a trade-off between the complexity of the model of the system and framework of analysis.

In this talk, few important features of the systems will be considered to create a model of the complex dynamical system in an attempt to obtain/predict more realistic situation of the response. One such feature is delays in the system dynamics along with consideration of parametric uncertainties, hard and smooth nonlinearities, thereby making the system model more realistic but bit more complexes. The modeling is oriented in such a way that analytical framework remains easier, tractable, and further control development becomes straightforward. Thus, this talk will cover comprehensive analysis and control design for such system using established LMI (linear matrix inequality) approach.

This talk will further focus on solution of certain interesting complex systems from electric power networks, biomedical engineering, fuzzy and neural network dynamical systems as case studies.

### **Biography**



B.Tech Raieeb Dev received his (Electrical Engineering) from North Eastern Regional Institute of Science & Technology (NERIST), Itanagar, India, in 2001, M.Tech in Control System Engineering from Indian Institute of Technology (I.I.T) Kharagpur, India, in 2007, and PhD in Control Engineering from Jadavpur University, Kolkata, India, in 2012. He has been awarded National Associateship by Department of Bio-Technology, Govt. of India, to work on control aspect of Artificial Pancreas in Indian Institute of Science, Bangalore in 2013. In 2014, he was been awarded TWAS-CONACYT postdoctorate fellowship by TWAS (The World Academy of Science), Italy, to work on complex dynamical systems at CINVESTAV-IPN, Mexico City. He received AICTE (Govt. of India) funded research project for implementation of output delay feedback control for gantry crane problem in 2009 and in 2010 students working on this project has been awarded best undergraduate project in India by Indian National Academy of Engineers (INAE).

Dr. Dey holds a permanent position as Assistant Professor in Electrical Engineering in National Institute of Technology, Silchar, India. He has around 13 years experience of teaching undergraduate as well as postgraduate students and has guided one PhD and several master's thesis in the area of control system engineering. Dr. Dey has around 30 research publications in reputed international journals and conferences. He is a regular reviewer of over 15 SCI (E) journals related to applied mathematics and control engineering and also Editor of International Journal of Artificial Intelligence Paradigm (Inderscience Publishers).

His research interest includes robust control, control using LMI techniques, time-delay systems, intelligent control, control applications in biomedical engineering. He is a Senior Member of IEEE Control System Society, Member of SIAM, and Life Member of System Society of India. He is currently executive committee member of IEEE CSIM (Control system, Instrumentation and Measurement) Kolkata Chapter, India, and held the position of publication chair for First IEEE CMI 2016.

### **Theory and Practice of Business Intelligence**

Mihaela I. Muntean West University of Timişoara, Romania mihaela.muntean@e-uvt.ro

Abstract. Based on a selective literature review and some of the author's recent papers, a unifying theoretical approach of the most relevant business intelligence (BI)-specific concepts will be introduced. Business Intelligence is an umbrella term for various business managing approaches based on well-informed decisions, which lead to a high-performance level within organizations (Brohman, D.K., 2000; McKnigts, W., 2004; Melfert, F., Winter, R., Klesse, M., 2004; Mukles, Z., 2009; Hatch D., Lock M., 2009; Borysowich, C., 2010; Jamaludin, I. A., Mansor, Z., 2011; Mircea M. (ed.), 2012). Eleven definitions describing the actual BI phenomena are subject of the debate. In terms of a value proposition, the From-Data-To-Performance value chain is designed (Muntean, M., 2012), phases like business analysis, enterprise reporting, and performance management represent a series of activities that create and build value. Key forces like cloud, mobile, social and big data enrich the BI framework and contribute to the diversity of the BI phenomena. Based on the fact that most of the data (80% of the data) stored in corporate databases have a spatial component, a business intelligence approach for spatial enablement is recommended to be developed (Muntean, M., Cabau, L., 2012). Despite the importance of the technological dimension of the BI approaches, the business process model is determinant for any initiative (Muntean, M., Muntean C., Cabău, L., 2013). Considerations regarding business intelligence governance, based on the author's expertise, establish a framework for the BI life cycle and ensure consistent project delivery.

Based on these considerations, some practice examples have been introduced, closing the gap between theory and practice. Data warehouse proposals (Muntean, M., 2016), an innovative use of QR codes in BI reporting (Muntean, M., Mircea, G., Băzăvan, S., 2014), and a feasibility analysis for BI initiatives (Muntean, M., Muntean, C., 2013) are subject of the debate.

### Biography



Currently, Professor Mihaela I. Muntean is the Chair of the Business Information Systems Department at the West University of Timisoara and an IT independent consultant. With a background in computer science and a Ph.D. obtained both in Technical Science and in Economic Science (Economic Informatics), Professor Mihaela I. Muntean focused her research activity on topics like information technology, knowledge management, business intelligence, business information system. Over 70 papers in indexed reviews and conference proceedings and the involvement with success in eight multiannual national research grants/projects are sustaining her contributions in the research fields mentioned above.

# **Round Table**

### The Theory of Fuzzy Sets and Its Real-World Applications

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**Abstract.** The SOFA workshop focuses on theoretical and applied computational intelligence and informatics. Its aim is to provide a platform for scientists, researchers, and students on soft computing to publish to discuss and publish the results of their research.

The connection of the theoretical results and the practical applications is one of the most important tasks of the workshop. In the roundtable meeting, we will discuss how different operators could be applied in practice, first of all by using the fuzzy control systems. In this area, several problems arise:

- describing the logical expression (using different operators)
- representing the consequent
- aggregating the consequents
- defuzzification
- interpolative solutions, etc.

The fuzzy control can also be represented by neural network. A very interesting question is how to handle this approach. Finally, real practical application shows the effectiveness of the different configurations of fuzzy control. We can also mention that the input of the fuzzy control can be obtained from picture processing procedure or from other resources (e.g., using signal processing).

In summary, the topic of the roundtable discussion covers the theory of fuzzy sets and its real-world applications.

### **Biography**



József Dombi's degrees earned at University of Szeged. Academic degrees: University doctor's degree (1977, Summa cum laude), Candidate mathematical sciences (1994, CSc, Title of dissertation: Fuzzy sets' structure from the aspect of multicriteria decision aid.). Visiting positions: Leningrad (1971, 6 months), Leipzig (1974, 6 months), Bukarest (1978, 1 month), DAAD Scholarship, Aachen (1978, 12 months), Alexander von Humboldt Scholarship, Aachen (1986, 12 months), European Scholarship, Bristol (1987, 3 months), Academic research exchange (Paris, Helsinki, Turku, Tampere), CEEPUS guest professor, Linz (2000 and 2009, 1 month), and Klagenfurt (2008, 1 month). Awards: 1991 Minister of Education award, 1997 Pro Sciencia award for student, 1998 László Kalmár award, in 1997, DataScope won Information Technology award in Brussels, won the Best Software of the Year award in 2000 at COMDEX, Las Vegas, Editorial membership: editorial board's member of the Foundations of Computing and Decision Sciences magazine until 1997, editorial board's member of the International Journal of Systems Sciences, and editorial board's member of the International Journal of Advanced Intelligence Paradigms, Membership in international organizations: IFSA (International Fuzzy System Association), Member of European COST Action on Multicriteria Decision Making, ESIGMA (European Special Interest Group on Multicriteria Analysis), European Working Group on Multiple Criteria Decision Aid, MTA Public Body (Operational Research), MOT (Hungarian Association of Operational Research), Hungarian Humboldt Association. Business: 1993 founder and head of Cygron Research Ltd., 2000 scientific consultant of Mindmaker Ltd., 2002 founder and head of Dopti research and development Ltd. Research interest: computational intelligence, theory of fuzzy sets, multicriteria decision making, genetic and evolutional algorithms, operation research and visualization. Teaching: information visualization which has an enormously growing interest in Hungary and abroad, the theory of artificial intelligence, fuzzy systems, multicriteria decision making, and intelligent systems.

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