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ADVANCED TOPICS ON FUZZY SYSTEMS

Published by WSEAS Press
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Proceedings of the 9th WSEAS International Conference on FUZZY SYSTEMS (FS'08)

Honorary Editors:
Janusz Kacprzyk, International Fuzzy Systems Association, POLAND
Lotfi A. Zadeh, Univ. of Berkeley, USA

Editors:
Dimitar P. Dimitrov, Dean of Faculty of Automatics,
Technical University of Sofia, Bulgaria
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Hellenic Naval Academy, Greece

Sofia, Bulgaria, May 2-4, 2008

ISBN: 978-960-6766-57-2
ISSN: 1790-5109

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All papers of the present volume were peer reviewed by two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.
See also: http://www.worldses.org/review/index.html

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Preface

This book contains proceedings of the 9th WSEAS International Conference on FUZZY SYSTEMS (FS'08) which was held in Sofia, Bulgaria, May 2-4, 2008.

The reader can read state-of-the-art academic papers, high quality contributions and some breakthrough works on fuzzy systems theory from all over the world. Nice applications related to European and international industrial projects decorate a truly important panorama not only on fuzzy systems, but also on intelligent systems in general.

We thank the Technical University of Sofia for the sponsorship and the support. This conference aims to disseminate the latest research and applications in the fuzzy systems. The friendliness and openness of the WSEAS conferences, adds to their ability to grow by constantly attracting young researchers. The WSEAS Conferences attract a large number of well-established and leading researchers in various areas of Science and Engineering as you can see from **http://www.wseas.org/reports**. Your feedback encourages the society to go ahead as you can see in **http://www.worldses.org/feedback.htm**

The contents of this Book are also published in the CD-ROM Proceedings of the Conference. Both will be sent to the WSEAS collaborating indices after the conference: **www.worldses.org/indexes**

In addition, papers of this book are permanently available to all the scientific community via the WSEAS E-Library.

Expanded and enhanced versions of papers published in these conference proceedings are also going to be considered for possible publication in one of the WSEAS journals that participate in the major International Scientific Indices (Elsevier, Scopus, EI, ACM, Compendex, INSPEC, CSA .... see: www.worldses.org/indexes) these papers must be of high-quality (break-through work) and a new round of a very strict review will follow. (No additional fee will be required for the publication of the extended version in a journal). WSEAS has also collaboration with several other international publishers and all these excellent papers of this volume could be further improved, could be extended and could be enhanced for possible additional evaluation in one of the editions of these international publishers.

Finally, we cordially thank all the people of WSEAS for their efforts to maintain the high scientific level of conferences, proceedings and journals.

We are sure that this volume will be source of knowledge and inspiration for other academicians, scholars, advisors and industrial practitioners and will be considered as one more brilliant edition of the WSEAS related with a brilliant conference sponsored by Technical University of Sofia.

ADVANCED TOPICS ON FUZZY SYSTEMS

Table of Contents

Plenary Lecture I: From Fuzzy Systems to Fizzy Networks **10**
Alexander Gegov

Plenary Lecture II: Fuzzy Models in Bioinformatics **11**
Tuan D. Pham

Robustness of Systems with Various PI-like Fuzzy Controllers **13**
Snejana Yordanova

Code Evaluation Using Fuzzy Logic **20**
Zikrija Avdagic, Dusanka Boskovic, Aida Delic

Chaotic Time Series Forecasting using Locally Quadratic Fuzzy Neural Models **28**
Mohammad J. Mahjoob, Majid Abdollahzade, Reza Zarringhalam, Ahmad Kalhor

Bellman's Optimality Principle in the Weakly Structurable Dynamic Systems **33**
Gia Sirbiladze, Anna Sikharulidze

Average Misbelief Criterion in the Minimal Fuzzy Covering Problem **42**
Anna Sikharulidze, Gia Sirbiladze

Intuitionistic Fuzzy Concept for Navigation of Mobile Agents in Unknown Environment **49**
Zlatogor Minchev, Dimitar Dimitrov

Design Method for Robust PI-like Process Fuzzy Logic Controller **54**
Snejana Yordanova

Design and Implementation of Real-Time Fuzzy Control for Thermodynamic Plant **61**
Bilyana Tabakova

Multiple-Model Adaptive Control of Hydro Turbine Generator with Fuzzy TS Models **67**
Alexander Ichtev, Teofana Puleva

Parallel Distributed Fuzzy PID Control of Hydro Turbine Generator **73**
Michail Petrov, Albena Taneva, Teofana Puleva, Emil Garipov

Finding face features in color images using fuzzy hit-or-miss transform **79**
Desislava Dimitrova, Antony Popov

Fuzzy Control Approach to Mixed Culture Cultivation for PHB Production Process – Nitrogen Time Profile Synthesis **85**
Petia D. Koprinkova-Hristova

Cancer Classi cation using Kernelized Fuzzy C-means **90**
Vikram Chandramohan, Tuan D. Pham

Fuzzy control applied in prosthetics **100**
Chivu Catrina, Chivu Catalin

The Effects of Fuzzy Forecasting Models on Supply Chain Performance **107**
Hakan Tozan, Ozalp Vayvay

Fuzzy Multisubmeasures and Applications **113**
Alina Gavrilut, Anca Croitoru

From Fuzzy Systems to Fuzzy Networks **120**
Alexander Gegov

Fuzzy Navigation of Robot System **126**
Dimitar Lakov, Stanislav Vasilev

Optimization of Linear Objective Function Under Max-product Fuzzy Relational Constraint **132**
Ketty Peeva, Zlatko Zahariev, Ivajlo Atanasov

Advanced Modelling of Retail Pricing by Fuzzy Networks **138**
Alexander Gegov, Emil Gegov, Philip Treleaven

Fuzzy with LabVIEW Software for Reliability Prediction at Nuclear Complex System (NCS) **144**
Vasile Anghel

Compressed Domain Implementation of Fuzzy Rule-Based Contrast Enhancement **149**
Camelia Popa, Mihaela Gordan, Aurel Vlaicu, Bogdan Orza, Gabriel Oltean

Fuzzy model in urban planning **156**
Jasna Pleho, Zikrija Avdagic

Alternative Methods of Propagating Contradictory Evidence **161**
Chris J Hinde, Robert S Patching, Steve A McCoy

On Intuitionistic Fuzzy Negations and Intuitionistic Fuzzy Modal Operators with Contradictory Evidence **166**
Chris J Hinde, Krassimir T. Atanassov

Fuzzy Measure of Multiple Risk Factors in the Prediction of Osteoporotic Fractures **171**
Tuan D. Pham, Miriam Brandl, Nguyen D. Nguyen, Tuan V. Nguyen

Fuzzy Techniques in Optimization - Based Analog Design **178**
Gabriel Oltean

Fuzzy Joystick Control Algorithm for Telemanipulation Approach **192**
Daniela Gotseva

A Fuzzy Logic System for Performance Tuning of Novell Netware **198**
Khalil Shihab

A Contribution to the Design of Stable Fuzzy Controllers **206**
Dragan Z. Šaletic, Nikos E. Mastorakis

On defuzzyfication functionals in fuzzy number calculus **212**
Witold Kosinski

Flow Shop Scheduling and Its Extension to Fuzzy Processing Times **219**
Milos Šeda

Using Fuzzy and Grey Theory to Improve Green Design in QFD Processes **225**
Chih-Hung Hsu, Tzu-Yuan Lee, Wei-Yin Lu, Jun-Jia Lin, Hai-Fen Lin

Adaptive control with fuzzy logic solution for servo hydraulic linear axis **232**
Claudiu Ioan Ratiuf, Camelia Ioana Ucenic

Vehicle Dynamic Stability Control and Driving Crisis Analysis Using Fuzzy Logic **239**
Alireza Baharizadeh, Mahmood Fathy, Mohsen Davoudi

Author Index **248**

Plenary Lecture I

From Fuzzy Systems to Fuzzy Networks

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Abstract: The lecture will present some novel ideas and results in fuzzy networks – an emerging research area that has been recently pioneered and promoted by the presenter. The most common attribute of a fuzzy system is a 'black box' model in the form of a single large rule base with poor transparency of the rules. As opposed to this, a fuzzy network is characterised by a 'white box' model in the form of multiple smaller rule bases with good transparency of the rules. Also, a fuzzy network is a more accurate model of a complex process than a fuzzy system due to the ability of the multiple smaller rule bases to reflect explicitly all subprocesses and the interactions among them. This superiority in terms of improved transparency and higher accuracy does not come at the expense of reduced efficiency as any fuzzy network can be transformed into an equivalent fuzzy system entirely off-line.

The following topics will be highlighted in the lecture: capabilities of fuzzy logic, fuzzy systems and fuzzy networks to deal with uncertainty, non-linearity and topology in complex systems, problems of fuzzy rule based systems, foundations of fuzzy rule base networks, mathematical modelling of nodes and connections in fuzzy networks by means of Boolean matrices, binary relations, incidence matrices and adjacency matrices, formal operations in fuzzy networks such as horizontal, vertical and output merging and splitting of nodes, structural properties of fuzzy networks such as associativity of horizontal, vertical and output merging and permutability of output splitting, analysis and synthesis of feedforward and feedback fuzzy networks, comparison between fuzzy networks and fuzzy systems in terms of accuracy, efficiency and transparancy, theoretical importance, application areas, future developments and related research for fuzzy networks.

Brief Biography of the Speaker: Alexander Gegov is Senior Lecturer in the School of Computing at the University of Portsmouth. He holds a PhD in Control Systems and a DSc in Intelligent Systems – both from the Bulgarian Academy of Sciences. His research interests are in the theory of computational intelligence and complex systems as well as their application for modelling, simulation and control in areas such as transport networks and the environment. He has published his main research results in complex systems in a number of international journals such as the International Journal of Control and Systems & Control Letters. He is also the sole author of two books – the first one in the Kluwer Series in Intelligent Technologies in 1996 and the second one in the Springer Series in Fuzziness and Soft Computing in 2007. He has been reviewing papers for a number of journals in computational intelligence such as IEEE Transactions on Fuzzy Systems and the International Journal of Fuzzy Sets and Systems as well as research proposals to the Australian Research Council. He was first prize winner for young researchers of the Bulgarian Union of Scientists in 1996, invited lecturer to the NATO Advanced Study Institute on Soft Computing in 1997 and invited presenter at the House of Commons Conference on Promoting Britain's Young Researchers in 2000. He was also tutorial presenter at the IEEE International Conference in Fuzzy Systems in 2007 and invited lecturer at the EPSRC Summer School in Complexity Science in 2007. He has been affiliate of the International Federation of Automatic Control (IFAC) since 1991 and member of the European Society for Fuzzy Logic and Technology (EUSFLAT) since 2001.

Plenary Lecture II

Fuzzy Models in Bioinformatics

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Abstract: Cancer classification using high-throughput mass spectrometry data for early disease detection and prevention has recently become an attractive topic of research in bioinformatics. Recently, several studies have shown that the synergy of proteomic technology and pattern classification techniques is promising for the predictive diagnoses of several cancer diseases. However, the extraction of some effective features that can represent the identities of different classes plays a critical factor for any classification problems involving the analysis of complex data. In this paper we present the concept of a fuzzy fractal dimension that can be utilized as a novel feature of mass spectrometry data. We then applied vector quantization to model the class prototypes using the fuzzy fractal dimensions for classification. Using a simple vector-quantization based classification rule, the overall average classification rates of the proposed approach were found to be superior to some other methods. In bio-imaging classification, we applied vector quantization and Markov modeling methods for cell-phase classification using time-lapse fluorescence microscopic image sequences. However this method is not always effective because cell features are treated with equal weight of importance that may not be always true. We proposed a subspace vector-quantization method to overcome this drawback. The proposed method can automatically weight cell features based on their attribute importance in fuzzy clustering analysis. Two weighting algorithms based on fuzzy c-means and fuzzy entropy clustering were studied, whose performances improved the classification rates.

Brief Biography of the Speaker: Tuan D. Pham is an Associate Professor in the School of Mathematics, Physics, and Information Technology; and Director of the Bioinformatics Applications Research Centre at James Cook University. His research experience and interests are diverse which cover image processing, pattern recognition, signal processing, geostatistics, computational intelligence, bioinformatics, and biomedical informatics. He has contributed pioneering research work on fuzzy finite element analysis of engineering problems; and applications of computational prediction models for disease classification using bioimaging, microarray gene-expression and mass-spectrometry data.
Dr. Pham has published two research books, more than 150 papers in edited books, peer-reviewed journals and conference proceedings. He has served as member of Editorial Board of Pattern Recognition, Bioinformatics and Biomedical Imaging Book Series, Editor-in-Chief of WSEAS Transactions on Biology and Biomedicine, international technical committees of numerous international conferences, and regular reviewer of many high-quality journals in the areas of pattern recognition, machine learning, bioimaging, bioinformatics, neuroscience, biomedical informatics, signal processing, and computational intelligence.

Author Index

Abdollahzade M.	26
Anghel V.	144
Atanasov I.	132
Atanassov K. T.	166
Avdagic Z.	20, 156
Boskovic D.	20
Brandl M.	171
Catalin C.	100
Catrina C.	100
Chandramohan V.	90
Croitoru A.	113
Delic A.	20
Dimitrov D.	49
Dimitrova D.	79
Garipov E.	73
Gavrilut A.	113
Gegov A.	120, 138
Gegov E.	138
Gordan M.	149
Gotseva D.	192
Hinde C. J.	161, 166
Hsu C.	225
Ichtev A.	67
Kalhor A.	26
Koprinkova-Hristova P. D.	85
Kosinski W.	212
Lakov D.	126
Lee T. Y.	225
Lin H. F.	225
Lin J. J.	225
Lu W. Y.	225
Mahjoob M. J.	26
Mastorakis N. E.	206
McCoy S. A.	161
Minchev Z.	49
Nguyen N. D.	171
Nguyen T. V.	171
Nski W. K.	216
Oltean G.	149, 178
Orza B.	149
Patching R. S.	161
Peeva K.	132
Petrov M.	73
Pham T. D.	90, 171
Pleho J.	156
Popa C.	149
Popov A.	79
Puleva T.	67, 73
Ratiu C. I.	232
Šaletic D. Z.	206
Šeda M.	219
Shihab K.	198
Sikharulidze A.	33, 42
Sirbiladze G.	33, 42
Tabakova B.	61
Taneva A.	73
Tozan H.	107
Treleaven P.	138
Ucenic C. I.	232
Vasilev S.	126
Vayvay O.	107
Vlaicu A.	149
Yordanova S.	13, 54
Zahariev Z.	132
Zarringhalam R.	26

978-960-6766-57-2