

Preface

This volume can be viewed from different perspectives. First of all, it is a result of a special project initiated by the editors, and then implemented thanks to an enthusiastic response of the contributors to the invitation to present their new ideas and solutions. The idea of the volume has been a result of, first of all, discussions of the editors between themselves and with the participants at the well-known IEEE Intelligent Systems, IEEE IS, which since 2002 have been a popular venue for the international research community interested in broadly perceived intelligent systems theory and applications. These idea of these conferences was born in Bulgaria in the beginning of the new century and the first IEEE IS conferences were held in 2002, 2004 and 2008 in Varna, Bulgaria, where both the scientific level and a very attractive venue at the Black Sea coast attracted many participants from all over the world. Due to a growing importance of the IEEE ISs, and a growing interest from the international research community, the third and fifth conferences, in 2006 and 2010, were organized in London, UK and the sixth conference, in 2012 was held in Sofia, Bulgaria.

Following the tradition that had existed since the very beginning, that is, since IEEE IS'2002, during the IEEE IS'2012 the International Program Committee again decided to choose the best papers, both from the point of view of their novelty of ideas and tools, and technical content, to be included in a special volume meant as some sort of a summary of the state of the art and new trends in broadly perceived intelligent systems.

This volume has resulted from that decision and careful analyses of both the theoretical and applied contents of the papers and interests of the participants and the entire research community, with an emphasis on, on the one hand, what has been presented in the best papers at the conference, and on the other hand, with some emphasis of what has been proposed by leading Bulgarian scientists and scholars who have inspired many people around the world with new ideas and solutions.

In this short preface, we will briefly summarize the content of the consecutive papers included in the volume, emphasizing novel concepts, and ideas.

Samuel Delepoulle, André Bigand Christophe Renaud and Olivier Colot (Chapter “[Low-Level Image Processing Based on Interval-Valued Fuzzy Sets and Scale-Space Smoothing](#)”) present a new approach for image analysis and restoration based on interval-valued fuzzy sets and scale-space smoothing. To show the effectiveness and efficiency of their solution, two specific and significant image processing applications are considered: no-reference quality evaluation of computer-generated images and speckle noise filtering.

In his paper Dimitar G. Dimitrov (Chapter “[Generalized Net Representation of Dataflow Process Networks](#)”) presents translation rules for mapping from a given dataflow process network to a generalized net which is a novel, highly effective and efficient model of, among others, discrete event processes and systems.

Stefka Fidanova, Miroslav Shindarov and Pencho Marinov (Chapter “[Wireless Sensor Positioning Using ACO Algorithm](#)”) deal with spatially distributed sensors which communicate wirelessly and form a wireless sensor network. The minimization of the number of sensors and energy consumption by the network is then performed using an Ant Colony Optimization (ACO) algorithm.

In the paper by Petia Georgieva, Luis Alberto Paz Suárez and Sebastião Feyo de Azevedo (Chapter “[Time Accounting Artificial Neural Networks for Biochemical Process Models](#)”) the problem of developing more efficient computational schemes for the modeling of biochemical processes is discussed. A theoretical framework for the estimation of process kinetic rates based on different temporal (time accounting) Artificial Neural Network architectures is introduced.

Tomohiro Hara, Tielong Shen, Yasuhiko Mutoh and Yinhua Liu (Chapter “[Periodic Time-Varying Observer-Based Learning Control of A/F Ratio in Multi-cylinder IC Engines](#)”) present an air-fuel ratio control scheme via individual fuel injection for multi-cylinder internal combustion (IC) engines. Their concern is to improve the air-fuel ratio precision by a real-time compensation of the unknown off-set in the fuel path of the individual cylinder, which represents the effect of the cylinder-to-cylinder imbalance caused by the perturbations in each injector gain or disturbances in the dynamics of fuel injection path.

Tatjana Kolemishavska-Gugulovska, Mile Stankovski, Imre J. Rudas, Nan Jiang and Juanwei Jing (Chapter “[Fuzzy T–S Model-Based Design of Min–Max Control for Uncertain Nonlinear Systems](#)”) present an approach to robust control synthesis for uncertain nonlinear systems through the use of the Takagi–Sugeno fuzzy model and fuzzy state observer. The existence conditions the output feedback min-max control in the sense of Lyapunov asymptotic stability are derived, and a convex optimization algorithm is used to obtain the minimum upper bound on the performance and the optimum parameters of mini-max controller. An example of an inverted pendulum is shown and the results are promising.

A novel application of a generalized net is described in the paper by Maciej Krawczak, Sotir Sotirov and Evdokia Sotirova (Chapter “[Modeling Parallel Optimization of the Early Stopping Method of Multilayer Perceptron](#)”) for the parallel optimization of the multilayer perception (MLP) based on an early stopping algorithm.

Paper Jinming Luo and Georgi M. Dimirovski (Chapter “[Intelligent Controls for Switched Fuzzy Systems: Synthesis via Nonstandard Lyapunov Functions](#)”) investigate the synthesis of intelligent control algorithms for switched fuzzy systems by employing non-standard Lyapunov functions and some combined, hybrid techniques. The control plants are assumed to be nonlinear and to be represented by some specific Takagi–Sugeno fuzzy models.

The latest advances in the field of switching adaptive control based on hybrid multiple Takagi–Sugeno (T–S) models are presented in paper by Nikolaos A. Sofianos and Yiannis S. Boutalis (Chapter “[A New Architecture for an Adaptive Switching Controller Based on Hybrid Multiple T-S Models](#)”).

Ketty Peeva (Chapter “[Optimization of Linear Objective Function Under \$\min\$ – Probabilistic Sum Fuzzy Linear Equations Constraint](#)”) presents a method for the solution of a linear optimization problem when the cost function is subject to the constraints given as fuzzy linear systems of equations.

Tania Pencheva and Maria Angelova (Chapter “[Intuitionistic Fuzzy Logic Implementation to Assess Purposeful Model Parameters Genesis](#)”) are concerned with the derivation of intuitionistic fuzzy estimations of model parameters of the process of yeast fed-batch cultivation. Two kinds of simple genetic algorithms with the operator sequence selection-crossover-mutation and mutation-crossover-selection are considered, and both applied for the purposes of parameter identification of *S. cerevisiae* fed-batch cultivation.

Patrick Person, Thierry Galinho, Hadhoum Boukachour, Florence Lecroq and Jean Grieu (Chapter “[Dynamic Representation and Interpretation in a Multiagent 3D Tutoring System](#)”) present an intelligent tutoring system aimed at decreasing the students’ dropout rate by offering a possibility of a personalized follow up. An architecture of an intelligent tutoring system is described and the experimental results of the decision support system used as the core of the intelligent tutor are given.

The dynamics of the upper extremity is modeled in Simeon Ribagin, Vihren Chakarov and Krassimir Atanassov (Chapter “[Generalized Net Model of the Scapulohumeral Rhythm](#)”) as the motion of an open kinematic chain of rigid links, attached relatively loosely to the trunk.

A method for the interpretation of propositional binary logic functions that allows the logical concepts ‘true’ and ‘false’ to be treated as stochastic variables is described in Vassil Sgurev and Vladimir Jotsov (Chapter “[Method for Interpretation of Functions of Propositional Logic by Specific Binary Markov Processes](#)”). Examples are presented and a numerical realization is done by using some functions of propositional logic by binary Markov processes.

Shannon, A.G., B. Riecan, E. Sotirova, K. Atanassov, M. Krawczak, P. Melo-Pinto, R. Parvathi and T. Kim (Chapter “[Generalized Net Models of Academic Promotion and Doctoral Candidature](#)”) propose a new generalized net based model for the analysis of the process of academic promotion through the hierarchy in higher education and the preparation of PhD candidates.

The generalized net model, described in paper “Maria Stefanova-Pavlova, Velin Andonov, Todor Stoyanov, Maia Angelova, Glenda Cook, Barbara Klein, Peter

Vassilev and Elissaveta Stefanova's paper (Chapter "[Modeling Telehealth Services with Generalized Nets](#)"), presents the processes related to the tracking of changes in health status (diabetes) of adult patients. The progress in telecommunications and navigation technologies allow this model to be extended to the case of active and mobile patient.

Yancho Todorov, Margarita Terziyska and Michail Petrov (Chapter "[State-Space Fuzzy-Neural Predictive Control](#)") give a novel view of potentials of the state-space predictive control methodology based on a fuzzy-neural modeling technique and different optimization procedures for process control. The proposed controller methodologies are based on the Fuzzy-Neural State-Space Hammerstein model and variants of Quadratic Programming optimization algorithms.

Vesela Vasileva and Kalin Penev (Chapter "[Free Search and Particle Swarm Optimisation Applied to Global Optimisation Numerical Tests from Two to Hundred Dimensions](#)") investigate two methods of global optimization, Free Search (FS) and Particle Swarm Optimisation (PSO), and show results of some numerical tests on difficult examples. The objective is to identify how to facilitate the evaluation of effectiveness and efficiency of heuristic, evolutionary, adaptive, and other optimisation and search algorithms.

Peter Vassilev (Chapter "[Intuitionistic Fuzzy Sets Generated by Archimedean Metrics and Ultrametrics](#)") investigates a general metric approach for the generation of intuitionistic fuzzy sets, notably the cases when the generation is done by a norm on R^2 and a field norm on Q^2 .

Boriana Vatchova and Alexander Gegov (Chapter "[Production Rule and Network Structure Models for Knowledge Extraction from Complex Processes Under Uncertainty](#)") consider processes with many inputs, some of which are measurable, and many outputs from different application areas, and in which uncertainty plays a key role.

We wish to thank all the contributors to this volume. We hope that their papers, which constitute a synergistic combination of foundational and application oriented works, including relevant real world implementations, will be interesting and useful for a large audience interested in broadly perceived intelligent systems.

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