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GUEST EDITORIAL

Intelligent systems

This Special Issue of the *International Journal of General Systems* has been inspired by the presentations of the Fourth International IEEE Conference on Intelligent Systems (IEEE IS'08), which took place from 6–8 September 2008 in Varna, Bulgaria. The conference has been organised since 2002, and ever since has kept its traditions of focusing on contemporary intelligent systems as an integral concept that highlights several factors. Among others, it bridges theoretical research with applications in automation, information technologies and measurements. Interest in intelligent systems has widely increased in the last two decades. Vivid examples of that interest are numerous intelligent system-oriented scientific events and journals, as well as the fast-growing worldwide societies such as the IEEE Computational Intelligence Society, International Neural Networks Society, and International Fuzzy Systems Association, amongst others.

Recent research trends increasingly attempt to interpret intelligence as a computational phenomenon, and treat intelligent systems as multi-resolutional systems of knowledge (Albus and Meystel 2001). The achievements in fuzzy sets and logics, neural networks, machine learning, evolutionary computation, game theory and operations research, nature-inspired knowledge bases, approximate reasoning and other fields might be considered as important contributions to intelligent systems. Yet, the focus of researchers is on the attempt to find a unified framework that ties together these areas of knowledge, and its application to all kinds of machine and living intelligent systems.

During the IEEE IS'08, scientists from Bulgaria, UK, USA, New Zealand, Australia, Japan, France, Spain, Germany, Austria, Hungary, Italy, The Netherlands, Poland, Slovakia, Portugal, Sweden, Switzerland, Finland, Romania, Greece, Turkey, Russia, Canada and many other countries shared ideas and achievements in the theory and practice of intelligent control, artificial intelligence, decision support systems, neural networks, soft computing, data mining and knowledge discovery, ontologies, machine learning, intelligent measurement, etc. Some 152 papers were included in the Proceedings (2008), and at least twice as many were initially submitted. The 65-member Programme Committee of respected scientists in the field of intelligent systems provided a high-quality anonymous reviewing process for all manuscripts. The accepted papers were distributed into technical, poster and student sessions. A Plenary Session of seven papers was also organised, with keynote speakers coming from the USA, Japan, Poland, Russia and Bulgaria.

Based on the quality of submissions, their reviews and their presentations, a list of the best papers from the conference was prepared for several post-conference publications. In this Special Issue, we have collected seven papers from that list, which match the aims and scope of the *International Journal of General Systems*, and are also representative of the topics of the IEEE IS'08 conference. The papers in this Special Issue are authored by multinational teams of authors and include both internationally acknowledged names in the field of intelligent systems science and talented young researchers (some of which

participated as students in recent IS events). The substantially extended versions of the conference papers received at least two post-conference anonymous reviews in order to help authors improve their material.

The papers in this Special Issue focus on: application of neural networks in medical diagnostics; modelling of intelligent systems using generalised nets; analysis of typicality in terms of intuitionistic fuzzy sets (IFSs); factorisation of systems of fuzzy sets by similarity and similarity preservation in input–output mapping of fuzzy sets; fuzzy rationality and its effect on parameter elicitation in quantitative decision analysis and development of a methodology for multiple ontologies for the business domain using mediator ontology.

Krassimir Atanassov and Mincho Hadjiski are among the leading names in current Bulgarian science, and are representatives of research institutes of the Bulgarian Academy of Sciences (the Centre for Bio-Medical Engineering and the Institute of Information Technologies). In their scientific careers, both scientists have made outstanding contributions to the development of the concepts of IFSs and generalised nets (Atanassov), and in the areas of mathematical modelling and advanced control, softensing, inference control, intelligent control, multi-agent and ontology-based control and intelligent diagnostics (Hadjiski). In their extended plenary paper from the IEEE IS'08 conference, they present a collaborative work on the possibility of modelling intelligent systems with the apparatus of generalised nets. They emphasise the lack of a common approach for the design of intelligent systems for general purposes. In line with this, they first propose a flexible framework for modelling and design of intelligent systems that is easily tailored to different applications. Secondly, they investigate the abilities of the generalised nets to serve as an alternative general tool for IS-design in both structural, functional and parameterisation stages.

The team of Florin Gorunescu, Marina Gorunescu, Elia El-Darzi and Smaranda Gorunescu (from the University of Medicine and Pharmacy of Craiova and University of Craiova, Romania, and the University of Westminster in the UK) has several successful publications in the fields of health care modelling and computing and the implementation of neural networks in the health domain. Their paper discusses an application of neural networks for medical diagnostics of recurrent breast cancer. Neural network algorithms are first applied to real medical data, and statistical approaches are also used to verify the experiments and prove that the classification performance of the algorithms is robust. Equally good results are produced by the simple network structure of both the multilayer perceptron and the radial basis function network.

The team of Eulalia Szmidt and Janusz Kacprzyk, from the Systems Research Institute of the Polish Academy of Sciences, is internationally recognised for its achievements in uncertainty and imprecision in systems modelling, fuzzy logic, intelligent decision support systems and data mining. They present a paper that investigates the modelling of typicality in terms of Atanassov's IFSs (A-IFSs). This paper verifies how reasoning known from linguistic experiments works in classification. A model of categories with a geometrical centroid with the similarity defined in terms of a distance to centroids is considered. The possibility of generating comparative results with extreme ideals in cases when categories are learned in the presence of their contrasting one is verified. Results prove that A-IFSs allow reflecting positive and negative information via the membership and non-membership degrees.

The only single-authored paper in this Special Issue, by Petr Osicka of Palacký University in the Czech Republic, also discusses the problems of preserving similarity. The paper answers the question of whether an input–output mapping, which is defined by logical formulas and which maps fuzzy sets to fuzzy sets, preserves similarity and to what extent. The author also investigates a more general question of whether it is possible to

estimate similarity degrees of the output fuzzy sets in terms of similarity degrees of the input fuzzy sets. The research takes into account truth-stressing hedges, i.e. truth functions of connective 'very true'.

The team of Radim Belohlavek and Michal Krupka (from the State University of New York at Binghamton, USA, and Palacký University, Czech Republic) presents a paper that investigates the factorisation of systems of fuzzy sets by similarity. The authors search for the 'central' of a collection of fuzzy sets, such that it is sufficiently similar to every fuzzy set from the collection. The truth degree is modelled with complete residuated lattices. The similarity is assessed via a Leibniz rule and a description of central fuzzy sets and optimal central fuzzy sets is provided.

Over the last 10 years, the Bulgarian research team from the Technical University Varna has been active in the fields of decision analysis and subjective statistics. Its contribution to this Special Issue focuses on the differences between the classical notion of rationality and the concept of fuzzy rationality, and the way they affect the elicitation process in quantitative decision analysis. The overview of techniques to choose between alternatives with interval probabilities outlines the scalarisation methods as most appropriate. The ribbon functions resulting from the interval estimates of probabilities, are compared with p -boxes. It is also demonstrated that approximation of utilities does not depend on the probabilities, but the approximation of probabilities is dependent on preferences.

The Portuguese team of João Sarraipa, Ricardo Jardim-Goncalves and Adolfo Steiger-Garcão from the University of Lisbon investigates problems arising in distributed and heterogeneous systems employing multiple ontologies. They study the interoperability problems arising from worldwide diversity of knowledge organisation principles, which is considered an obstacle in increasing the computational intelligence of information systems. The proposed solution is to use the reference ontology as a mediator in the communication process. The MENTON methodology (Methodology for Enterprise Reference Ontology Development) uses the Mediator Ontology concept and is proposed as a possibility for creating a common reference ontology for a group of organisations from the same domain.

The papers in this Special Issue do not pretend to cover all aspects of intelligent systems, but they attempt to present some recent contributions in this area. The team of Guest Editors would like to express its most sincere gratitude to all contributors and reviewers. We extend special thanks to the Editor-in-Chief, Distinguished Prof. George Klir and to the entire Editorial Office of the *International Journal of General Systems* for their constant support and guidance, without which this Special Issue would not have been possible.

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