Preface to the Special Issue on Neural Networks, Fuzzy Logic, and Evolutionary Computing for Intelligent System Design

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Soft computing can be used to build hybrid intelligent systems for achieving different goals in real-world applications. Soft Computing techniques include, at the moment, fuzzy logic, neural networks, genetic algorithms, chaos theory methods, and similar techniques that have been proposed in recent years. Each of these techniques has advantages and disadvantages, and several real-world problems have been solved, by using one of these techniques. However, many real-world complex problems require the integration of several of these techniques to really achieve the efficiency and accuracy needed in practice. In particular, evolutionary computing can be used to optimize the topology of a fuzzy or a neural system. Also, there are neuro-fuzzy approaches or even neuro-fuzzy-genetic approaches for designing the best intelligent system for a particular application.

This special issue consists of fourteen papers that consider the use and integration of different soft computing techniques for the development of hybrid intelligent systems for modeling, simulation and control of non-linear dynamical systems. The ten papers, of this special issue, describe different applications of soft computing techniques to real-world problems and can be considered a significant contribution to the field of hybrid intelligent systems.

The first paper, "A Fuzzy Clustering Approach for Face Recognition based on Face Feature Lines and Eigenvectors" by Mario Chacon et al., deals with a new approach using fuzzy clustering for face recognition. The new approach is based on face feature lines and eigenvectors. To achieve good performance the best combination of methods has to be defined very carefully. Experimental results show the suitability of the architecture and effectiveness of the proposed intelligent approach.

The second paper, "Fuzzy Inference Systems Type-1 and Type-2 for Digital Images Edge Detection" by Olivia Mendoza et al., describes a fuzzy logic approach for edge detection in images. The method is applied to achieve the goal of making edge detection a soft decision process, in this way allowing uncertainty management. Type-2 fuzzy logic can handle a higher degree of uncertainty than type-1 fuzzy logic. Comparative simulation results confirmed the applicability of type-2 fuzzy logic.

The third paper, "One-Dimensional Kohonen Networks and their Application to Automatic Classification of Images" by Ricardo Perez-Aguila et al., describes the use of neural network approach for the classification of images in an automated way. Human experts perform the classification of images and neural networks can be used to learn to do this task. In this paper, Kohonen neural networks are used to solve the problem of automatic classification of images. Simulation results show the efficiency and accuracy of the proposed classification method.

The fourth paper, "Object Oriented Design and Implementation of an Inference Engine for Fuzzy Systems" by Jose Mario Garcia-Valdez et al., describes the design and implementation of an inference engine for the execution of Fuzzy Inference Systems

(FIS). The architecture of the systems is presented, and the object-oriented design of the main modules is also discussed. The engine is implemented as a component to be referenced by other applications locally or remotely as a web service. The distinctive characteristic of this component is the ability to define fuzzy objects and attributes.

The fifth paper, “Long-Term Prediction, Chaos and Artificial Neural Networks. Where is the Meeting Point?” by Pilar Gomez-Gil, describes an approach combining recurrent and feed-forward neural networks for long-term prediction of chaotic time series. It is well-known that point-to-point, long term prediction for chaotic time series is not possible; however, in this paper a method to build dynamical systems using neural networks is presented. The dynamical systems must have chaotic invariants similar to the ones presented in the time series. Simulation results are presented to illustrate the proposed approach.

The sixth paper, “Modelling and Prediction of the MXNUSD Exchange Rate using Interval Singleton Type-2 Fuzzy Logic Systems” by Maria de los Angeles Hernandez Medina and Gerardo M. Mendez et al., proposes a new approach for time series prediction using interval type-2 fuzzy logic. The new approach is applied to the problem of one step ahead prediction of the daily exchange rate between the Mexican Peso and the US Dollar (MXNUSD) using a recursive least squares (RLS) with back-propagation learning algorithm to optimize the parameters of the type-2 fuzzy system. Experiments show that the exchange rate is predictable and according to a simple short-term investment strategy, a good annual profit rate can be obtained.

The seventh paper, “Development of a Functional Neuromuscular Stimulation System for Independent Ambulation of Patients with a Spinal Cord Injury” by Alejandro Garcia-Blanco et al., describes a new fuzzy logic controller approach to support impaired individuals in independent ambulation. In this paper a simple, portable and economically accessible device that allows limited movement of the inferior extremities on patients with lumbar spinal cord injuries is described. The system was tested on a mechanical model instead of using real patients. A data-glove on the right hand was used as the input control interface. Simulation results illustrate the advantages of the proposed approach

The eighth paper, “Data Mining for Extraction of Fuzzy IF-THEN rules using Mamdani and Takagi-Sugeno-Kang FIS” by Juan E. Moreno et al., deals with the application of fuzzy logic models for data mining problems. This paper describes the application of clustering techniques to specific databases (Iris data, and Mackey-Glass time series) to automatically extract fuzzy rules. The goal is to extract significative patterns in databases using Mamdani and Takagi-Sugeno-Kang fuzzy models. Computer simulations are presented confirming the performance of the method and its application to different mining problems.

The ninth paper, “Interval Type-2 Fuzzy Logic Toolbox” by Juan R. Castro et al., proposes a new software tool for building, editing and executing type-2 fuzzy systems. The Interval Type-2 Fuzzy Logic System toolbox is an environment for interval type-2 fuzzy inference system development. The toolbox’s best qualities are the capacity to develop complex fuzzy systems and the flexibility that allows the user to extend the availability of functions for working with type-2 fuzzy operators, interval type-2 membership functions, and evaluation of interval type-2 inference systems. Simulation results of several examples show the advantages of the new toolbox.

The tenth paper, “Demodulation of Interferograms of Closed Fringes by Zernike Polynomials using a Technique of Soft Computing” by Luis Ernesto Mancilla Espinosa et al., describes a hybrid approach combining genetic algorithms and mathematical models for demodulation of interferograms. Simulation results of phase recovering of interferograms with closed fringes using the proposed hybrid approach are very good.

The eleventh paper, “Monitoring and Diagnostics with Intelligent Agents using Fuzzy Logic” by Arnulfo Alanis Garza et al., describes a new paradigm for intelligent agents with applications to monitoring non-linear processes. The new paradigm helps in dealing with failures of a non-linear plant. A new way to visualize fault tolerant systems is proposed with the incorporation of intelligent agents. Three different types of agents are needed, which are the node agent, task agent, and system agent. The basic idea is that with the help of intelligent agents we maybe able to achieve fault tolerant systems. The idea is to detect errors and correct the failures that could happen in industrial control by monitoring and diagnosis.

The twelve paper, “Fault Tolerant Multi-Agent Systems: its communication and cooperation” by Arnulfo Alanis Garza et al., describes the communication and cooperation of a group of intelligent agents working with the goal of achieving fault tolerant systems. The operation of the node agent is described in detail. Simulation results are shown to illustrate the proposed approach.

The thirteenth paper, “Adaptive Wavelet-based-CMAC Network Predictor Design for Lossless Image Coding” by Ching-Hung Lee and Bo-Hang Wang, describes a novel wavelet based CMAC network for predictive image coding. The Gaussian functions of traditional CMAC are replaced by wavelet functions. In addition, properties and advantages of fuzzy TSK model are used to modify the activation functions of CMAC for obtaining high approximation accuracy and convergence rate. The proposed approach is tested with the prediction of differential pulse code modulation of image compression. Experimental results and comparisons with other state of the art lossless predictors are given to highlight the advantages of the proposed approach.

The fourteenth paper, “Utilizing Neural Network for DJIA Stock Selection” by Tong-Seng Quah and Wee-Ding Ng, describes a new approach to select equities based on soft computing models. The paper compares the performance of three soft computing models, namely multi-layer perceptrons, adaptive neuro-fuzzy inference systems, and general growing and pruning radial basis function. This paper suggests how equities can be picked systematically by using relative operating characteristics (ROC) curves.

We can conclude this introduction by saying that, in our opinion, all of the papers, of this special issue, make an important contribution to the state of the art in the field of hybrid intelligent systems, and also to the areas of fuzzy logic, neural networks, and genetic algorithms. Finally, we have to say that it is our sincere hope that this issue will be of great interest and use to researchers and students all over the world.