

Preface of the Special Issue on Hybrid Intelligent Systems using Soft Computing Techniques

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The special issue on hybrid intelligent systems using soft computing techniques comprises seven contributions, which are representative of the state of the art in this area. The papers describe different contributions to the area of hybrid intelligent systems with application on control, pattern recognition, time series prediction, and automation. In the papers, optimal combinations of intelligent techniques are applied to solve, in an efficient and accurate manner, problems in particular areas of application.

The first paper, “Optimization of the Fuzzy C-Means Algorithm using Evolutionary Methods”, by Oscar Castillo et al., proposes a novel approach to the optimization of the Fuzzy C-Means algorithm by evolutionary or bio-inspired methods, this in order to automatically find the optimal number of clusters and the weight exponent. The optimization methods used for the realization of this paper were genetic algorithms and particle swarm optimization. The results obtained by both methods are presented, and a comparison between both methods to observe if one method is better than the other.

The second paper, “Artificial Neural Image Processing Applications: A Survey”, by Juan Ramirez-Quintana et al., provides a review of neural networks applied in image processing. Artificial Neural Networks (ANNs) have been useful for decades to the development of Image Processing algorithms applied to several different fields, such as science, engineering, industry, security and medicine. This close relationship between ANNs and Image Processing has motivated a study of 160 papers that propose and deal with said algorithms. The information contained in these papers is analyzed, commented and then classified according to its contribution and applications. Then, some important aspects of recent visual cortex-based ANN models are described to finally discuss about the conclusions reached throughout the process.

The third paper, “Automatic Handling of Expert Knowledge Using Artificial Immune Systems Applied to Combinatorial Optimization Problems”, by Francisco Javier Díaz Delgadillo et al., provides methods to reduce computing time of combinatorial optimization problems that can be applied to any population based algorithm such as: genetic algorithms, artificial immune systems, ant colony optimization, etc. To demonstrate the usefulness of the proposed methodology an Artificial Immune System was used since we used concepts derived from this paradigm. The proposed methodology was applied to solve the Traveling Salesman Problem (TSP) and it is introduced the concept of vaccination to reduce cities in the TSP. It is able to work practically with any optimization population based method in order to obtain optimal and suboptimal routes of the original problem. Comparative experimental results of several experiments with large number of cities (711 cities) are shown.

The fourth paper, “A Hybrid Fuzzy Time Series Model for Forecasting”, by Saima Hassan et al., describes a hybrid model for time series prediction. Researchers are finding their way to solve the chaotic and uncertain problems using the extensions of classical fuzzy model. At present Interval Type-2 Fuzzy logic Systems (IT2-FLS) are extensively used after the thriving exploitation of Type-2 FLS. Fuzzy time series models have been used for forecasting stock and FOREX indexes, enrollments, temperature, disease diagnosing and weather. In this paper an integrated fuzzy time series model based on ARIMA and IT2-FLS is presented. The propose model will use ARIMA to select appropriate coefficients from the observed dataset. IT2-FLS is utilized here for forecasting the result with more accuracy and certainty.

The fifth paper, “Optimization of Neural Networks for the Identification of Persons using Images of the Human Ear as a Biometric Measure”, by Patricia Melin et al., presents a novel learning method for human recognition based on ear biometrics. Biometrics of the ear is a recent tool for the recognition of people with a great advantage, because ears seem to maintain their structure with age. This paper describes the application of modular neural network architecture, with pre-processing, to improve the recognition of people using images of the Ear as a biometric measure. The Ear database used in this work was obtained from the University of Science and Technology of Beijing (USTB). We show the results obtained with the modular neural network, the optimization using genetic algorithms, and the integration using different methods: Winner Takes All (WTA), type-1 fuzzy integration and fuzzy integration optimized by genetic algorithms. The behavior of the simulations show a good identification, using the appropriate pre-processing, integrators and the best structure found by the genetic algorithm.

The sixth paper, “Tool path Optimization for Computer Numerical Control Machines based on Parallel ACO”, by Nataly Medina-Rodríguez et al., describes an efficient solution to determine the best sequence of G commands of a set of holes for a printed circuit board in order to find the hole-cutting sequence that shortens the cutting tool travel path. A Parallel proposal of Ant Colony Optimization was used to find an optimal travel path, then the new G-codes sequence is used instead the original sequence as part of the process program. This application can be formulated as a special case of the Traveling Salesman Problem (TSP).

The seventh paper, “Fuzzy Logic Predictive Algorithm for Wireless-LAN Fast Inter-Cell Handoff”, by Roberto Sepulveda et al., describes data transmission systems based on the IEEE 802.11 standard, universally known as WiFi wireless communications, which are strengthening their already dominant position as the powerhouse of wireless Internet in homes and public hot spots due to the new IEEE 802.11n standard, capable of delivering up to 450 Mbps. 802.11 standard was initially designed without provision of QoS guarantees. Eventually the need to include voice and video urged the development of the 802.11e standard, which provides a proficient level of QoS for real time applications. With the two former additions IEEE 802.11 systems are poised to join the family of 4G wireless networks, comprised by LTE (Long Term Evolution) and WiMax. However, still remains a challenge to overcome in the transfer of a session from one cell to another. Considering that the inter-cell handover consumes around 300 ms, it becomes unsuitable for real-time applications like Voice over IP (150 ms maximum delay) and video (200-400 ms).

In conclusion, it can be concluded that all of the papers, in this special issue, make an important contribution to the state of the art in the field of hybrid intelligent systems and also to the different areas of application, such as pattern recognition, time series prediction, intelligent control, manufacturing and robotics. The papers comprising this special issue are representative to the diversity of the application areas to which hybrid intelligent systems are good to achieve the accuracy, robustness and efficiency needed for real-world applications.