Special Issue on Hybrid Learning Machines

The concept of Machine Intelligence (MI) is complex, and thus many theories and definitions have emerged recently. Last few decades have seen a new era of machine intelligence focusing on the principles, theoretical aspects, and design methodology of algorithms gleaned from nature and biology. Examples are artificial neural networks inspired by mammalian neural systems, evolutionary computation inspired by natural selection in biology, simulated annealing inspired by thermodynamics principles and swarm intelligence inspired by collective behavior of insects or micro-organisms, etc. interacting locally with their environment causing coherent functional global patterns to emerge. These techniques have found their way in solving some real world problems in science, business, technology and commerce. The integration of different learning and adaptation techniques, to overcome individual limitations and achieve synergetic effects through hybridization or fusion of these techniques, has in recent years contributed to a large number of new intelligent system designs. Despite the advances made, progress across the board has been moderate. One reason stems from the relatively slow pace at which work to understand biological intelligence has progressed. Another reason is rooted in the same inertia that has hampered the development of the research on intelligence previously – the reluctance to actively benefit from the achievements of the hybrid approaches.

2nd International Workshop on Hybrid Artificial Intelligence Systems (HAIS 07 - CAEPIA 2007) was held in conjunction with the Conference of the Spanish Association for Artificial Intelligence (CAEPIA) in Salamanca, Spain, from the 12th to the 16th November, 2007. It was organized by the Biomedicine, Intelligent Systems and Educational Technology Group of the University of Salamanca. HAIS 2007 gathered individual researchers who see the need for synergy between various intelligent techniques. This special issue comprising of ten papers is focused on different hybrid learning approaches and its real world applications. Papers were selected on the basis of fundamental ideas/concepts rather than the thoroughness of techniques deployed. The papers are organized as follows.

In the first paper, *Gutiérrez et al.* [1] propose a hybrid neural network model using a possible combination of different transfer projection functions and kernel functions in the hidden layer of a feed-forward neural network. An evolutionary algorithm is adapted to this model and applied for learning the architecture, weights and node typology. Three different combined basis function models are proposed with all the different pairs that can be obtained. Combined functions using projection and kernel functions are found to be better than pure basis functions for the task of classification in several datasets.

Corchado et al. in the second paper [2] present a novel ambient intelligence based solution for shopping assistance. The core of the proposal is a Case Base Reasoning (CBR) system developed for guiding and advising users in shopping areas. The CBR incorporates a neural based planner that identifies the most adequate plan for a given user based on user profile and interests. This hybrid application, which works on execution time, has been in a shopping mall and the evaluation results are presented in this paper.

In the Third paper, *Corral et al.* [3] present how to use clustering methods for discovering hidden patterns and abnormal behaviors through the identification of device groups with similar vulnerabilities, which is a very important problem in the Network security domain. Self-Organizing Maps are used and integrated into a computer-aided system to detect network vulnerabilities.

Faceli et al. [4] in the Fourth paper illustrate an algorithm for cluster analysis that integrates aspects from cluster ensemble and multi-objective clustering. The algorithm is based on a Pareto-based multi-objective genetic algorithm, with a special crossover operator that uses clustering validation measures as objective functions. The algorithm is used for clustering gene expression data sets.

In the Fifth paper, *Herrero et al.* propose a novel hybrid artificial intelligent system for intrusion detection system. The hybrid model is built using a multiagent system that incorporates an unsupervised connectionist intrusion detection system. This hybrid system facilitates the intrusion detection in dynamic networks, in a more flexible and adaptable manner. The proposed framework includes deliberative agents characterized by the use of an unsupervised connectionist model to identify intrusions in computer networks.

Serrano et al. [6] in the Sixth paper illustrate some developments made with an agent oriented methodology for modeling complex agent oriented systems. These techniques can be regarded as intelligent data analysis techniques, all of which are oriented towards providing simplified representations of the system. These techniques range from raw data visualization to clustering and extraction of association rules.

In the Seventh paper *Tang et al*.[7] propose a Selective Negative Correlation Learning (SNCL) for constructing neural network ensembles. When a new training data set is presented, the previously trained neural network ensemble is cloned. Then the cloned ensemble is trained on the new data set. After that, the new ensemble is combined with the previous ensemble and a selection process is applied to prune the whole ensemble to a fixed size. This paper presents a deeper investigation into SNCL, considering different objective functions for the selection process and comparing SNCL to other NCL-based incremental learning algorithms.

Martín et al. [8] in the Eighth paper illustrate a general method (independent of the robot morphology) to learn the inverse kinematic of multi-link robots by means of neuro-controllers. The method is based on evolutionary computation paradigm and works by obtaining incrementally better neuro-controllers. Furthermore, the proposed method solves some specific issues in robotic neuro-controller learning: it avoids any neural network learning algorithm which relies on the classical supervised input-target learning scheme and hence it lets to obtain neuro-controllers without providing targets.

In the Ninth paper, *Ni and Yin* describe a hybrid model formed by a mixture of various regressive neural network models, such as temporal self-organizing maps and support vector regressions, for modeling and prediction of foreign exchange rate time series. A genetic algorithm is applied to fuse all the information from the mixture regression models and the economical indicators. A virtual trading system is built to examine the performance of the proposed method.

In the last paper, Barbero *et al.* present two Focused Grid Search (FGS) alternatives in which one repeatedly zooms into more concentrated sets of discrete grid points in the parameter search space. The first one, Deterministic FGS (DFGS), is much faster than standard search although still too costly in problems with a large number of parameters. The second one, Annealed FGS (AFGS), is a random version of DFGS where a fixed fraction of grid points are randomly selected and examined. The proposed method is illustrated over several classification problems.

The editors wish to thank Professor Tom Heskes (Editor-in-Chief of Neurocomputing) for providing the opportunity to edit this special issue on Hybrid Learning Machines. We would also like to thank the referees who have critically evaluated the papers within the short stipulated time. Finally we hope the reader will share our joy and find this special issue very useful.

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[5] Álvaro Herrero, Emilio Corchado, María A. Pellicer, and Ajith Abraham, *MOVIH-IDS: A Mobile-Visualization Hybrid Intrusion Detection System.*

[6] Emilio Serrano, Jorge J. Gomez-Sanz, Juan A. Botia, Juan Pavon*, Intelligent Data Analysis Applied to Debug Complex Software Systems.*

[7] Ke Tang, Minlong Lin, Fernanda L. Minku and Xin Yao, *Selective Negative Correlation Learning Approach to Incremental Learning.*

[8] José Antonio Martín, Javier de Lope, Matilde Santos, *A Method to Learn the Inverse Kinematics of Multi-link Robots by Evolving Neuro-Controllers.*

[9] He Ni and Hujun Yin, *Exchange Rate Prediction Using Hybrid Neural Networks and Trading Indicators.*

[10] Alvaro Barbero, Jorge López Lázaro, José R. Dorronsoro, *Finding Optimal Model Parameters by Deterministic and Annealed Focused Grid Search.*