10th Symposium on Artificial Neural Networks
Final Program

Sunday October 26th

Joint Conference Openning Section - 18:30-19:00h
Welcome Cocktail - 20:00-21:30h

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<u>Tutorial</u>: "From ILP to PILP", Stephen H. Muggleton (1st Part)</td><td>Room 2
<u>Tutorial</u>: Evolving & Self-learning Connectionist Systems: The Knowledge Engineering Approach, Nikola Kasabov (1st Part)</td><td><u>Tutorial</u>: Text Mining, Raymond J. Mooney (1st Part)</td></tr>
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<tr><td>17:45 - 18:45</td><td colspan="2"><u>Plenary Talk</u>: Neural-, Genetic-, and Quantum Information Processing: Towards an Integrative Connectionist Theory and Systems, Nikola Kasabov, School of Computer and Information Sciences, Auckland University of Technology</td><td colspan="2"><u>Plenary Talk</u>: Logical and Relational Learning, Luc De Raedt, Department of Computer Science of the Katholieke Universiteit Leuven, Belgium</td><td>MEETING CERN/CEIA</td></tr>
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Monday 27th

S1: Architectures
Chair: Profa. Teresa Ludermir, UFPe

(39509) Using a Probabilistic Neural Network for a Large Multi-label Problem, Elias Oliveira

Abstract: The automation of the categorization of economic activities from business descriptions in free text format is a huge challenge for the Brazilian governmental administration in the present day. So far, this task has been carried out by humans, not all of them well trained for this job. When this problem is tackled by humans, the subjectivity on their classification brings another problem: different human classifiers can give different results when working on a set of same business descriptions. This can cause a serious distortion on the information for the planning and taxation of the governmental administrations on the three levels: County, State and Federal. Furthermore, the number of possible categories considered is very large, more than 1000 in the Brazilian scenario. The large number of categories makes the problem even harder to be solved, as this is also a multi-labeled problem. In this work we compared the multi-label lazy learning technique, M L - K NN, to our Probabilistic Neural Network approach. Our implementa- tion overcome the M L - K NN algorithm in the five metrics typically used in the literature from multi-label categorization problem.

(**40084**) **The Growing Self-Organizing Surface Map: Improvements**, Vilson Mole, Aluizio Araújo

Abstract: The Growing Self Organizing Surface Map (GSOSM) is a novel map model that learns a 2D surface immersed in a 3D space. The GSOSM model introduces a novel connection learning rule called CCHL. In this paper we present an overview of GSOSM model and its connection learning rule CCHL. The GSOSM dynamic is analyzed and are proposed changes to improve the algorithm performance and time run. The results of proposed improvements are depicted and discussed.

(**41316**) **Applying Static and Dynamic Weight Measures in Ensemble Systems**, Raul Paradeda, Joao Carlos Xavier Junior, Anne Canuto

Abstract: It is well known that the use of ensemble systems usually increases the accuracy rate of individual machine learning systems. A way of improving the accuracy of these systems even further is through the use of weight measures. This paper analyzes the influence of the use of static and dynamic weights in the accuracy of two structures (homogeneous and heterogeneous) of ensemble systems. Furthermore, it investigates the relation between diversity and the use weights in ensemble system.

(**41404**) **Weightless Neural Networks: Knowledge-based Inference System**, Teresa Ludermir, Marcilio de Souto, Wilson de Oliveira

Abstract: A knowledge-based inference system for Weightless Neural Networks (WNNs) is described in this paper. With the use such a system, rules can be inserted and extracted into/from WNNs. The process of rule insertion and rule extraction in WNNs is often more natural than in other neural network models. The system proposed allows the understanding on how the neural networks reach the solution to a problem. A straightforward application of the system is the design of expert systems and data mining techniques.

(**41428**) **Multi-Label Text Categorization using VG-RAM Weightless Neural Networks**, Claudine Badue, Felipe Pedroni, Alberto De Souza

Abstract: In automated multi-label text categorization, an automatic categorization system should output a label set, whose size is unknown a priori, for each document under analysis. Many machine learning techniques have been used for building such automatic text categorization systems. In this paper, we examine Virtual Generalizing Random Access Memory Weightless Neural Networks (Vg-ram wnn), an effective machine learning technique which offers simple implementation and fast training and test, as a tool for building automatic multi-label text categorization systems. We evaluate the performance of Vg-ram wnn on the categorization of Web pages, and compare our results with that of the multi-label lazy learning approach Ml-knn, the boosting-style algorithm Boostexter, the multi-label decision tree Adtboost.MH, and the multi-label kernel method Rank-svm. Our experimental comparative analysis shows that, on average, Vg-ram wnn either outperforms the other mentioned techniques or show similar categorization performance.

(**42250**) **Quantum Logical Neural Networks**, Wilson de Oliveira, Adenilton da Silva, Amanda Leonel, Wilson Galindo, Jefferson Pereira

Abstract: Quantum analogues of the (classical) Weightless Neural Networks (WNN) models [16] are proposed in [5] (q-WNN fors hort). In this paper we further develop and investigate the q-WNN composed of the quantum analogue of the Probabilistic Logic Node (PLN) and the multiple-valued PLN (MPLN) variations, dubbed q-PLN and q-MPLN respectively. Besides a clearer mathematical description we present a computationally efficient and simply described learning algorithms for these quantum analogs, in contrast to what happens with the quantum version of weighted neural networks.

S2: Theory
Chair: Prof. Antonio Braga, UFMG

(**40954**) **Optimization of the Area Under the ROC Curve**, Cristiano Castro, Antônio Braga

Abstract: In this paper, we propose a new binary classification algorithm (AUCtron), based on gradient descent learning, that directly optimizes AUC (Area Under the ROC Curve). We compare it with a linear classifier and with AUCsplit proposed by [5]. The AUCtron algorithm implicitly considers class prior probabilities in the decision criteria. Our results demonstrated that AUC is a sensitive enough metric that when used in small and imbalanced data sets may lead to a better separation.

(**41298**) **A multi-objective learning algorithm for RBF neural network**, Illya Kokshenev, Antônio Braga

Abstract: In this paper the problem of multi-objective supervised learning is discussed within the non-evolutionary optimization framework. The proposed MOBJ learning algorithm performs the search of Pareto-optimal models determining the weights, width, prototype vectors and quantity of the basis functions of the RBF network. In combination with Akaike information criterion, the algorithm provides high quality solutions.

(**41023**) **Segmented Overdetermined Nonlinear Independent Component Analysis for Online Neural Filtering**, Eduardo Simas, José Manoel de Seixas, Luiz Calôba

Abstract: In particle collider experiments a huge amount of information is generate, but only a small part is relevant for physics characterization. An efficient filtering (trigger) system is required to guarantee that valuable signatures will be recorded and most of the background noise rejected. In previous works the standard linear independent component analysis (ICA) model was used for feature extraction and good results were obtained, but it is known that the measured signals are modified by nonlinear phenomena. Another characteristic of our particular application is that there exists more sensors than original sources (the problem is overdetermined). In this work is proposed a novel structural model for the overdetermined NLICA problem. Multi-layer perceptron networks were applied for nonlinear mixing function blocks estimation. The extracted nonlinear independent components were used to feed a neural filter that performs online particle classification with high discrimination performance.

(**41367**) **Binary Tree Decomposition of Multiclass Problems**, Ana Lorena, André P. de L. F. de Carvalho

Abstract: Several popular Machine Learning techniques are originally designed for the solution of two-class problems. However, several classification problems have more than two classes. One approach to deal with multiclass problems using binary classifiers is to decompose the multiclass problem into multiple binary sub-problems disposed in a binary tree. This approach requires a binary partition of the classes for each node of the tree, which defines the tree structure. This paper presents two algorithms to determine the tree structure taking into account information collected from the used dataset. This approach allows the tree structure to be determined automatically for any multiclass dataset.

(**41673**) **Error Entropy and Mean Square Error Minimization Algorithms for Neural Identification of Supercritical Extraction Process**, Rosana Soares, Adriana Rosa Garcez Castro, Roberto Célio Limão de Oliveira, Vladimiro Miranda

Abstract: In this paper, Artificial Neural Networks (ANN) are used to model an extraction process that uses a supercritical fluid as solvent which its pilot installation is located at the Institute of Experimental and Technological Biology IBET in Oeiras Lisbon Portugal. A strategy is used to complement the experimental data collected in laboratory during extraction procedures of useful compositions for the pharmaceutical industry using Black Agglomerate Residues (BAR) originating from of the cork production as raw material. The strategy involves fitting of data obtained during an operation of extraction. Two neural models are presented: the neural model trained using a Mean Square Error (MSE) minimization algorithm and the neural model which the learning was based on the error entropy minimization. A comparison of the performance of the two models is presented.

(**41696**) **Searching for a cryptographic model based on the pre-image calculus of cellular automata**, Heverton Macedo, Gina Oliveira

Abstract: This paper is about the application of chaotic cellular automata (CA) in cryptography. In the approach investigated here, the ciphering is accomplished by pre-image calculus while deciphering is accomplished by CA temporal evolution. We use the pre-image calculus algorithm proposed by Wuensche and Lesser (1992) known as reverse algorithm. The viability of this algorithm when applied to any arbitrary plaintext is based on the prerogative that all configurations of CA lattices have at least one pre-image. We speculate transition rules with chaotic dynamical behavior are more probable to exhibit this characteristic. Therefore, we investigate if it is possible to find rule sets that guaranty the existence of one pre-image for all possible CA lattices. Theses rule sets were found by using a genetic algorithm (GA) that was guided by a forecast dynamical behavior parameter named Z . The results of our experiments show that, beyond the dynamics forecast performed by Z, other two characteristics are important: the symmetric level (S) and the balance between two components of Z named Zleft and Zright.

Tuesday 28th

S3: Neurocontrol
Chair: Prof. Aluízio Araújo, UFPe

(**40070**) **Applying Neural Networks to Control Gait of Simulated Robots**, Milton Heinen, Fernando Osório

Abstract: This paper describes the LegGen simulator, used to automatically create and control stable gaits for legged robots into a physically based simulation environment. In our approach, the gait is defined using two different methods: a finite state machine based on robot's leg joint angles sequences; and a recurrent neural network. The parameters for both methods are optimized using genetic algorithms. The model validation was performed by several experiments realized with a robot simulated using the ODE physical simulation engine. The results showed that it is possible to generate stable gaits using genetic algorithms in an efficient manner, using these two different methods.

(**40983**) **Controlling Chaos in Elman Network**, Gustavo Melo, Aluizio Araújo

Abstract: This paper initially presents a study about chaotic dynamics of the Elman neural network. Effects of chaotified activation function parameters variation on the network dynamic behavior are analyzed through bifurcation diagrams of the chaos route. We perceived a rich dynamics. Then we proposed a chaos control method based on pinning control which could extinguish chaos behavior and converge to periodicity or fixed point without changing the network parameters.

(**41573**) **Imitation Learning of an Intelligent Navigation System for Mobile Robots using Reservoir Computing**, Eric Antonelo, Benjamin Schrauwen, Dirk Stroobandt

Abstract: The design of an autonomous navigation system for mobile robots can be a rough task. Noisy sensors, unstructured environments and unpredictability are among the problems which must be overcome. Reservoir Computing (RC) uses a randomly created recurrent neural network (the reservoir) which functions as a temporal kernel of rich dynamics that projects the input to a high dimensional space. This projection is mapped into the desired output (only this mapping must be learned with standard linear regression methods). In this work, RC is used for imitation learning of navigation behaviors generated by an intelligent navigation system in the literature. Obstacle avoidance, exploration and target seeking behaviors are reproduced with an increase in stability and robustness. Experiments also show that the RC-based controller generalize the behaviors for new environments.

(**41590**) **A neural network generating adaptive rhythms for controlling Behavior Based Robotic Systems**, Ernesto Burattini, Massimo De Gregorio, Silvia Rossi

Abstract: Influenced by the results obtained in neuroscience and biology, we have introduced a model (AIRM) that, inspired by biological rhythms, adaptively controls a behavior based robotic system (BBRS). The proposed model is implemented by means of an NSP (Neuro Symbolic Processor). Since the NSP can be implemented on FPGA, we can take advantage of a parallel execution of the AIRM model and then an improvement of the BBRS performance.

(**41667**) **Bio-inspired Optimization Techniques for SVM Parameter Tuning**, André Rossi, André Ponce de Leon F de Carvalho

Abstract: Machine learning techniques have been successfully applied to a large number of classification problems. Among these techniques, Support Vector Machines are well know for the good classification accuracies reported in several studies. However, like many Machine Learning techniques, the classification performance obtained by Support Vector Machines is influenced by the choice of proper values for their free parameters. In this paper, we investigate what is the influence of different optimization techniques inspired by Biology when they are used to optimize the free parameters of Support Vector Machines. This comparative study also included the default values suggested in the literature for the free parameters and a grid algorithm used for parameter tuning. The results obtained suggest that, although Support Vector Machines work well with the default values, they can benefit from the use of an optimization technique for parameter tuning.

(**41627**) **Neural Control Applied to the Problem of Trajectory Tracking of Mobile Robots with Uncertainties**, Nardenio Martins, Douglas Wildgrube Bertol, Ebrahim El''youssef, Warody Lombardi, Edson De Pieri

Abstract: In this paper, a trajectory tracking control for a nonholonomic mobile robot by the integration of a kinematic neural controller (KNC) and a torque neural controller (TNC) is proposed, where both the kinematic and dynamic models contains parametric and nonparametrics uncertainties. The proposed neural controller (PNC) is constituted of the KNC and the TNC, and were designed by use of a modeling technique of Gaussian radial basis function neural networks (RBFNNs). The KNC is applied to compensate the uncertainties of the mobile robot. The TNC, based on the computed torque control, is applied to compensate the mobile robot dynamics, significant uncertainties, bounded unknown disturbances, neural networks modeling errors, influence of payload, and unknown kinematic parameters. Also, the PNC are not dependent of the mobile robot kinematics and dynamics neither requires the off-line training process. Stability analysis and convergence of tracking errors to zero, as well as the learning algorithms for weights, centers, and variances are guaranteed with basis on Lyapunov theory. In addition, the simulations results are provided to show the efficiency of the PNC.

S4:Hybrid Systems
Chair: Profa. Anne Canuto, UFRN

(**39392**) **Predicting the Performance of Learning Algorithms Using Support Vector Machines as Meta-Regressors**, Silvio Guerra, Ricardo Prudêncio, Teresa Ludermir

Abstract: In this work, we proposed the use of Support Vector Machines (SVM) to predict the performance of machine learning algorithms based on features of the learning problems. This work is related to the Meta-Regression approach, which has been successfully applied to predict learning performance, supporting algorithm selection. Experiments were performed in a case study in which SVMs with different kernel functions were used to predict the performance of Multi-Layer Perceptron (MLP) networks. The SVMs obtained better results in the evaluated task, when compared to different algorithms that have been applied as meta-regressors in previous work.

(**39394**) **Selecting Neural Network Forecasting Models Using the Zoomed-Ranking Approach**, Patrícia dos Santos, Teresa Ludermir, Ricardo Prudêncio

Abstract: In this work, we propose to use the Zoomed-Ranking approach to ranking and selecting Artificial Neural Network (ANN) models for time series forecasting. Given a time series to forecast, the Zoomed-Ranking provides a ranking of the candidate models, by aggregating accuracy and execution time obtained by the models in similar series. The best ranked model is then returned as the selected one. In order to evaluate this proposal, we implemented a prototype to rank three ANN models for forecasting time series from different domains. In the experiments, the rankings of models recommended by Zoomed-Ranking were significantly correlated to the ideal rankings.

(**40021**) **Improving Support of Appropriate Executive Decisions by Combining Artificial Immune Systems and Fuzzy Logic**, Bernardo Caldas, Flávio Oliveira, Fernando Buarque de Lima Neto

Abstract: This paper presents a novel approach to support appropriateness of executive decisions by using combined principles of Artificial Immune System (AIS) and Fuzzy Logic (FL). The main goal is to show that more Appropriate Executive Decisions (AED) may be obtained if strategic decision makers are equipped with supportive tools based on AIS and FL (Fuzzy-AED). In addition, this work aims at improving the quality of the system response by adding new features to the original version of the AED model. A proof of concept for Fuzzy-AED is also included here along with experiments carried out within a real business environment. Experimental results suggest that this hybrid approach to executive decision making could be used to assemble helpful executive decision systems that may be easily deployed to reduce some of the risks inherent in strategic decision making.

(**40186**) **Neurons and neural fuzzy networks based on nullnorms**, Michel Hell, Pyramo Pires, Fernando Gomide

Abstract: This paper suggests a new type of elementary unit for neural fuzzy networks based on the concept of nullnorm. A nullnorm is a category of fuzzy set-oriented operators that generalizes triangular norms and conorms. The new unit, called nullneuron, is a generalization of and/or logic-based neurons parametrized by an element u, called the absorbing

element. If the absorbing element u = 0, then the nullneuron becomes an and neuron and if u = 1, then the nullneuron becomes a dual or neuron. The paper also addresses two learning schemes for a class of hybrid neural fuzzy networks with nullneurons. The first scheme uses the gradient descent technique and the second reinforcement learning. Both learning schemes adjust not only the weights associated with the inputs of the nullneurons, but also the role of the nullneuron in the network (and or or) by individually adjusting the parameter u of each nullneuron. The neurofuzzy network presented here is more general than alternative approaches discussed in the literature because they allow different triangular norms in the same network structure. Experimental results show that nullneuron-based networks provide accurate results with low computational effort.

(**41337**) **Structural and Parametric Evolution of Continuous-time Recurrent Neural Networks**, Cesar Gomes Miguel, Carolina Feher da Silva, Marcio Netto

Abstract: Neuroevolution comprehends the class of methods responsible for evolving neural network topologies and weights by means of evolutionary algorithms. Despite their good performance in several control tasks, most of these methods use variations of simple sigmoidal neurons. Recent investigations have shown the potential applicability of more realistic neuron models, opening new perspectives for the next generation of neuroevolutionary methods. This work aims to extend a recent method known as NEAT to evolve continuous-time recurrent neural networks (CTRNNs). The proposed model is compared with previous methods on a control benchmark test. Preliminary results reveal some advantages when evolving general CTRNNs over traditional models.

(**42045**) **Adjusting Weights and Architecture of Neural Networks through PSO with Time-Varying Parameters and Early Stopping**, Lamartine Teixeira, Felipe Oliveira, Adriano Oliveira, Carmelo Bastos Filho

Abstract: This paper presents results of an approach to optimize architecture and weights of MLP Neural Networks, which is based on Particle Swarm Optimization with time-varying parameters and early stopping criteria. This approach was shown to achieve a good generalization control, as well as similar or better results than other techniques, but with a lower computational cost, with the ability to generate small networks and with the advantage of the automated architecture selection, which simplify the training process.

Wednesday 29th

S5: Applications
Chair: Prof. Marcilio Souto, UFRN

(**41444**) **Combining distances through an auto-encoder network to verify signatures**, Milena Souza, Leandro Almeida, George Cavalcanti

Abstract: In this paper we present a system for off-line signature verification. The paper contributions are: i) Five distances were calculated and evaluated over the signature database, they are: furthest, nearest, template, central and ncentral. Also, a normalization procedure is established to turn each distance scale invariant; ii) These distances are combined using the following rules: product, mean, maximum and minimum; iii) The calculated distances can be used as a feature vector to represent a given signature. So, the feature vectors found and their combination were finally used as input vector for an auto-encoder neural network. All the experimental study are done using one-class classification, which demands only the genuine signature to generalize. The proposed approaches achieved very good rates for the signature verification task.

(**41769**) **A Methodology using Neural Networks to Cluster Validity Discovered from a Marketing Database**, Renato Sassi, Leandro Silva, Emilio Del-Moral-Hernandez

Abstract: The databases of real world contains a huge volume of data and among them there are hidden piles of interesting relations that are actually very hard to find out. The knowledge discovery databases (KDD) appear as a possible solution to find out such relations aiming at converting information into knowledge. However, not all data presented in the bases are useful to a KDD. Usually, data are processed before being presented to a KDD aiming at reducing the amount of data and also at selecting more relevant data to be used by the system. The purpose of this paper is to describe a validation methodology, through of a MLP neural network, to the knowledge discovered by a Hybrid Architecture composed by Rough Sets Theory used to pre-processing the data to be presented to Self-Organizing Maps neural network, which data cluster.

(**41866**) **A Method to Detect Novelty in Time Series by Bata Clustering and Prediction**, Leonardo Aguayo, Guilherme Barreto

Abstract: This paper addresses the issue of finding samples which appears to be inconsistent with a previously modeled set of data, a topic directly related to the monitoring of time series. The problem may be interpreted as a classification procedure where a data sample is labeled as normal or abnormal according to a decision rule. In this work, data classification is performed by an Artificial Neural Network (ANN) framework and the decision rule is based on the analysis of either quantization or prediction errors provided by such algorithms. Computational simulations with synthetic and real data shows the feasibility of the method.

(**41920**) **Automatic Information Extraction in Semi-Structured Official Journals**, Valmir Macário, Ricardo Prudêncio, Francisco De Carvalho, Leandro Rodriguez Torres, Laerte Rodrigues Júnior, Marcos Lima

Abstract: Information extraction systems are used to extract only relevant text information in digital repositories. The current work proposes an automatic system to extract information in semi-structured official journals. In our approach,given an input document, a Machine Learning (ML) algorithm classifies the documents fragments into class labels which correspond to the data fields to be extracted. The implemented system deployed different features sets and algorithms used in the classification of the fragments. The system was evaluated through experiments on a sample containing 22770 lines of the Pernambucos Official Journal.The performed experiments revealed, in general, good results in terms of precision, which ranged from 70.14% to 98.63% depending on the feature set and algorithm used in the classification of the fragments.

(**41976**) **On Frequency Sensitive Competitive Learning for VQ Codebook Design**, Paulo Espírito Santo, Rebecca Albuquerque, Daniel Cunha, Francisco Madeiro Bernardino Junior

Abstract: Vector quantization (VQ) plays an important role in many image coding systems. The present paper examines the application of frequency sensitive competitive learning for VQ codebook design. Simulation results are presented for: the influence of the initialization on codebook design; the normalized entropy of the codevectors; the number of

multiplications spent in the codebook training; the ``evolution'' of the codebook by the end of each iteration of the algorithm; the quality of the designed codebooks in terms of the peak signal to noise ratio of the reconstructed images. A comparison with both LBG (Linde-Buzo-Gray) and non frequency sensitive competitive learning is presented.

(**41558**) **Hierarchical Agglomerative Clustering of Short-Circuit Faults in Transmission Lines**, Claudomir Cardoso, Yomara Pires, Jefferson Morais, Aldebaro Klautau

Abstract: Data mining can play a fundamental role in modern power systems. However, a major problem is to extract useful information from the currently available non-labeled digitized time series. This work proposes a new methodology based on hierarchical clustering for labeling faults that occurred in transmission lines. A graphical user interface can benefit from the complementary information provided by the methodology. These faults are responsible for the majority of the disturbances and cascading blackouts. Simulation results using the public dataset UFPAfaults are presented to validate the proposed method.

S6: Optimization Algorithms
Chair: Prof. André Carvalho, USP São Carlos

(**40474**) **GASpeech: A Framework for Automatically Estimating Input Parameters of Klatt's Speech Synthesizer**, José Borges, Igor Couto, Tales Imbiriba, Fabíola Oliveira, Aldebaro Klautau, Edward Bruckert

Abstract: The paper presents GASpeech: a framework centered on Genetic Algorithms for automatically estimating the input parameters of Klatt's speech synthesizer. GASpeech allows to speed up the process of speech imitation (or utterance copy), where one has to find the model parameters that lead to a synthesized speech sounding close enough to the natural target speech. The problem is a non-convex with many local minimal optimization. The results show the ability of GASpeech in solving the problem for a synthesized vowel database in different degrees of complexity.

(**40596**) **Selection of Radial Basis Functions via Genetic Algorithms in Pattern Recognition Problems**, Renato Tinós, Luiz Otavio Murta Junior

Abstract: The mixed use of different shapes of radial basis functions (RBFs) in RBF Networks is investigated in this paper. For this purpose, the use of the q-Gaussian function, which reproduces different RBFs by changing a real parameter q, in RBF Networks is proposed. In the proposed methodology, the centers of the radial units are determined by the k-means algorithm. Then, a Genetic Algorithm is employed to select the number of hidden neurons, and type and width of each RBF associated with each radial unit. In order to test the performance of the proposed methodology, an experimental study with two pattern recognition problems is presented. The RBF Network with the q-Gaussian RBF is compared to RBF Networks with Gaussian, Cauchy, and Inverse Multiquadratic RBFs.

(**40707**) **A Solution of Dynamic Vehicle Routing Problem via Ant Colony System Metaheuristic**, Sabrina Moreira de Oliveira, Sérgio Souza, Maria Amélia Lopes Silva

Abstract: This paper addresses an architecture for solving the Dynamic Vehicle Routing Problem with Time Windows (DVRPTW) and capacitated fleet using Ant Colony System (ACS) metaheuristic. All customers are known in advance, but their demands take place at any instant within a time horizon. The architecture has been developed to run in a centralized fashion, having two main elements, i.e, the Events Manager Element and the ACS Element. The Events Manager Element is the central structure of the solution architecture. The Static Problem Element receives the orders and selecting them according with their time windows, sending them to the ACS Element. It defines, at each static problem, the number of routes and the sequence of customers to be served. All routes arisen from the ACS Element are dispatched to the Events Manager, that will be responsible for assigning them to the vehicles. All the architecture provided results are feasible and all the time windows are always respected.

(**41718**) **A Strategy for the Selection of Solutions of the Pareto Front Approximation in Multi-Objective Clustering Approaches**, Katti Faceli, Marcilio de Souto, André Ponce de Leon F de Carvalho

Abstract: One of the advantages of Pareto-based multi-objective genetic algorithm approaches for clustering, when compared to classical clustering algorithms, is that, instead of a single solution (partition), they give as an output a set of solutions (approximation of the Pareto front or Pareto front, for short). However, such a set could be very large (e.g.,

hundreds of partitions) and, consequently, difficult to be analyzed manually. We present a selection strategy, based on the corrected Rand index, that aims at recommending, as final solution for Pareto-based multi-objective genetic algorithm approaches, a subset of partitions from the Pareto front. This subset should be much smaller than the the latter and, at the same time, keep the quality and the diversity of the partitions. In order to test our strategy, we develop a study of case in which we apply the strategy to the sets of solutions obtained with the Multi-Objective Clustering Ensemble algorithm (MOCLE) in the context of several data sets.

(**41998**) **Multi-Ring Particle Swarm Optimization**, Carmelo Bastos-Filho, Marcel Caraciolo, Péricles Miranda, Danilo Carvalho

Abstract: Particle Swarm Optimization (PSO) has been used to solve many different types of optimization problems. By applying PSO to problems where the feasible solutions are too much difficult to find, new ways of solving the problems are required, mainly for hyper dimensional spaces. Many variations on the basic PSO form have been explored, targeting the velocity update equation. Other approaches attempt to change the structure of the swarm. In this paper a novel PSO topology based on multiples rings is proposed for improving the results achieved focusing on the diversity provided by the ring rotations. A comparison with star and ring topologies was performed. Our simulation results have shown that the proposed topology achieves better results than the well known star and ring topologies.

(**42016**) **Easy efficiency-enhancement techniques for the ECGA**, Vinicius Melo, Alexandre Delbem

Abstract: Several works have shown that population size affects the performance and efficiency of evolutionary optimization algorithms. There are works in the literature proposing techniques for the determination of the best size of a population using complex equations or synthetic benchmarks. Nevertheless, higher population size usually lead to more function evaluations and higher running time. On the other hand, lower population size in general implies a poor sampling of the search space and premature convergence of the algorithm. This paper investigates the influence of the first population on estimation of distribution algorithms. The basic idea is that the first population has a very larger effect on the estimation of distribution than the remaining populations. We analyzed the effects on an ECGA produced by different population sizes and distribution functions in the first population. We verified that the population size can be smaller than the one estimated by the authors of the ECGA if a larger initial population is used. An acceptable population size was chosen after the execution of various experiments. An optimum smaller population size is not well defined yet, requiring new tests to develop the theory. Moreover, the distribution of the population over the search-space directly affects the result of the optimization process. A small bias in the generation of the population can increase the success rate from 0% to 100% in most cases. Thus, it is possible the development of ECGAs requiring relatively lower running time and evaluations without decreasing the success rate. Therefore, the knowledge provided by this work can contribute largely for the improvement of general estimation of distribution algorithms.