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Evolutionary Optimization for Intelligent Systems Design

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Evolutionary Optimization is becoming omnipresent technique in almost every process of intelligent system design. Just to name few, engineering, control, economics and forecasting are some of the scientific fields that take advantage of an evolutionary computational process that aid in engineering systems with intelligent behavior.

This special issue of Journal of Universal Computer Science is devoted to reporting innovative and significant progress in intelligent systems design through an evolutionary computational process. It includes eight contributed papers, whose main contributions are described in the sequel.

In the first contribution, which is entitled "Automatic Construction of Fuzzy Rule Bases: a further Investigation into two Alternative Inductive Approaches", Marcos Evandro Cintra, Heloisa Arruda Camargo, Estevam R. Hruschka Jr. and M. do Carmo Nicoletti discuss the results of two different hybrid methods for the automatic generation of fuzzy rules from numerical data. One of the methods proposes the creation of fuzzy rule bases using genetic algorithms in association with a heuristic for preselecting candidate rules based on the degree of coverage. The other method induces a Bayesian classifier using a dataset previously granulated by fuzzy partitions and then translates it into a fuzzy rule base. A comparative analysis between both approaches focusing on their main characteristics, strengths/weaknesses and easiness of use is carried out. The reliability of both methods is also compared by analyzing their results in a few knowledge domains.

In the second contribution, which is entitled "Parallel Strategies for Stochastic Evolution", Sadiq M. Sait, Khawar S. Khan and Mustafa I. Ali propose the discussion of parallelization of Stochastic Evolution meta-heuristic, for a distributed parallel environment. VLSI cell placement is used as an optimization problem. A

comprehensive set of parallelization approaches are tested and an effective strategy is identified in terms of two underlying factors: workload division and the effect of parallelization on meta-heuristics search intelligence. The strategies are compared with parallelization of another similar evolutionary meta-heuristic. The role of the two mentioned underlying factors is discussed in parallelization of stochastic evolution.

In the third contribution, which is entitled "A Hybrid Transgenetic Algorithm for the Prize Collecting Steiner Tree Problem", Elizabeth Ferreira Gouvêa Goldbarg, Marco César Goldbarg and Cristine Cunha Schmidt present an algorithm based on living processes where cooperation is the main evolutionary strategy and apply it to the Prize Collecting Steiner Tree Problem, which is an *NP*-hard combinatorial optimization problem. The transgenetic algorithm presented is hybridized with path-re-linking. Computational results of an experiment performed with benchmark instances are reported. The results obtained for the Prize Collecting Steiner Tree Problem with the application of the hybrid transgenetic algorithm are compared with the results of three other effective approaches. The computational experiment shows that the proposed approach is very competitive concerning both quality of solution and processing time.

In the fourth contribution, which is entitled "Bus Network Optimization with a Time-Dependent Hybrid Algorithm", Ana C. Olivera, Mariano Frutos, Jessica A. Carballido and Nélida B. describes a new hybrid technique that combines a Greedy Randomized Adaptive Search Procedure (GRASP) and a genetic algorithm with simulation features in order to solve the Bus-Network Scheduling Problem. The GRASP is used as an initialization method to find the routes between bus stops. The Genetic Algorithm is used to find the whole configuration of the bus network, together with a simulation tool that finds the values of the environmentally dependent dynamic variables. The new method was tested with an academic case of study, and the results clearly satisfy the requirements of both the transport user and the transport operator.

In the fifth contribution, which is entitled "Quantum-Inspired Evolutionary State Assignment for Synchronous Finite State Machines", Marcos Paulo Mello Araujo, Nadia Nedjah and Luiza de Macedo Mourelle present a quantum inspired evolutionary algorithm designed for finding a state assignment of a given synchronous finite state machine, which attempts to minimize the cost related to the state transitions. The authors show clearly that the proposed quantum-inspired evolutionary algorithm always evolves better state assignments when compared to known classical systems and GA-based systems.

In the sixth paper, which is entitled "Optimal Sensor Network Layout Using Multi-Objective Meta-heuristics", Guillermo Molina, Enrique Alba and El-Ghazali Talbi address the wireless sensor network layout problem using Multi-Objective Meta-heuristics. We employ a set of multi-objective optimization algorithms for this problem where we define the energy efficiency and the number of nodes as the independent optimization objectives. Our results prove the efficiency of multi-objective meta-heuristics to solve this kind of problem and encourage further research on more realistic instances and more constrained scenarios.

In the seventh paper, which is entitled "GADYM - A Novel Genetic Algorithm in Mechanical Design Problems", Khadiza Tahera, Raafat N. Ibrahim and Paul B. Lochert proposes a variant of genetic algorithm – GADYM, Genetic Algorithm with

Gender-Age structure, DYnamic parameter tuning and Mandatory self perfection scheme. The motivation of this algorithm is to increase the diversity throughout the search procedure and to ease the difficulties associated with the tuning of GA parameters and operators. The experimental results of the proposed algorithm based on a mechanical design problem show promising results.

In the eighth paper, which is entitled "Two Step Swarm Intelligence to Solve the Feature Selection Problem", describe a new feature selector method based on a new approach to swarm intelligence. The feature selector looks for reducts, the search process is implemented by using ACO or PSO, and a measure based on rough sets is used to build the evaluation function. The basic idea is to split the heuristic search performed by agents (particles or ants) into two stages. In the first step the agents build partial solutions which are used as initial states in the second step. The authors also assess the performance of the proposed method.

As guest editors of this special issue of J.UCS, we wish to thank all the contributors for their hard work and their promptness. Also, our special thanks go to the reviewers that provided us with the right feedback at the right time. This allowed us to fulfill our aim within the expected quality and delays.

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