
Editorial – New trends on swarm intelligence: algorithms and applications

Nadia Nedjah*

Department of Electronics Engineering and Telecommunications,
Faculty of Engineering,
State University of Rio de Janeiro,
Rua São Francisco Xavier, 524,
5022-D Maracanã, Rio de Janeiro 20550-900, Brazil
Email: nadia@eng.uerj.br
*Corresponding author

Luiza de Macedo Mourelle

Department of Systems Engineering and Computation,
State University of Rio de Janeiro University,
Rua São Francisco Xavier, 524,
5022-D Maracanã, Rio de Janeiro 20550-900, Brazil
Email: ldmm@eng.uerj.br

Biographical notes: Nadia Nedjah is an Associate Professor in the Department of Electronics Engineering and Telecommunications at the Faculty of Engineering, State University of Rio de Janeiro, Brazil. Her research interests include functional programming, embedded systems and reconfigurable hardware design as well as cryptography and computational intelligence. She received her PhD in Computation from the University of Manchester – Institute of Science and Technology (UMIST), England, MSc in System Engineering and Computation as well as her Engineering degree in Computer Science from the University of Annaba, Algeria.

Luiza de Macedo Mourelle is an Associate Professor in the Department of System Engineering and Computation at the Faculty of Engineering, State University of Rio de Janeiro, Brazil. Her research interests include computer architecture, embedded systems design, hardware/software co-design and reconfigurable hardware as well as computational intelligence. She received her PhD in Computation from the University of Manchester – Institute of Science and Technology (UMIST), England, MSc in System Engineering and Computation from the Federal University of Rio de Janeiro (UFRJ), Brazil and Engineering degree in Electronics also from UFRJ, Brazil.

The focus of this special issue of the *International Journal on Bio-Inspired Computation* is on new trends on swarm intelligence, both in theory and applications. Swarm intelligence is the collective behaviour of distributed, self-organised artificial systems inspired by the overall behaviour of natural social systems, such as ant colonies, bird flocking, animal herding, bacterial growth, fish schooling and microbial intelligence. The concept is employed in work on artificial intelligence. Swarm intelligence-based techniques are now witnessing a very flourishing era leading the advent of many new effective yet efficient such optimisation techniques. The included are mostly either on improving or applying particle swarm optimisation, memetic algorithms ant and bat colony optimisation to solve some hard engineering problems. Their contributions are papers are summarised in the sequel.

First, in a paper entitled ‘Population-based variable neighbourhood search algorithm applied to unconstrained continuous optimisation’, the authors present a population-based variable neighbourhood search approach

for unconstrained continuous optimisation. The main contributions of the proposed algorithm consist in evolving a population of candidate solutions and allowing them to adapt their own neighbourhood search area accordingly to their performance. This strategy allows the solution to autonomously exploit and explore promising regions in the search space adaptively. The performance of the proposed strategy is evaluated via the usage of several unconstrained continuous benchmark functions with a high dimensionality. The obtained results are compared to those the results yielded by some well-known population-based approaches, such as differential evolution, particle swarm optimisation and artificial bee colony. The results suggest that the proposed approach is a promising and competitive algorithm for unconstrained continuous optimisation.

Then, in a paper entitled ‘An alternative approach for particle swarm optimisation using serendipity’, the authors deal with the problem known as premature convergence. They approach the issue using the concept of serendipity and its adaptation in this new context. Several strategies that

implement serendipity are evaluated in order to develop a particle swarm optimisation variant based on this concept. The results are compared the traditional algorithm of particle swarm optimisation considering the quality of the solutions and the ability to find global optimum. The results show promising performance regarding the mentioned criteria.

Subsequently, in a paper entitled 'Feature selection based on binary particle swarm optimisation and neural networks for pathological voice detection', the authors deal with pathological voice discrimination. For this purpose, they use 52 Haralick texture features, extracted from two-dimensional wavelet coefficients of speech signals from recurrence plots pathologies. Three pathologies are considered for analysis: vocal fold paralysis, oedema and nodules. For feature selection, they exploit a binary particle swarm optimisation algorithm using multilayer perceptron neural network with cross-validation. Statistical results for individual measures show significance for several employed measures. The measures are combined and the more relevant ones based on the highest accuracy are selected by the optimisation algorithm. The comparison of the approach performance with and without the application of the optimisation algorithm shows that the latter increases the accuracy rates and reduces the amount of features by almost half.

Then, in a paper entitled 'Embedded implementation of template matching using correlation and particle swarm optimisation', the authors apply template matching, which is an important technique used in pattern recognition, to find a given pattern, from a prescribed model, in a frame sequence. In order to evaluate the similarity of two images, they employ the Pearson's correlation coefficient. Instead of computing this coefficient for each of the image pixels, which entails a computationally very expensive operation, the authors propose the implementation of template matching together with particle swarm optimisation as an embedded system. This approach allows for a high versatility of usage in portable equipments. A hardware/software co-design system with coefficient computation implemented in hardware, while the optimisation process in software, is used to achieve real time template matching, which is a pre-requisite in real-word applications. The results indicate that the matching process becomes up to $131\times$ faster than the brute force exhausted search.

Thereafter, in a paper entitled 'A memetic algorithm for power system damping controllers design', the authors present a hybrid algorithm for robust and coordinated design of power system stabilisers. Power system stabilisers are controllers installed on synchronous generators for excitation control in order to damp power system oscillations. The authors cast the tuning procedure regarding the gain and phase compensation stage as an optimisation problem, which aims at maximising the damping coefficients in closed-loop operation. Robustness is dealt with by using multiple operating scenarios. For the optimisation problem solution, the authors combine the bio-inspired bat algorithm with the steepest descent method for local search capability enhancement. The proposed algorithm is applied to benchmark systems for validation.

Last but not least, in a paper entitled 'Using the metaheuristic methods for real-time optimisation of dynamic school bus routing problem and an application', the authors approach the vehicle routing problem as an optimisation process of distribution and transportation systems, which should lead to significant gains both in cost and time. They developed a mobile-supported visual application using the ant colony optimisation together with a genetic algorithm. These methods are used via the application for bus routes of a school located in the province of Ankara, and the yielded performances are compared. The authors show that performance regarding both time and distance for the routes to current school are improved significantly.

The papers published in this issue were selected among the best papers presented at the 2015 edition of the Brazilian Congress on Computational Intelligence (CBIC 2015) and the 2015 edition of the Latin-American Conference on Computational Intelligence (LA-CCI 2015). They were extended with new results and peer reviewed according to the journal's standards by outstanding researchers in this field. We are very grateful to them for their valuable and timely contribution. Moreover, the guest co-editors are very much grateful to the Editor-in-Chief of the journal, namely Dr. Zhihua Cui, for the opportunity to organise this special issue as well as the managing editor Liz Harris and all the editorial team at Inderscience for the assistance during the submission, review and production steps.