GUEST EDITORIAL PREFACE

Special Issue on Bio-Inspired Computation

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Among the approaches of natural computing, those that take biological organisms and societies as models are probably the most salient. This special issue of IJNCR is dedicated to bio-inspired computation in the wake of the track dedicated to that theme in Iberamia 2012, which took place 13-16 November 2012, in Cartagena de Indias, Colombia. A specific call for papers was issued and, as the result of the ensuing review process, the most relevant papers were selected and their authors invited to submit extended versions of their work to form this special issue of IJNCR. These papers went through an extensive review process to ensure they meet the highest quality standards.

The set of articles here presented all use evolutionary approaches to optimization. Following different approaches, they are all concerned with the crucial problem in optimization of controlling population diversity. In line with the most recent approaches to that problem, the four articles present dynamic processes to control population diversity.

The two first articles share as underlying model the NEAT evolutionary algorithm, NeuroEvolution of Augmenting Topologies (Stanley & Miikkulainen 2002), which deploys fitness function, in favor of novelty search in the genotype space. Both articles apply the developments in robotic swarms. In the first article, Gomes, Urbano and Christensen, extend the Minimal Criteria Novelty Search (MCNS) approach (Lehman & Stanley, 2010), which combines fitness evaluation with novelty search. In the newly proposed model, Progressive MCNS (PMCNS) a progressive threshold is used to limit the amount of exploration of uninteresting zones of the search space. The approach has the additional advantage of not needing to specify limits to the value of the threshold, relying only on the dynamics of its updating. Results obtained in two robotic swarm tasks, resource sharing and aggregation, compare favorably to previous approaches.

The second article, by Silva, Urbano and Christensen, extends the odNEAT model (Silva,

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Urbano, Oliveira, & Christensen 2012) with neuromodulation (Soltoggio, Bullinaria, Mattiussi, Dürr, & Floreano, 2008). odNEAT is a online, distributed, and decentralized version of NEAT (Stanley & Miikkulainen 2002) appropriate for evolution of robotic controllers in swarms. Adding neuromodulation increases the plasticity of the controllers and this feature is exploited in a successful application to a difficult dynamic task. In the Concurrent Foraging Task robots must feed on two different types of items, which exchange nutritional values between nutritious and noxious at regular time intervals. The article includes an ablation study to assess the importance of each component of the model.

The article by Guerrero, Berlanga and Molina introduces a dynamic mechanism in the mutation operator in order to increase population diversity in an evolutionary strategy. This approach is an improvement over the previous model using gene matrix and mutagenesis artifacts in a fixed way (Guerrero, Gómez-Jordana, Berlanga, & Molina, 2012). In that work the gene matrix represents the zones of the search space allowing to mark the ones that were explored distinguishing them from the zones that remain to be explored. The current approach, by introducing a dynamic representation increases resolution of the search space representation on a when-needed basis, thus improving the efficiency of the algorithm.

In the article by Hernández-Riveros and Urrea-Quintero the Multidynamics Algorithm for Global Optimisation (MAGO) (Hernández & Ospina, 2010) is used to optimize PID controllers for a range of standard plants modeled as a Second Order System plus Time Delay. The MAGO model makes, in each generation, a dynamic partition of the population into three subsets using different heuristics. By combining the results obtained in the three subpopulations the model also controls population diversity. Results obtained compare better to previous approaches and show robustness to optimization of different modes of the controller.

We believe that this set of articles on state of the art research evolutionary algorithms presents a relevant body of work for readers interested in optimization. The different approaches to one of the most significant problems in optimization, diversity of solutions, moreover with dynamic approaches provide a unique perspective gathered in this special issue.

We take this opportunity to thank the contributing authors, the reviewers involved, and the editor in chief for their cooperation, which resulted in the high quality of this issue.

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