Guest Editorial: Special Issue on Nature Inspired Cooperative Strategies for Optimization (Part II)

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Nature is an unlimited source of resilient, robust, fine tuned, complex mechanisms and phenomena which have been the subject of exploration and exploitation in science and engineering. In particular, understanding complex cooperative systems in nature has driven computer scientists and practitioners to outstanding developments ranging from versatile models and architectures to highly effective methodologies and computing strategies. Examples of these include, but are not limited to, artificial bee colony, memetic-computing agent-models, bacteria metabolism inspired robot controllers, evolutionary design optimization, particle swarm optimization, emergent collective robotics behavior to name but a few.

This thematic issue brings a selection of the best research works published in the IV International Workshop on Nature Inspired Cooperative Strategies for Optimization (NICSO) held on May 2010 in Granada, Spain. The aim of NICSO is to bring together scientists from all over the world to discuss the latest ideas and state of the art on nature inspired cooperative strategies. As in its previous editions, NICSO 2010 has covered topics related to adaptive behavior, ant colonies, amorphous computing, artificial life, bio-inspired architectures, distributed computing, evolutionary robotics, evolvable systems, membrane computing, software self-assembly, evolutionary computation, swarm intelligence and quantum

computing. Since NICSO 2010 has been one of the most successful editions to date we chose to split this thematic issue in two parts. The first part focuses on swarm intelligence, evolutionary design optimization, distributed memetic computing models and neural networks design. The second part centers on robotics research bringing together strategies for self-organization, control architecture design and emergent collective behavior.

To begin with the second part of this thematic issue, the work of V. Fischer and S. Hickinbotham report on the evolutionary design of a robotic control architecture. Inspired by bacteria metabolism, this approach layouts a novel subsumption architecture that distributes the robotic control among information processing entities which interact with each other by means of simple reaction rules resembling biochemical reaction networks. In this way, behavioral strategies emerge from a metabolic control system regulated by interaction rates, network topology and concentration values. This achieved metabolic controller is compared to other subsumption architectures aided by evolutionary parameter optimization, open source simulators and physical hardware to deploy e-puck robots. Besides the qualitative evaluation in performance, models are subject to quantitative analyses and assessment regarding their capability for adaptation and flexibility to develop different behavioral strategies.

H. F. Satizábal, A. Upegui, A. Perez-Urbe, F. Mondada and P. Régnier describe a novel collaborative methodology applied to forager robots. The goal of this work is to improve the localization of targets by means of cooperation and coordination between robots. Interestingly, this is a self-organization approach in which robots are autonomous entities which navigate an environment without pre-loaded planning or central control benefiting as a whole by broadcasting information among neighbors. In order to achieve this, robots employ the so called state communication, thus

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simplifying the communication system and making the coordination mechanism more robust and scalable than other classical approaches such as central planing, global positioning systems or odometry based strategies. Robots together with software simulations were employed to experimentally test and validate this idea, the outstanding results of which are supported by statistical analyses and comparisons to other existing methodologies.

Finally, A. F. T. Winfield and M. D. Ebas report preliminary results of their research work on emergent collective behavior in robot societies. In particular, this work centers in embodied imitation using e-puck robots capable of learning from each other by imitation. This interesting piece of research takes place in an artificial culture laboratory equipped with a state-of-the-art platform of hardware and software where robots are physically placed to interact with one another. Robots are programmed with a finite state machine which allows them to switch between two independent modes: teacher and learner. In the teacher

mode, robots perform a sequence of selected movements while in the learner mode robots attempt to learn an observed sequence of movements. The authors focus their investigations on the way teacher robots select their movements in order to shed light on whether employing different selection mechanisms is crucial for the emergence of artificial collective behavior.

We consider that the content presented in this issue is a compilation of high quality research product of several months of coordinated work between authors, reviewers and editors. We thank authors for their utmost effort on preparing and submitting their manuscripts and also reviewers for their support and assistance on the strict peer review process each contribution has been subjected to. As guest editors, we hope the articles published in this thematic issue are perceived as key contributions to the field of cooperative strategies for optimization and propel the development of innovative research related to this topic.