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Editorial

Editorial: Special issue on advances in swarm intelligence for neural networks

Very recently, swarm intelligence (SI) became the hottest paradigm in the community of computational intelligence and has received extensive attention from many researchers. As we know, SI is the collective problem-solving behavior of groups of animals or artificial agents that result from the local interactions of the individuals with each other and with their environment. As usual, SI systems are primarily inspired by natural systems and greatly depend on certain key principles such as decentralization, stigmergy, collaboration, and self-organization which are observed in the organization of social insect colonies and other animal aggregates, such as ant colonies, bird flocks, fish schools, bacterial foraging, honey bee, fireworks explosion, brainstorming process, etc. Besides the research on theoretical analysis and algorithms, extensive application research of SI have also been carried out, in particular, the swarm intelligence for neural networks. Up to now, there are a number of research articles to deal with the applications of SI in neural networks which would inspire certain new research directions and solutions in the community of neural networks as well as swarm intelligence. The annual international conference on swarm intelligence (ICSI) (official website: http://www.ic-si.org) eventually became one of the most important forums for scientists, engineers, educators, and practitioners to exchange the latest advantages in theories, technologies, and applications of swarm intelligence and related areas and attracts hundreds of researchers all over the world each year.

This special issue included 24 highly evaluated papers from the third international conference on swarm intelligence (ICSI) (http://www.ic-si.org), which was held from June 15 to 18, 2012, Shenzhen, China. All the papers were thoroughly revised and have been extended essentially by authors and then re-submitted to Neurocomputing for a regular peer reviewing process. These papers are divided into 5 groups which are briefly summarized as follows.

Papers in the first group is to present improvements and theoretical analyses of some typical swarm intelligence algorithms including the genetic algorithm (GA), particle swarm optimization (PSO) and ant colony optimization (ACO). In particular, some of the improvements were specialized for certain type of applications. Zhang et al. proposed a new fitness scaling method, named powered distance sums scaling (PDSS), to eliminate the influence of fitness distribution on stochastic selection. PDSS maintains a more constant and consistent selective pressure in different optimization conditions and may help GA designers in balancing exploration and exploitation during evolution procedures. Hsu et al. proposed a genetic algorithm to solve MEDP. In comparison to the multi-start simple greedy algorithm and the ant colony optimization method, the proposed GA method performs better in most of the instances in terms of solution quality and time. Cheng et al. proposed an improved multi-objective particle swarm optimization with preference strategy (IMPSO-PS) for optimal integration of distributed generation (DG). The method introduces the dynamic selection of the global bests and a special mutation operation. The results show that the proposed approach can provide a wider range of Pareto solutions of high quality while satisfying special preference demands. Yusoff et al. proposed an improved discrete particle swarm optimization (DPSO) algorithm for solving the evacuation vehicle assignment problem (EVAP). The results show that DPSO with a min–max approach offers a good performance with respect to maximizing the number of individuals who can be evacuated by vehicles. Vitorino et al. presented a mechanism based on the artificial bee colony to generate diversity when all particles of the PSO converge to a single point of the search space. The improved method is named as ABeePSO, which is evaluated and compared to other well-known swarm based approaches using many benchmark functions. Deng et al. proposed an improved ant colony optimization (ACO) algorithm called pheromone mark ACO (PM-ACO) for the non-ergodic optimal problems. The PM-ACO associates the pheromone to nodes and has a pheromone trace of scattered points referred to as pheromone marks. Experimental results show that the improved PM-ACO has a good performance when applied to the shortest path problem.

The four papers in the second group are to consider various emerging swarm intelligence algorithms inspired from nature, such as bacteria foraging optimization (BFO), artificial bee colony optimization (BCO) and firework algorithm (FWA). Applications and improvements of these algorithms are also included. To achieve high-quality solutions for constrained optimization problems, Niu et al. employed two modified bacterial foraging optimization (BFO), BFO with linear and non-linear decreasing chemotaxis step (BFO-LDC and BFO-NDC) to balance global search and local search. Wu et al. proposed a new model based on an assumption that the plasmodium of *Physarum polycephalum* forages for food along the gradient of chemo-attractants on a nutrient-poor substrate. Growth of Physarum is determined by the simple particle concentration field relating the distance to food source and the shape of food source. The model can imitate Physarum to avoid repellents and performs well in spanning tree construction. Maeda et al. presented a reduction of the artificial bee colony algorithm for global optimization. Bees sequentially reduce to reach a predetermined number of them grounded in the evaluation value. The proposed method had superiority in comparison with existing algorithms for complicated functions.

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The Fireworks algorithm is inspired by the phenomenon of fireworks display. Zheng et al. developed an improved fireworks algorithm (FWA) by combining with differential evolution operators, which increases the information sharing among the individual solutions to a great extent. Experimental results show that the DE operators can improve diversity and avoid prematurity effectively.

Four papers of researches on swarm robot systems and multiagent systems are included in the third group. Several interesting tasks are involved, including exploring unknown environments, path planning, automatic assembly, disassembly and construction of user-defined structures. Kuyucu et al. achieved a guided probabilistic exploration of an unknown environment via combining random movement with pheromone-based stigmergic guidance. The emergent strategy is shown to provide a scalable solution to multi-robot coordination for the area exploration task, with a faster than linear speed-up with the addition of new robots. Mo et al. presented a new method of global path planning by combining Biogeography-based Optimization (BBO) and PSO to optimize paths in approximate Voronoi boundary network (AVBN) in a static environment. Yeom presented a decentralized approach, inspired by biological cells, for the automatic construction of user-defined three dimensional structures. By investigating the evolutionary aspects of morphogenesis, regulated by the interplay of the cell processes such as differential cell adhesion, gene-regulation and inter-cellular signaling, an approach was developed for the construction of an arbitrary structure via swarms of agents. Li et al. presented a co-evolution framework for the swarm of self-assembly robots Sambots in changing environments. Sambot robots are able to autonomously aggregate and disaggregate into a multi-robot organism. To obtain the optimal pattern for the organism, the configuration and control of locomotion co-evolve by means of genetic programming with specialized genetic operators.

Hybrid algorithms for solving various applications are described in the fourth group. Particle swarm optimization, evolution computation, genetic programming and other non-heuristic methods are taken into consideration in those works. The applications include scheduling, optimizing, forecasting and discovering. Shou et al. proposed a hybrid particle swarm optimization procedure to solve the preemptive resource-constrained project scheduling problem with various types of particle representations, schedule generation schemes and updating mechanisms. Computational results show that introduction of preemption helps to reduce project duration and the proposed particle swarm optimization procedures are effective for the scheduling. Li et al. developed a new class of two-stage minimum risk problems for insuring critical path problem. The first-stage is to minimize the probability of total costs exceeding a predetermined threshold value, while the second-stage maximizes the insured task durations. A new hybrid algorithm by combining dynamic programming method (DPM) and genotype–phenotype-neighborhood based binary particle swarm optimization (GPN-BPSO) is proposed and achieved a better performance than the hybrid GA and hybrid BPSO. Wu et al. proposed a hybrid optimization strategy (HPSOGA) by incorporating particle swarm optimization (PSO) into genetic algorithm (GA) with elitist strategy, to build a Radial Basis Function Neural Networks for rainfall forecasting. HPSOGA is more effective in global exploration and avoiding premature convergence, and may be used as a promising alternative forecasting tool for higher forecasting accuracy and better generalization ability. Tang et al. proposed a hybrid evolutionary algorithm called HEA-GP for discovering high-level knowledge modeled by systems of ordinary differential equations (ODEs) from the observed data. A prototype of KDD Automatic System has also been developed to discover models automatically.

In the fifth group, swarm intelligence algorithms were adopted for several interesting applications including feature selection, analysis of slop stability, error estimation, charging strategy and pattern recognition. Zhang et al. proposed a new method to find optimal feature subset by the BPSO, the binary BPSO, in which a reinforced memory strategy is designed to update the local leaders of particles for avoiding the degradation of outstanding genes, and a uniform combination is also proposed to balance the local and global explorations. Zhang et al. proposed an immune cooperation mechanism based learning (ICL) framework. This ICL framework simulates the biological immune system in the view of immune signals and takes full advantage of the cooperation effect of the immune signal 1 and signal 2. Different from previous works, it does not involve the concept of the danger zone. Chen et al. used the standard landslide analysis program (STABL) for analysis of slope stability and turned it into a computation engine for PSO. The results of STABL were automatically analyzed by the program to produce the next generation's input data files. The results showed very promising potentials on a standard soil slope. The system not only converged to a solution but also generated the best solution ever in the literature. Tungadio et al. utilized the particle swarm optimization (PSO) to solve the state estimation problem which aims to minimize all measurement errors available at the control center. Lee et al. designed a dual-battery management scheme as charging task scheduler in Electric Vehicle (EV) charging stations to reduce peak load brought by concentrated charging from a large number of EVs. The scheduler uses the genetic algorithm to select the power source out of two station batteries and the main power line. Cachón et al. proposed a genetic algorithm (GA) to automatically adjust the parameters of the Integrate and Fire (I&F) spiking model. The proposed method achieved very good results in all five test cases.

I hope that this special issue could stimulate some new directions and solutions that can lead to theoretical insight and effective applications in swarm intelligence for neural networks. I appreciate the Editor-in-Chief of Neurocomputing Prof. Tom Heskes for giving us this opportunity to make this special issue possible. I would like to express my heartfelt thanks to all reviewers for your timely and in-depth reviews of these papers. Finally, I am grateful to all the authors who made great efforts in writing and revising their papers which consisted of this special issue with a high quality. This work was supported by NSFC 61375119 and 61170057.

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