
Editorial

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Biographical notes: Zhijia Cui is an Associate Professor and the Director of Complex System and Computational Intelligence Laboratory at Taiyuan University of Science and Technology, China. His research interests include swarm intelligence and random algorithms. He has published three books and more than 100 research papers in international journals and conferences.

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Bio-inspired computation is a field of study that loosely knits together subfields related to the topics of connectionism, social behaviour and emergence. It is often closely related to the field of artificial intelligence, as many of its pursuits can be linked to machine learning. It relies heavily on the fields of biology, computer science and mathematics. Bio-inspired computation is an umbrella term for different computational approaches that are based on principles or models of biological systems. Therefore, bio-inspired methods are becoming increasingly important in face of the complexity of today's demanding applications, and accordingly they have been successfully used in various fields ranging from computer engineering and mechanical engineering to chemical engineering and molecular biology.

We believe that the series of works in this special issue provide a useful reference for understanding new trends on bio-inspired computation. In total, 15 papers have been selected to reflect the call thematic vision. The contents of these studies are briefly described as follows.

Project scheduling has attracted an ever-growing attention in recent years both from science and practice. Nowadays, enterprises have to focus more on improving product development efficiency due to the global economic crisis and the increasingly intense market competition. In practice, as activity duration times are always vague in practice, uncertainty (e.g., uncertain productivity of workers, bad weather, etc.) always exists in project scheduling problem. It is often encounters situations where the duration of particular activities cannot be given precisely at the project initialisation stage. In addition, the ready-time

and deadline of a project are flexible and are often determined by the preference of the project manager. In the paper, ‘A chaotic PSO approach to multimode resource-constraint project scheduling with uncertainty’, Weiming Chen, Renbin Xiao and Hongzhi Lu propose a new optimisation method based on chaotic PSO (CPSO) algorithm for solving multimode resource-constraint project scheduling problem (MRCPSP) under uncertainty. A searching technique using CPSO algorithm is adopted to search for the minimum of fuzzy project completion time. A case with uncertain activity duration is used to illustrate the performance of the proposed method. The result indicates that CPSO algorithm can assist project managers in selecting a schedule with the least possibility of being late in an uncertain scheduling environment.

In the paper, ‘Particles swarm optimisation algorithm for radio frequency identification network topology optimisation’, Li Zhang et al. apply the PSO to solve the optimisation problem of topology of radio frequency identification network in this paper. The topology optimisation model of radio frequency identification is discussed at first. The detailed procedures and computer implementation of PSO algorithm are given then for optimisation problem of topology of radio frequency identification network.

To explore the relations between the population structure and the performance of the PSO, paper entitled with ‘Particle swarm optimisation based on self-organisation topology driven by different fitness rank’ (authored by Simin Mo, Jianchao Zeng and Ying Tan) proposes one self-organisation population structure driven by fitness rank (SOTDFR). Meanwhile, to improve the performance of PSO, under invariable network size, the SOTDFR evolution involves two kinds of operations: adding and removing link. Moreover, due to the particle’ fitness rank impacting heavily on the SOTDFR evolution, two kinds of fitness rank is designed and also SOTDFR according to different fitness rank designs is referred to as VSOTDFR and UVSOTDFR respectively. To make a deep insight, VSOTDFR-based PSO and UVSOTDFR-based PSO are used to solve two type benchmarks: unimodal and multimodal functions. Simulation results demonstrate that UVSOTDFR-based PSO can generally obtain the better solution than VSOTDFR-based PSO within the allowed iterations. In addition, the performances between the UVSOTDFR-based PSO and some variants of PSO are compared. The simulation results show that UVSOTDFR-based PSO is competitive.

Water distribution network optimisation is highly complex and possesses non-linear relationship of the problem variables, cascading nature of hydraulic network that make the problem of finding global optimum difficulty using standard optimisation methods. In the paper, ‘Optimal water distribution network design with improved particle swarm optimisation’, Jun-Fei Qiao et al. present an improved PSO algorithm (IPSO) to overcome the drawback that the basic PSO algorithm is easy to fall into local optimal solutions in the optimal design of water

distribution network. The procedure of optimisation is divided into two-phases and searched by PSO with extremum disturbed arithmetic operator and differential evolution (DE) respectively. Extremum disturbed PSO accelerates the particles to overstep the local extremum and DE keeps the diversity of population, with two swarms exchanging information in each iteration to avoid local optimum and reduce iterations. Water distribution networks are designed by improved particle swarm algorithm to achieve the goal of lowest cost of network. Application results show that IPSO reduces the cost of network with rapid convergence rate and strong global searching ability.

In the paper, ‘A novel particle swarm algorithm for solving parameter identification problems on graphics hardware’, Jing Wang, Zhijian Wu and Hui Wang presents a fine-grained novel PSO algorithm on graphics hardware. It has good performance on a collection of parameter identification problems. In this algorithm, a generalised opposition-based learning (GOBL) strategy is embedded into PSO algorithm. This strategy can transform the current solution space to provide more chances of finding better solutions, and the parallel computing on graphics hardware can accelerate the convergence rate significantly. Experiment results show that the novel algorithm on graphics hardware has not only a good tolerability with the noise in the observed data but also a very high speedup.

PSO is a novel swarm intelligent algorithm inspired by fish schooling and birds flocking. Due to the complex nature of engineering optimisation tasks, the standard version can not always meet the optimisation requirements. Therefore, in this paper, ‘Group-decided Watts-Strogatz particle swarm optimisation’, Xiaobo Zhou and Ying Tan incorporate a new group decision mechanism into PSO methodology to enhance the escaping capability from local optimum. Furthermore, a Watts-Strogatz small-world model is incorporated into PSO to increase the population diversity. Seven famous numerical benchmarks are used to testify the new algorithm. Simulation results show that it achieves the best performance when compared with three other variants of PSO especially for multi-modal problems.

Image denoising is an important task in image analysis. To improve the performance of high-density salt and pepper noise denoising, in the paper, ‘An effective approach for removing heavy salt-peppers noise based on bee colony optimisation’, Yonghao Xiao et al. propose a novel approach which includes two-steps. In the first step, the noise pixels are distinguished from the image pixels and set initial values for noise pixels; in the second step, denoising image is obtained using bee colony optimisation. Experimental results show that the proposed approach is very effective and fast, especially for heavy noise image. It can remove salt-and-pepper noise with a noise level from 50% to 95%.

In the paper, ‘Double elite co-evolutionary genetic algorithm’, Xiao-Yan Wang et al. propose a new double elite co-evolutionary genetic algorithm (DECGA) to avoid the premature convergence and low speed of convergence based on the elite strategy and the concept of

co-evolution. In the DECGA, the two different and high fitness individuals (elite individuals) are selected as the core of the evolutionary operation, and the team members are selected by the different evaluation functions to form two-teams by these two-elite individuals. The two-subpopulations can balance the capability of exploration and exploitation by the different evolutionary strategies. Theoretical analysis proves that the algorithm converge to the global optimisation solution. Tests on the functions show that the algorithm can find the global optimal solution for the most test functions, and it can also maintain the population diversity to a certain range. Compared with the existing algorithms, DECGA has a higher performance in precision of convergence and search efficiency.

In the paper, 'An intelligent oil reservoir identification approach by deploying quantum Levenberg-Marquardt neural network and rough set', Nanping Liu, Fei Zheng and Kewen Xia design an intelligent identification approach combining the features of parallel computation of quantum Levenberg-Marquardt neural network (Q-LMNN) and information reduct of rough set as an improved alternative to common statistical identification methods and single-intelligent-based methods which are unable to attain satisfactory result in engineering applications. This approach has been testified to have better performance on reducing the cost and improving the identification accuracy than other methods in practical oil log applications.

Motivated by the knowledge of biological neural system being an asymmetry three dimensional structure and the effect of inhibition within cerebral cortex, paper 'Research on artificial neural networks with spatial architecture based on span connection and lateral inhibition mechanism', authored by Gang Yang et al., proposes a novel topology of artificial neural network called spatial artificial neural network (SANN), which including two types of processing networks: basic network and spatial connection network. The basic network introduces the lateral inhibition mechanism between hidden units and realises the competition in neurons. The spatial connection means that any two-neurons in SANN may have random and long-range connectivity. Supervised learning rules for synaptic weights update is derived from the steepest descent gradient, and the descent gradient with momentum (GDM) is used for network learning. From the experimental analysis of benchmark problems such as pattern recognition, non-linear function approximation, we proof the powerful representation capability and generalisation performance of SANN network.

Recently, biological intelligent computing gains more and more attention in analysing large-scale real world datasets. Because the performance of the support vector machine (SVM) classifier is always degraded by poor feature subsets and inappropriate parameters for training, paper 'A novel hybrid model for image classification', which is authored by Yi-Ming Liu, Min Yao and Rong Zhu, introduces an improved quantum-behaved PSO (IQPSO) to optimise the features and parameters synchronically, aiming

to improve the generalisation of the SVM classifier. That is, a novel hybrid image classification model by combing SVM and IQPSO, called as IQPSO-SVM is presented in this paper. Experimental results show that the proposed IQPSO-SVM improves the classification accuracy greatly compared to the traditional SVM with grid search, and outperforms such SVM based on genetic algorithm (GA-SVM) without accuracy loss.

Using images instead of keywords as query input to search image resources is more practical and convenient in some cases. To this end, one of the key issues is the image similarity computation. In the paper, 'Shape similarity computation for SVG', Dong Li et al. focus on the shape similarity computation of graphics represented by SVG which is the newest W3C standard for describing two-dimensional graphics on web. From our knowledge, there are no effective algorithms for SVG-based shape similarity computation. This paper discusses the geometric features of SVG shapes and the effects of coordinate transformations on shapes in detail, and proposes similarity measuring metrics and methods for the similarity computation. The methods which have been verified through experiments solve the problem of misjudgement brought by transformation effects on the shapes, and the problem of contour comparison between different types of shapes.

In the paper, 'QoS scheduling of fuzzy strategy grid workflow based on the bio-network', Hong-bin Sun and Yong-sheng Ding originally designed a new preference method to designing grid workflow schedule based on the bio-network. The grid workflow matching relation is achieved by mobile bio-entities negotiation based on projection-join closure to capture such message situations. Abstract workflows represent a grid application, its internal structure and data/control flow on a functional level with no execution details. Such dynamic workflow rescheduling may provide the functionality to rethink some parts of workflow which are not executable at the moment in order to devise a better strategy to obtain the demanded results.

In the paper, 'Economic load dispatch solution by improved harmony search with wavelet mutation', V. Ravikumar Pandi et al. present a new evolutionary optimisation algorithm to solve economic load dispatch (ELD) problem with operational constraints using the improved harmony search algorithm. Harmony search algorithm is a recently developed derivative-free, meta-heuristic optimisation algorithm, which draws inspiration from the musical process of searching for a perfect state of harmony. In this paper, we replace the random selection process in the classical harmony search method by wavelet theory-based mutation process to improve the performance of the algorithm. The proposed methodology easily takes care of solving non-convex economic load dispatch problems along with different constraints like power balance, ramp rate limits of the generators and prohibited operating zones. Simulations were performed over various standard test systems with different number of generating units and a comparative study is

carried out with other existing relevant approaches. The result obtained reveals the robustness and ability of the proposed methodology over other existing techniques.

In the paper, 'Principal components analysis by the galaxy-based search algorithm: a novel metaheuristic for continuous optimisation', Hamed Shah-Hosseini formulates the principal components analysis (PCA) as a continuous optimisation problem. Then, a novel meta-heuristic inspired from nature is employed to explore the search space for the optimum solution to the PCA problem. The new meta-heuristic is called galaxy-based search algorithm or GbSA. The GbSA imitates the spiral arm of spiral galaxies

to search its surrounding. This spiral movement is enhanced by chaos to escape from local optimums. A local search algorithm is also utilised to adjust the solution obtained by the spiral movement of the GbSA. Experimental results demonstrate that the proposed GbSA for the PCA or GbSA-PCA is a promising tool for the PCA estimation.

For this special issue, we received abundant responses from researchers. Among them, 15 papers were accepted and are included in this special issue. Overall, we feel that these papers cover quite a spectrum of, what is, a novel yet highly important research field.