Editorial

Zhihua Cui* and Jianchao Zeng

Complex System and Computational Intelligence Laboratory,
Taiyuan University of Science and Technology,
Taiyuan 30024, China
E-mail: cuizhihua@gmail.com E-mail: zengjianchao@263.net
*Corresponding author

Guoji Sun

State Key Laboratory for Manufacturing Systems Engineering,
Xi'an Jiaotong University,
Xi'an, China
E-mail: gjsun@sei.xjtu.edu.cn

Biographical notes: Zhihua Cui is Co-Founder and Research Group Leader in the Complex System and Computational Intelligence Laboratory, and Associate Professor in the School of Computer Science and Technology at Taiyuan University of Science and Technology, China. He received his PhD in System Engineering from Xi'an Jiaotong University in 2008 and his MS in Machine Electronic Engineering from Taiyuan Machinary Institute in 2003. He is the Editor-in-Chief of *International Journal of Bio-Inspired Computation*. In 2005, he received the Natural Science Award (3rd place prize) of Shanxi Province (study of non-linear genetic algorithm). His current research interests are in swarm intelligence and bio-inspired algorithms. He has published nearly 60 international journal and conference papers.

Jianchao Zeng is a Professor and Tutor of PhD students at the Department of Computer Science and Technology, Taiyuan University of Science and Technology, Taiyuan, China. He is now the Vice-President of TUST. He received his MSc and PhD in System Engineering from Xi'an Jiaotong University in 1985 and 1990, respectively. His current research focuses on modelling and control of complex systems, intelligent computation, swarm intelligence and swarm robotics. He has published more than 200 international journal and conference papers.

Guoji Sun is a Professor in the School of Electronics and Information, Xi'an Jiaotong University, China. He received his BS from Shanghai Jiaotong University in 1957. He has supervised more than 20 PhD students. His research interests include complex system modelling and simulation.

Particle swarm optimisation (PSO) is a swarm intelligent modelling algorithm proposed by Kennedy and Eberhart in 1995. It simulates the animal collective behaviour, such as birds flocking and fish schooling. Owing to its simple concepts, fast convergent speed and easy implementation, PSO has been widely applied into many research areas and real-world engineering fields, such as task assignment and scheduling, reactive power and voltage control and so on.

In a PSO system, multiple candidate solutions coexist and collaborate simultaneously. Each solution called a 'particle', flies in the problem search space looking for the optimal position to land. A particle, as time passes through its quest, adjusts its position according to its own 'experience' as well as the experience of neighbouring particles. Tracking and memorising the best position encountered build the particle's experience. For that reason, PSO possesses a memory (i.e., every particle remembers the best position it reached during the past). A PSO system combines local search method (through self-experience) with global search methods (through neighbouring experience), attempting to balance exploration and exploitation.

Since PSO is a new swarm intelligent technique, many researchers focus their attention on this area. Currently, the research on PSO generally can be categorised into five parts: algorithms, topology, parameters, merging/combination with other techniques and applications. Although PSO achieves many successfully applications, however, it still encounters two main problems:

1 the bad computational efficiency in the later evolutionary stage

2 it is easy to get trapped in a local optimum when solving high-dimensional multi-modal problems.

We believe that the series of works in this special issue provide a useful reference for understanding these two problems of PSO. In total, 13 papers have been selected to reflect the call thematic vision. The contents of these studies are briefly described as follows.

In the paper, 'An adaptive mutation-dissipation binary particle swarm optimisation for multidimensional knapsack problem', L. Wang, X-t. Wang and M-r. Fei propose a novel adaptive mutation-dissipation binary particle swarm optimisation (MDBPSO) for tackling the multidimensional knapsack problem (MKP). In MDBPSO, the adaptive mutation operator and dissipation operator are introduced to enhance the local search ability and keep the diversity of swarm.

In the paper, 'Performance-dependent attractive and repulsive particle swarm optimisation', Z. Cui proposes a performance-dependent attractive and repulsive particle swarm optimisation (PDARPSO) aiming to improve the performance of ARPSO by introducing the different trajectory for each particle according to its performance. In this new variant, the phase transition is not two extreme cases, but also an interval range to distinguish the performance difference.

In the paper, 'Velocity-free particle swarm optimiser with centriod', Y. Gao designs a new variant of PSO. Similar to bare bones PSO, particles in the proposed algorithm have only position without velocity. Besides, not only the 'social' component and 'cognitive' component of the particle swarm but also the 'centriod' component of the particle swarm is considered to update the particle position.

In the paper, 'Species-conserving particle swarm optimisation for multimodal functions', J-P. Li and A.S. Wood propose a species-conserving particle swarm optimisation (SCPSO) to seek multiple solutions of multimodal functions. The SCPSO is implemented by modifying the velocity function to allow a PSO to locate multiple solutions, using species conservation to maintain the diversity of particles.

In the paper, 'Individual social strategy with non-linear manner', X. Cai proposes four non-linear social learning factor selection strategies to improve the performance of dispersed PSO. Compared with linear automation manner, non-linear manner may more fit for the complex nature of collective behaviour among animal society. Simulation results show the exponential curve strategy can achieve best performance than three other non-linear strategies though the improvements are relied on the test functions significantly.

In the paper, 'A hybrid ACO/PSO algorithm and its applications', Y. Zhang, M. Zhang and Y-c. Liang present a hybrid optimisation algorithm with PSO and ant colony optimisation (ACO). In the proposed algorithm, the PSO is used to optimise the parameters in the ACO, which makes the selection of parameters do not depend on artificial experiences or trial and error, but rely on the adaptive search of the particles in the PSO.

In the paper, 'Hybrid PSO and DE approach for dynamic economic dispatch with non-smooth cost functions', T.S. Chung and T.W. Lau present a novel hybrid optimisation based on the PSO and differential evolution (DE) algorithms to manage the dynamic economic dispatch. The hybrid approach (HPSO) incorporates DE operators into the PSO model to enrich the information exchanges amongst candidate solutions.

In the paper, 'A hybrid PSO with EM for global optimisation', Y. Tian, D. Liu, X. Ma and C. Zhang focus on a hybrid method combining two heuristic optimisation techniques, particle swarm optimisation (PSO) and electromagnetism-like mechanism (EM), called PSO-EM, for the global optimisation of functions. This hybrid technique incorporates concepts of PSO and EM and creates individuals in a new generation not only by features of PSO, but also by attraction-repulsion mechanism of EM.

In the paper, 'Particle swarm optimisation for multi-project location problems with interval profits', D-w. Gong and Y. Zhang present a novel method based on an improved PSO aiming at solving the multi-project location problems with interval objective profits. This improved variant of PSO is coding based on the equivalent probability matrix, and a reverse mutation operator is designed for it.

In the paper, 'Gene selection and parameter determination of support vector machines based on BPSO algorithm', S. Li, X. Wu and M. Tan propose a BPSO based algorithm to accomplish the task of simultaneously obtaining the optimal gene subset from microarray data and tuning the SVM parameters for classification.

In the paper, 'Controlling swarm robots for target search in parallel and asynchronously', S. Xue and J. Zeng present an extended PSO for target search approach. In this new PSO variant, two asynchronous update principles, i.e., the communication cycle-based and evolution position-based control strategies are presented. Besides, a concept of time-varying character swarm is proposed to facilitate decision-making on the best-found position.

In the paper, 'Constrained particle swarm optimisation for sequential quadratic programming', Z.D. Richards combines the strengths of the traditional sequential quadratic programming (SQP) method with an evolutionary algorithm, PSO for solving a constrained non-linear optimisation problem with equality and inequality constraints.

In the paper, 'On the application of PSO algorithm for multi-channel polarisation-mode dispersion compensation systems', G. Duan, L. Xi, X. Zhang and B. Yang apply the PSO algorithm in multi-channel polarisation mode dispersion (PMD) compensation systems.

For this special issue, we received abundant responses from researchers. A total of 49 papers were submitted to us. Among them, 13 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.