Editorial

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Biographical notes: Zhihua Cui is a Professor of Computer Science and Technology, and Director of Complex System and Computational Intelligence Laboratory at the Taiyuan University of Science and Technology, China. He is a member of the IEEE and ACM, senior member of the China Computer Federation (CCF) and member of the Chinese Association of Artificial Intelligence (CAAI). He received his PhD in System Engineering from the Xi'an Jiaotong University, China in 2008, and BSc in Computer Science from the Taiyuan Heavy Machinery Institute in 2003. He is the Founding Editor-in-Chief of the *International Journal of Bio-inspired Computation*. His research interest includes computational intelligence, stochastic algorithm, and combinatorial optimisation. He has published over 60 peer-reviewed journal papers, 60 peer-reviewed full conference papers, and five books in computational intelligence.

Xiao-Zhi Gao received his BSc and MSc degrees from the Harbin Institute of Technology, China in 1993 and 1996, respectively. He obtained his DSc (Tech.) degree from the Helsinki University of Technology (now Aalto University), Finland in 1999. He was appointed as a Docent at the same university in 2004. He has been working as a Professor at the University of Eastern Finland, Finland since 2018. He is also a Guest Professor at the Harbin Institute of Technology, Beijing Normal University, and Shanghai Maritime University, China. His current research interests are nature-inspired computing methods with their applications in optimisation, data mining, machine learning, control, signal processing, and industrial electronics. He has published more than 350 technical papers in the referred journals and conferences, and his present Google Scholar H-index is 29.

Evolutionary algorithms and metaheuristics are widely used to provide efficient and effective approximate solutions to computationally hard optimisation problems. With the widespread use of intelligent systems in recent years, evolutionary algorithms have been applied, beyond classical optimisation problems, as components of intelligent systems for supporting tasks and decisions in the fields of machine vision, natural language processing, parameters optimisation for neural networks, and features selection in machine learning systems. Moreover, they are also applied in areas like complex networks dynamics, evolution and trend detection in social networks, emergent behaviour in multi-agent systems and adaptive evolutionary user interfaces. In these systems, the evolutionary components are integrated in the overall architecture and they provide services, e.g., pattern matching services, to the specific algorithmic solutions.

We believe that the series of works in this special issue provide a useful reference for learning the current progress on intelligent systems with evolutionary algorithms. In total, ten papers have been selected to reflect the call of the thematic vision. The contents of these studies are briefly described as follows.

In particle filter algorithm, the weight values of particles will gradually decrease as the increase of iteration times and the variance of the weight values of the particles will increase. This will lead to an increase in the deviation between the estimated state and the true state. Therefore, in this paper, 'Object tracking using the particle filter optimised by the improved artificial fish swarm algorithm', Zhigao Zeng et al. propose an improved particle filter algorithm. That is, an improved artificial fish swarm optimisation algorithm is used to optimise the traditional particle filter. In the improved particle filter algorithm, the re-sampled particles will be driven to the region with high likelihood function to increase the weight values of the particles. Thus, the estimated state is closer to the real state. Experiment results show the advantage of our new algorithm over a range of existing algorithms.

In this paper, 'Solve the IRP problem with an improved discrete differential evolution algorithm', Shi Cheng and Zelin Wang analyse the inventory-routing optimisation problem. In order to improve the performance of the differential evolution (DE) algorithm to solve the inventory routing problem (IRP), this paper puts forward dynamic adjustment of mutation factor and crossover factor of the DE. It is proved by numerical experiments that the proposed algorithm has certain performance advantages, and it also proves that the improved algorithm can improve the performance of the algorithm by dynamic adjustment of the mutation factor and crossover factor.

The IRP is to minimise inventory and transportation costs simultaneously for increasing profitability of the system. However, the two costs are conflicting in most case and hard to solve. As a promising evolutionary algorithm, DE has been successfully applied to solve many real-world optimisation problems, but it is not used to optimise the IRP. Therefore, in the paper, 'Inventory routing optimisation using differential evolution with feasibility checking and local search', Hu Peng et al. utilise the DE algorithm to optimise the one-to-many IRP where a product is shipped from supplier to a set of retailers over a planning period. In the proposed DEIR algorithm, the solution feasible checking method, the local search method and the optimal routing method based on DE are designed to suit the IRP solving. The computational tests have been conducted on 50 benchmark instances. Experimental results and comparison with different parameter settings have proved that the proposed algorithm is competitive.

As a population-based intelligence algorithm, fireworks algorithm simulates the fireworks explosion process to solve optimisation problem. A comprehensive study on

enhanced fireworks algorithm (EFWA) reveals that the explosion operator generates too much sparks for the best firework limits the exploration ability. Therefore, in this paper, 'Hybrid fireworks algorithm with differential evolution operator' by Jinglei Guo et al., a hybrid version of EFWA (HFWA_DE) is proposed by adding the DE operator. In HFWA_DE, the population is divided into two subpopulations then each subpopulation evolves with FWA operator and DE operator separately and exchanges the elitist individual. Experiments on 20 well-known benchmark functions are conducted to illustrate the performance of HFWA_DE. The results turn out HFWA_DE outperforms some state-of-the-art FWAs on most testing functions.

The bandwidth minimisation problem on graphs (BMPG) is an NP-complete problem, which consists of labelling the vertices of a graph with the integers from 1 to n (n is the number of vertices) such that the maximum absolute difference between labels of adjacent vertices is as small as possible. In this paper, 'Ant colony optimisation with local search for the bandwidth minimisation problem on graphs' by Jian Guan et al., an application of the ant colony optimisation with local search is presented to solve the bandwidth minimisation problem. The main novelty of the proposed approach is an efficient local search combined with first improvement and best improvement strategies. A fast incremental evaluation technique is employed to avoid excessive fitness evaluations of moves in local search. Computational experiments on 56 benchmark instances show that the proposed algorithm is able to achieve competitive results.

DE is eligible for solving continuous optimisation problems. So far, the imbalance between exploration and exploitation in DE runs often leads to the failure to obtain good solutions. In this paper, 'Applying distance sorting selection in differential evolution', Yuxiang Shao et al. propose distance sorting selection. According to the individual has the best fitness among parents and offspring is selected firstly. Then, the genotype distance from another individual to it, the distance in their chromosome structure, decides whether the former individual is selected. Under the control of an adaptive scheme proposed by us, we use it replace the original selection of the CoBiDE in runs from time to time. Experimental results show that, for many among the 25 CEC 2005 benchmark functions, which have the similar changing trend of diversity and fitness in runs, our adaptive scheme for calling selection based on distance sorting brings improvement on solutions.

Outlier detection is an important task in data mining with numerous applications. Recent years, the study on outlier detection is very active, many algorithms were proposed including that based on clustering. However, most outlier detection algorithms based on clustering often need parameters, and it is very difficult to select a suitable parameter for different dataset. Therefore, in this paper, 'Outlier detection based on cluster outlier factor and mutual density' by Zhongping Zhang et al., an outlier detection algorithm called outlier detection based on cluster outlier factor (COF) and mutual density is proposed in this paper which combining the natural neighbour search algorithm of the natural outlier factor (NOF) algorithm and based on the density and distance cluster (DDC) algorithm. The mutual density and γ density is used to construct decision graph. The data points with γ density anomalously large in decision graph are treated as cluster centres. This algorithm detect the boundary of outlier cluster using COF, it can automatic find the parameter. This method can achieve good performance in clustering and outlier detection which be shown in the experiments.

In this paper, 'A new quantum evolutionary algorithm using dynamic rotation angle catastrophe for knapsack problem' by Jialin Li and Wei Li, a quantum evolution algorithm (IQEA) based on dynamic rotation angle catastrophe technology is proposed to solve the knapsack problem. A quantum revolving gate operator with adaptive dynamic adjustment of the rotation angle is designed according to the evolution generations and fitness values. The population is divided into three parts equally, while preserving the optimal solution for each generation. Using the quantum rotation angles of different periods in the evolution process, the catastrophe operations of these three parts are carried out, and the parallel evolution of four types of individuals is realised. With the guidance of better individuals, multi-path optimisation is performed to improve the parallelism of the algorithm. Effectively increase the diversity of the population, carry out multi-directional search, and also retain the excellent information in the offspring population, ensuring the stability of the population. Experimental results show that the proposed algorithm is superior to traditional evolutionary algorithms and traditional quantum evolution algorithms.

Identification of variable interaction and grouping of variables plays an important role in the divide-and-conquer algorithm. In this paper, 'A novel particle swarms with mixed cooperative co-evolution for large scale global optimisation' by Yufeng Wang et al., a novel particle swarms optimisation with mixed cooperative co-evolution (MCCPSO) is proposed. It has two strategies and one mechanism: mixed grouping of variables (MGV) strategy, reallocate computational resources (RCR) strategy and a competitive leadership with a lifecycle mechanism. MGV can effectively identify the direct and indirect interactive variables and form a spare sub-group pool. RCR can give more computational resources to the more important subcomponents. The leader mechanism can prevent the PSO algorithm from falling into a local optimum. In order to understand the characteristics of MCCPSO, we have carried out extensive computational studies on the CEC'2010 benchmark function. The experimental results show that the performance of MCCPSO is better than the other four state-of-the-art algorithms.

In recent years, evolutionary algorithms have developed rapidly and become an important method for solving complex and nonlinear optimisation problems. Many evolutionary algorithms, such as DE algorithm, artificial bee colony (ABC) algorithm and brainstorming (BSO) algorithm, adopt the natural selection principle of 'survival of the fittest' to determine the individuals of new populations. For a long time, researchers regard the selection operator as an important part of maintaining the evolution of the algorithm, and seldom distinguish the optimisation ability of the selection operator. In fact, the natural selection operator also has some capability to optimise. For this reason, in this paper, 'Study on the optimisation ability of natural selection mechanism', Huichao Liu and Fengying Yang take DE algorithm as an example to construct different DE variants, and compare the optimisation results of them with the standard DE algorithm. Simulation results show that the new algorithm which only using natural selection can achieve certain optimisation results, meanwhile, DE algorithm which removing its greedy selection operator only has poor performance. This proves that natural selection operator has certain optimisation capability. Theoretical analysis shows that natural selection mechanism can determine a searching baseline during evolution and make exploration and exploitation fuse with each other.

This special issue on 'Evolutionary algorithms in intelligent systems' present the latest research and development of evolutionary algorithms in intelligent systems. The

guest editors expect that the readers will benefit from the papers presented in the special issue.

The guest editors of this special issue would like to thank all authors for submitting their interesting work. We are grateful to the reviewers for their great contributions to this special issue. Moreover, the guest co-editors are very much grateful to the Editor-in-Chief of the journal, namely Ngoc Thanh Nguyen, for the opportunity to organise this special issue as well as the Managing Editor, Alexandra Starkie and all the editorial team at Inderscience for the assistance during the submission, review and production steps.

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