GUEST EDITORIAL PREFACE

Special Issue on Developments and Applications of Fireworks Algorithm

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The Fireworks Algorithm (FWA), a recently developed swarm intelligence (SI) technique based on simulating the explosion of fireworks in air, proposed by (Tan & Zhu, 2010), has attracted the attention of many researchers and has shown great success on optimization problems, not only the benchmark functions but also the real-world problems. Compared to other swarm intelligence (SI) techniques such as PSO and ACO, FWA presents a new search manner in the solution space and shows a promising performance (Tan, Yu, Zheng & Ding, 2013).

The developments of FWA can be grouped into three categories, the algorithm researches, parallel implementations, and developments of applications, thus to suggest that FWA is a promising algorithm and needs further developments (Tan, 2015a); (Tan & Zheng, 2014). The aim of this special issue is to let more and more researchers to understand the principles of FWA, trying to do some significant improvement works on this novel SI algorithm and applying FWA to practical optimization problems in both academic and industrial fields.

At present, the FWA research is in its infant, most of work on FWA are lying at new FWA algorithms and their variants for single-objective optimization problem and the applications of FWA in several real-world problems, all of which illustrate the high efficiency and excellent performance of FWA.

In order to popularize and promote the research of FWA efficiently and easily, a number of tutorials and introductions to FWA are published in referred journals as of (Tan, Yu, Zheng & Ding, 2013); (Tan & Zheng, 2014). Very recently, the first monograph on FWA is also published by Prof. Ying Tan by Springer International Publishing Corporation in this (Tan, 2015a), and also a Chinese version will be published by Science Press accordingly (Tan, 2015b). Furthermore, a

specific web forum of FWA was created in 2012 and maintained by the Computational Intelligence Laboratory of Peking University at http://www.cil.pku.edu.cn/research/fwa/index.html, where some recent research works and resources (including sources codes and benchmark functions) on FWA are available for interested readers and researchers who are intended for conducting the novel research investigations in FWA developments and its applications.

This special issue aims at boosting the research of FWA for publishing some of the important achievements in current researches of FWA. A number of active researchers respond enthusiastically and quickly to our call for contribution, and submit their latest works to this issue. Five papers are chosen for this special issue through a strict peer-reviewing process, which is briefly introduced below one by one.

The first paper is entitled "Attract-Repulse Fireworks Algorithm and Its CUDA Implementation Using Dynamic Parallelism" authored by Ke Ding and Ying Tan. In this paper, a novel GPU-based FWA variant, Attract-Repulse FWA (AR-FWA) is proposed. The AR-FWA introduces an efficient adaptive search mechanism (AFW Search) and a non-uniform mutation strategy for spark generation. Compared to the state-of-the-art FWA variants, the AR-FWA is able to improve the performance on complicated multimodal problems greatly. Leveraging the edge-cutting techniques (e.g. dynamic parallelism, shuffle et al.) provided by CUDA, the AR-FWA is easily and efficiently implemented on the latest GPU platform.

The second paper is entitled "Parallelization of the Enhanced Fireworks Algorithm using the MapReduce Framework" authored by Simone A. Ludwig and Deepak Dawar. This paper investigates the scalability of the parallelization of the enhanced fireworks algorithm (EFWA), an improved version of FWA, in terms of the MapReduce (MR) platform with help of Apache Hadoop Distributed File System (HDFS). It studies its ability to scale, and the speedup rate obtained on different benchmark functions as increase of problem dimensions. Comparing MapReduce PSO (MR-PSO) with MapReduce EFWA (MR-EFWA), it is shown that the utilization of the MapReduce framework is better for MR-EFWA than MR-PSO algorithm.

The third paper is entitled "Analytics on Fireworks Algorithm Solving Problems with Shift in Decision Space and Objective Space" authored by Shi Cheng, Quande Qin, Yuhui Shi, Qingyu Zhang, and Ruibin Bai. This paper analyzes FWA for solving problems with optima shift in decision space and/or objective space in terms of modular arithmetic mapping strategy which is utilized in the conventional FWA to handle solutions out of search range. The solutions are implicitly guided to the center of search range for problems with symmetrical search range via this strategy. Four kinds of mapping strategies, i.e., modular arithmetic, mapping to the boundary, mapping to stochastic region, and mapping to limited stochastic region, are proposed and compared on problems with different dimensions and different optimum shift range in this paper. In addition, the definitions of population diversities measurement are also proposed from the observations on population diversity changes for different kinds of problems solved by fireworks algorithm.

The fourth paper entitled "Fireworks Algorithm Based Thermal Unit Commitment" authored by Lokesh Kumar Panwar, Srikanth Reddy K, and Rajesh Kumar. This paper applies FWA to solve unit commitment problem (UCP) which is used for effective management of the technical and economic aspects of the power system planning and operation. Generally, the UCP is can be visualized as a cost minimization problem accompanied by appropriate ON/OFF states and effective power sharing among the generating units to arrive at minimum cost of operation yet satisfying all system and generator constraints, that is, a typical constrained combinatorial optimization problem. So the binary FWA (BFWA) is proposed and used for checking its performance for UCP by considering larger system size with a maximum of 100 units. Simulation results show that the BFWA algorithm is superior to other optimization techniques in performance and computational time, especially in case of high dimensionality.

The fifth paper is entitled "Application of Fireworks Algorithm in Gamma-Ray Spectrum Fitting for Radioisotope Identification" by Miltiadis Alamaniotis, Chan K. Choi, and Lefteri H. Tsoukalas. This paper presents a new application of FWA for solving gamma-ray isotope identification problems. The FWA based method utilizes linear fitting of known template signatures in the measured gamma-ray spectrum. Spectrum fitting is formulated as an optimization problem whose solution is computed by FWA while statistical testing is utilized to determine whether a solution non-zero templates. The proposed methodology is tested on two complex spectra, and provided perfect performance in both cases. The other two tested methodologies, i.e., MLR and genetic algorithm, did not provide perfect performance in both scenarios. In general, FWA outperforms both MLR and genetic fitting, though it is much slower than the other two methodologies, which can be used in cases where accuracy and precision is of priority and speed is of no importance.

These five papers can be regarded as the epitome of current FWA studies, for attracting more and more researchers who are interested in FWA to join the research of FWA so that much more high-quality and excellent achievements can come out timely. We wish this special issue could stimulate some of new directions and solutions that can lead to both theoretical insight and practical applications in FWA research. In such a way, we hope FWA can serve our society and life better and more efficient.

We are grateful to the Editor-in-Chief Prof. Yuhui Shi for giving us this chance to organize this special issue timely. Then, we also appreciate all reviewers for their in-depth reviews of these papers in time. At last, we want to thank all of the authors who worked hard in writing and revising their papers carefully and earnestly.

List of Papers

1. Ke Ding and Ying Tan, "Attract-Repulse Fireworks Algorithm and Its CUDA Implementation Using Dynamic Parallelism"
2. Simone A. Ludwig and Deepak Dawar, "Parallelization of the Enhanced Fireworks Algorithm using the MapReduce Framework"
3. Shi Cheng, Quande Qin, Yuhui Shi, Qingyu Zhang, and Ruibin Bai, "Analytics on Fireworks Algorithm Solving Problems with Shift in Decision Space and Objective Space"
4. Lokesh Kumar Panwar, Srikanth Reddy K, and Rajesh Kumar, "Fireworks Algorithm Based Thermal Unit Commitment"
5. Miltiadis Alamaniotis, Chan K. Choi, and Lefteri H. Tsoukalas, "Application of Fireworks Algorithm in Gamma-Ray Spectrum Fitting for Radioisotope Identification"

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Ying Tan is a full professor and PhD advisor at the School of Electronics Engineering and Computer Science of Peking University, and director of Computational Intelligence Laboratory at Peking University. He is the inventor of Fireworks Algorithm (FWA). He serves as the Editor-in-Chief of International Journal of Computational Intelligence and Pattern Recognition (IJCIPR), the Associate Editor of IEEE Transaction on Cybernetics (Cyb), the Associate Editor of IEEE Transaction on Neural Networks and Learning Systems (NNLS), International Journal of Swarm Intelligence Research (IJSIR), etc. He also served as an Editor of Springer's Lecture Notes on Computer Science (LNCS) for more than 12 volumes, and Guest Editor for several referred Journals, including Information Science, Softcomputing, Neurocomputing, Natural computing, IJAI, IJSIR, B&B, CJ, IEEE/ACM Transactions on Computational Biology and Bioinformatics. He is the founder and chair of the ICSI International Conference series, and program committee co-chair of WCCI 2014, etc. His research interests include computational intelligence, swarm intelligence, and data mining. Andreas Janecek is currently a Post-Doc Researcher at the Research Group Entertainment Computing (EC) and the Research Lab Computational Technologies and Applications which are departments at the Faculty of Computer Science at the University of Vienna. He received his PhD degree in Computer Science in 2010, and his MS degree in Business Informatics in 2005, both from the University of Vienna, Austria. Besides computational intelligence such as swarm optimization and evolutionary computing, his research activities include data mining and machine learning algorithms, with a focus on high performance and distributed computing aspects of these techniques.

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