



## Thematic issue on “Brain Storm Optimization Algorithms”

Shi Cheng<sup>1</sup> · Yuhui Shi<sup>2</sup>

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The Brain Storm Optimization (BSO) algorithm is a new kind of swarm intelligence method, which is based on the collective behavior of human being, that is, the brainstorming process. It is not only an optimization method but also could be viewed as a framework of optimization technique. The process of BSO algorithm could be simplified as a framework with two basic operations: the converging operation and the diverging operation. Figure 1 shown the two basic operations in BSO algorithms. A “good enough” optimum could be obtained through recursive solution divergence and convergence in the search space. The designed optimization algorithm will naturally have the capability of both convergence and divergence.

This thematic issue aims to present a collection of recent advances in brain storm optimization algorithms. Based on a double-blinded peer-review process, seven papers were accepted to be included in this issue, covering various ranging from variants of BSO algorithms, theoretical analysis, and applications. The first three papers focus on the new BSO algorithm variants, the fourth paper analyzes different search strategies in BSO algorithms, and the last three papers apply the BSO variants to the real-world applications.

The first paper titled “CBSO: a memetic brain storm optimization with chaotic local search” by *Yu et al.* proposes a method which combines the brain storm optimization with chaotic local search (CLS) to enhance the search ability of BSO. The second paper, “Close formation flight of swarm unmanned aerial vehicles via metric-distance brain storm optimization” by *Duan et al.* develops a metric distance based brain storm optimization algorithm which is further

utilized for the stable control of swarm UAV close formation flight. The third paper “Adaptive brainstorm optimisation with multiple strategies” by *Chu et al.* proposes a variant of BSO algorithm (AMBSO) to improve the performance of BSO algorithm on problems with diverse landscapes. In AMBSO, two heterogeneous but complementary strategies are studied: a differential-based mutation approach is investigated to enhance the global exploration capability, and the sub-gradient method is developed to strengthen the local exploitation capability.

The fourth paper “Search strategies investigation in brain storm optimization” by *Wang et al.* introduces the state-of-the-art search strategies in the BSO algorithm and analyzes the potential strengths and weaknesses of these strategies from the perspective of the analytical model. The numerical experiments are carried out to artificially amplify and highlight the performance of various strategies.

The fifth paper “A brain storm optimization approach for the cumulative capacitated vehicle routing problem” by *ke* proposes a BSO-based algorithm for the cumulative capacitated vehicle routing problem (CCVRP). The sixth paper titled “Multiobjective analog/RF circuit sizing using an improved brain storm optimization algorithm” by *Dash et al.* presents a multiobjective analog/RF circuit sizing tool using an improved brain storm optimization (IMBSO) algorithm with the purpose of analyzing the tradeoffs between competing performance specifications of analog/RF circuit block. The last paper, titled “A discrete bilevel brain storm algorithm for solving a sales territory design problem: a case study” by *Nucamendi-Guillén et al.* proposes a discrete bilevel optimization model for the sales territory design problem. Due to the difficulty of optimally solving the proposed bilevel model, a Discrete Bilevel Brain Storm Optimization (DBBSO) algorithm is proposed for obtaining good upper bounds of the optimal solution.

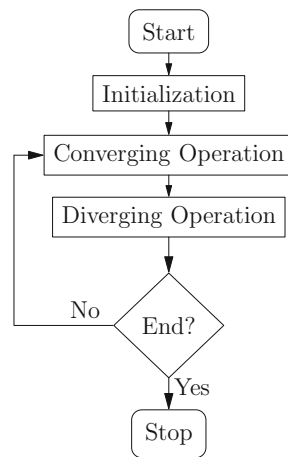
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✉ Shi Cheng  
cheng@snnu.edu.cn  
Yuhui Shi  
shiyh@sustc.edu.cn

<sup>1</sup> School of Computer Science, Shaanxi Normal University, Xi’an, China

<sup>2</sup> Shenzhen Key Lab of Computational Intelligence, Department of Computer Science and Engineering, Southern University of Science and Technology, Shenzhen, China

**Fig. 1** The two basic operations in brain storm optimization algorithms



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that have greatly helped improve the quality of the papers presented here. We hope that readers will find the papers included in this thematic issue interesting and helpful.