Adaptation, Learning, and Optimization

Volume 23

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Brain Storm Optimization Algorithms

Concepts, Principles and Applications

Springer

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Preface

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. Since the introduction of BSO algorithm in 2011, many studies have been conducted from different aspects. It not only is 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. 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 book aims to present a collection of recent advances in brain storm optimization algorithms. Based on a peer review process, eleven chapters were accepted to be included in the book, covering various topics ranging from variants of BSO algorithms, theoretical analysis, and applications.

The book is structured into three parts. In the first part, *i.e.*, Chapter "Brain Storm Optimization Algorithms: More Questions than Answers", a comprehensive introduction to the basic concepts, developments, and future research of BSO algorithms are described. Many works have been conducted on the BSO algorithms; however, there are still massive questions on this algorithm need to be studied.

The second part, *i.e.*, the methodology part, containing Chapters "Brain Storm Optimization for Test Task Scheduling Problem"–"Brain Storm Algorithm Combined with Covariance Matrix Adaptation Evolution Strategy for Optimization", introduces several variants of BSO algorithms. Chapter "Brain Storm Optimization for Test Task Scheduling Problem" introduces a modified BSO algorithm for solving the single-objective and the multi-objective test task scheduling problem (TTSP), respectively. Chapter "Oppositional Brain Storm Optimization for Fault Section Location in Distribution Networks" describes an oppositional brain storm optimization (OBSO) algorithm on solving the fault section location (FSL) problem. Chapter "Multi-objective Differential-Based Brain Storm Optimization for Environmental Economic Dispatch Problem" defines a multi-objective differential brain storm optimization (MDBSO) algorithm to solve

environmental–economic dispatch (EED) problem. Chapter "Enhancing the Local Search Ability of the Brain Storm Optimization Algorithm by Covariance Matrix Adaptation" designs a hybrid algorithm that combines the exploration ability of the global-best BSO (GBSO) algorithm and the local ability of the covariance matrix adaptive evolutionary strategy (CMA-ES) algorithm. Chapter "Brain Storm Algorithm Combined with Covariance Matrix Adaptation Evolution Strategy for Optimization" proposes a hybrid algorithm of the BSO algorithm and the covariance matrix adaptive evolutionary strategy (CMA-ES) algorithm to solve optimization problems.

Finally, the third part, *i.e.*, the applications part, contains Chapters "A Feature Extraction Method Based on BSO Algorithm for Flight Data"–"Enhancement of Voltage Stability Using FACTS Devices in Electrical Transmission System with Optimal Rescheduling of Generators by Brain Storm Optimization Algorithm," which gives a set of examples of utilizing BSO algorithms on solving real-world optimization problems. With applications in complex engineering or design problems, the strength and limitation of various brain storm optimization algorithms could be revealed and interpreted. Chapter "A Feature Extraction Method Based on BSO Algorithm for Flight Data" introduces BSO algorithms on solving the feature extraction problem for flight data. Chapter "Brain Storm Optimization Algorithms for Solving Equations Systems" describes BSO algorithms in solving equation systems (ES). Chapter "StormOptimus: A Single Objective Constrained Optimizer Based on Brainstorming Process for VLSI Circuits" presents the main aspects and implications of design optimization of electronic circuits using the StormOptimus algorithm based on the brainstorming process. Chapter "Brain Storm Optimization Algorithms for Flexible Job Shop Scheduling Problem" describes the BSO algorithms for solving flexible job shop scheduling problems (FJSP). Chapter "Enhancement of Voltage Stability Using FACTS Devices in Electrical Transmission System with Optimal Rescheduling of Generators by Brain Storm Optimization Algorithm" introduces the BSO-algorithm-based voltage stability maintenance by using flexible alternating current transmission system (FACTS) devices.

This book volume is primarily intended for researchers, engineers, and graduate students with interests in BSO algorithms and their applications. The chapters cover different aspects of BSO algorithms, and as a whole should provide broad perceptive insights on what BSO algorithms have to offer. It is very suitable as a graduate-level textbook whereby students may be tasked with the study of the rich variants of BSO algorithms coupled with a project-type assignment that involves a hands-on implementation to demonstrate the utility and applicability of BSO algorithms in solving optimization problems.

We wish to express our sincere gratitude to all the authors of this book who has put in so much effort to prepare their manuscripts, sharing their research findings as a chapter in this volume. Based on a compilation of chapters in this book, it is clear that the authors have done a stupendous job, each chapter directly or indirectly hitting on the spot certain pertinent aspect of swarm intelligence. As editors of this volume, we have been very fortunate to have a team of editorial board members

who besides offering useful suggestions and comments, helped to review manuscripts submitted for consideration. Finally, we would like to put in no definitive order our acknowledgments of the various parties who played a part in the successful production of this volume:

- Authors who contributed insightful and technically engaging chapters in this volume;
- The panel of experts in brain storm optimization algorithms that form editorial board members.
- The book series editor, Prof. Meng-Hiot Lim, who has made great efforts and support on this book.
- The publisher, who has been very helpful and accommodating, making our tasks a little easier.

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Acronyms

Lists of abbreviations are as follows:

ABC	Artificial bee colony
ACO	Ant colony optimization
BSO	Brain storm optimization
BSO-OS	Brain storm optimization in objective space
CI	Computational intelligence
CMA-ES	Covariance matrix adaptive evolutionary strategy
EA	Evolutionary algorithm
EC	Evolutionary computation
EMO	Evolutionary multi-objective optimization
EP	Evolutionary programming
ES	Evolution strategies
GA	Genetic algorithm
GBSO	Global-best brain storm optimization
KNN	k Nearest neighbor
MOO	Multi-objective optimization
OBSO	Oppositional brain storm optimization
PSO	Particle swarm optimizer/optimization
SI	Swarm intelligence
TTSP	Test task scheduling problem