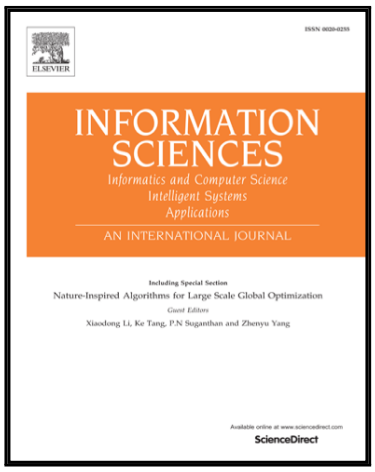

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Backtracking Search Optimization Algorithm Based on Knowledge Learning

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Abstract—As a new evolutionary computation method, the structure of backtracking search optimization algorithm (BSA) is simple and the exploration capability of it is strong. However, the global performance of the BSA is significantly affected by mutation strategies and control parameters. Designing appropriate mutation strategies and control parameters is important to improve the global performance of the BSA. In this paper, an adaptive BSA with knowledge learning (KLBSA) is developed to improve the global performance of the BSA. In the method, an adaptive control parameter based on the global and local information of the swarms in the current iteration is designed to adjust the search step length of individuals, which helps to balance the exploration and exploitation abilities of the algorithm. Moreover, a new mutation strategy based on the guidance of different information is designed to improve the optimization ability of the algorithm. In addition, a multi-population strategy is implemented to thoroughly improve the searching ability of the algorithm for different searching areas. To this end, experiments on three groups of benchmark functions and three real-world problems are implemented to verify the performance of the proposed KLBSA algorithm. The results indicate that the proposed algorithm performs competitively and effectively when compared to some other evolutionary algorithms.

Index Terms—Backtracking search optimization algorithm (BSA), Adaptive BSA with multiple sub-population (AMBSA), Evolutionary computation (EC), Optimization problem

1. Introduction

Optimization problems are widely encountered in science and engineering fields, and there have been some evolutionary algorithms (EAs) presented in recent decades to solve these problems. Some EAs have shown promising results for solving complex, nonlinear, nonconvex and multimodal problems. The genetic algorithm (GA) [1], particle swarm optimization (PSO) [2], differential evolution (DE) [3], teacher-learner based optimization (TLBO) [4], etc. are some classic representatives of these optimization algorithms. Some variants, such as the FDRPSO [5], CLPSO [6], jDE [7], SaDE [8], ETLBO [9], etc., are developed to improve performances of the corresponding original algorithms. Balancing the exploitation and exploration abilities of an evolutionary procedure is always an interesting problem for researchers.

In this work, a recently proposed algorithm (BSA) [10] is studied. The structure of the algorithm is simple, and there is only one control parameter that should be determined in the updating equations. Moreover, crossover and mutation operators of BSA are different from those of some other EAs, and some random history information of the population is memorized to generate the trial population. Some experiments have indicated that BSA has good exploration ability than some other EAs [11]. However, the BSA does not do well in exploitation. Similar to other EAs, the diversity of the population in the BSA is often lost in anaphase of the evolution. The loss of diversity makes the trail population of BSA