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Cuckoo search algorithm with dynamic feedback information

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Abstract: Cuckoo search (CS) algorithm is an effective global search method, while it is easy to trap in local optimum when tackling complex multimode problems. In this paper, a modified version namely CS with dynamic feedback information (DFCS) is proposed. In terms of the feedback control principle, the population properties such as fitness value, improvement rate of solution are used as the feedback information to dynamically adjust the algorithm parameters. Using the fitness value of each individual, the population is divided into three subgroups, and three different schemes based on cloud model are employed to yield the appropriate step size. Then, double evolution strategies are introduced to offer the online trade-off between exploration and exploitation, and the switching probability between them is tuned by the improvement rate of solution. To investigate the convergence accuracy and robustness, the presented DFCS algorithm is tested on 42 benchmark functions with different dimensions. The numerical and statistical results show that DFCS is a competitive method in comparison with five recently-developed CS variants and six state-of-the-art algorithms.

Keywords: Cuckoo search; Dynamic feedback information; Population property; Cloud model; Double evolution strategies

1. Introduction

In the past two decades, metaheuristic algorithms have been widely used for tackling complex optimization problems. These approaches are usually inspired from natural or physical processes [1], and the significant merit is to use the principle of "trial-and-error" to find the optimal solution. Generally, for these algorithms, new individuals are yielded by using proper operators, such as crossover, mutation and so on. Then, the solution quality can be improved through multiple iterations. In contrast with gradient-based algorithms, metaheuristic optimization techniques have been proved to be more effective [2]. Nevertheless, metaheuristic algorithms tend to converge slowly, and there is no a universal method to achieve good result for any problem [3]. Therefore, exploring an efficient metaheuristic algorithm is still an open question.

Broadly speaking, metaheuristic algorithms can be divided into two categories: evolutionary algorithms (EAs) and swarm intelligent (SI) algorithms. Evolutionary algorithms are usually based on the biological evolution, alternative processes or concepts, including genetic algorithm (GA) [4-5], differential evolution (DE) [6], harmony search (HS) [7], teaching-learning-based optimization (TLBO) [8], artificial raindrop algorithm (ARA) [9] and others. Swarm intelligence algorithms are inspired from the social behavior of animals, including particle swarm optimization (PSO) [10], ant colony optimization (ACO) [11], artificial bee colony (ABC) [12], grey wolf optimizer (GWO) [13] and satin bowerbird optimization (SBO) [14] and so on.

Cuckoo search (CS) algorithm [15] belongs to the field of swarm intelligence. In CS, Levy flight, biased random walk and greedy selection are employed to search for the optimal solution. Due to the simplicity and efficiency, CS has attracted extensive attention from the research community. However,

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