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Rain-fall optimization algorithm: A population based algorithm for solving constrained optimization problems

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ABSTRACT

This paper proposes rain-fall optimization algorithm (RFO), a new nature-inspired algorithm based on behavior of raindrops, for solving of real-valued numerical optimization problems. RFO has been developed from a motivation to find a simpler and more effective search algorithm to optimize multi-dimensional numerical test functions. It is effective in searching and finding an optimum solution from a large search domain within an acceptable CPU time. Statistical analysis compared the solution quality with well-known heuristic search methods. In addition, an economic dispatch (ED) optimization problem is run on an IEEE 30-bus test system, and the results, compared with those of recent optimization methods, show RFO performing relatively well, sufficiently effective to solve engineering problems. The constraint-handling strategy of the proposed method for solving ED problem is to generate and work with feasible solutions along all the optimization iterations without any mismatch between electricity demand and the total amount of power generation. Unlike the penalty methods, this strategy is unaffected by parameter setting of applied optimization method and its applicability for solving constrained optimization problems is not hampered. Eventually, its robustness is validated by the results of a sensitivity analysis of the parameters.

1. Introduction

Metaheuristic optimization methods are widely applied in searching for, and finding, approximate optimum solutions in large-scale optimization problems. The term “metaheuristic” refers to general-purpose algorithms applicable to optimization problems, usually without much modification to adapt to a given/specific problem. Most metaheuristic methods implement some form of stochastic optimization so their solutions depend on the set of random variables generated. A metaheuristic method will be successful on a given optimization problem if it can provide a balance between the exploitation of the accumulated search experience and the exploration of the search space to identify regions with high quality solutions in a problem specific, near optimal way. The main difference between the existing metaheuristic methods concerns the particular way in which they try to achieve this balance [1]. A graphical representation of how metaheuristics could be classified is show in Fig. 1. The metaheuristic approaches can be characterized by different aspects in to the different classes such as:

i Trajectory vs. discontinuous methods
ii Population-based vs. single-point search
iii Memory usage vs. memoryless methods
iv Single vs. multiple neighborhoods structures
v Dynamic vs. static objective function
vi Nature-inspired vs. non-nature inspiration

The computational drawbacks such as too many control parameters, excessive sensitivity to the initial value of these parameters, premature convergence, and time-consuming computation that are frequently encountered in different classes of metaheuristic optimization methods have encouraged researchers to develop naturally inspired metaheuristic optimization methods to solve large-scale optimization problems. Naturally inspired metaheuristic optimization methods are generic population-based optimization techniques that converge toward an optimum solution through stochastic exploration. In general, naturally inspired

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