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Global minimum routing in evolutionary programming using fuzzy logic

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ABSTRACT

It is well known that one of the basic advantages of evolutionary programming is in deciding the most suitable place for breeding offspring and finding the route toward the global minimum. To reach this goal, the algorithm needs to estimate the coordinates of the global minimum and then steer the new point toward it. In this paper, the estimation of the global minimum is calculated by weighted mean coordination of individuals (WMP), and then a road is mapped between the coordinates of the parents and the WMP. In the proposed method, fuzzy logic is used for deciding on the road and the best coordination to breed offspring. The proposed algorithm is tested on 65 well-known cost functions and is compared with five algorithms inside the EP family. In the next section of the paper, the algorithm is tested on the high-dimensional problem of modeling ozone layer data, which includes almost 26,000 unknown parameters. The results demonstrate the capability of the proposed method in having acceptable speed and accuracy.

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1. Introduction

Evolutionary algorithms (EAs) are a subset of evolutionary computation, i.e., generic population-based meta-heuristic optimization algorithms. An EA uses a number of mechanisms inspired by biological evolution, including reproduction, mutation, recombination and selection. Candidate solutions for the optimization problem play the role of individuals in a population, and the fitness/cost function determines the environment within which the solutions “live”. Evolution of the population then takes place after the repeated application of the above operators.

In the case of evolutionary computation, there are four historical paradigms, which serve as the basis for most of the activities in the field: Genetic Algorithms (GA) [15], Genetic Programming (GP) [18], Evolutionary Strategies (ES) [29] and Evolutionary Programming (EP) [10]. The basic differences between the paradigms lie in the nature of the representation schemes, reproduction operators and selection methods [33].

The general format of CEP (Classical EP) follows a two-step process of selection and variation in a population. Following the initialization of a population, the fitness of each individual in the population is scored with respect to an arbitrary fitness function. Parents are randomly varied to generate offspring, and the fitness of each member in the population is re-evaluated. Mutation is the only operator in the EP for producing offspring, which is often implemented by adding a random number or a vector from a certain distribution (e.g., a Gaussian distribution in the case of classical EP) to a parent [2]. In

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