Comparative Study of Adaptive Elitism and Mutation Operators in Flower Pollination Algorithm for Combinatorial Testing Problem

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The performance of meta-heuristic search algorithms highly depends on their intensification and diversification abilities. Different algorithms adopt intensification and diversification strategies in order to obtain better results. Elitism and mutation are common operators that are used for increasing the diversity of the population. Flower Pollination Algorithm (FPA) is one of the recent meta-heuristic algorithms for global optimization. Although proven to be efficient, FPA is prone to get stuck into a local optimum due to the weakness of its population’s diversity especially for multimodal optimization problem. In this paper, first, we propose two strategies based on mutation-FPA (mFPA) and elitism-FPA (eFPA) for t-way test generation (t refer to interaction strength). Then, a comparison between mFPA and eFPA is studied to analysis the effect of introducing elitism and mutation operators on FPA’s performance. The results of the experiments show that both of eFPA and mFPA strategies appear to produce better results than original FPA strategy, however, eFPA performs much better than mFPA in term of tests size.

Keywords: Meta-heuristic algorithms, Flower Pollination Algorithm, T-way testing Elitism Operator, Mutation Operator.

1. INTRODUCTION

Meta-heuristic algorithms are becoming rapidly popular in many software engineering fields over the last three decades. Meta-heuristic algorithms provide search guidance for movement in the search space in order to exploit (i.e. also known as intensification) and explore (i.e. also known as diversification) the search space more efficiently. In intensification, the algorithm explores the promising regions in the hope for finding better solutions, while diversification ensures that all regions of the search space have been visited.

Hence, the performance of meta-heuristic algorithms highly depends on their intensification and diversification operations. In the literature review, there are many operations for intensification and diversification that have been used by different algorithms. For example, crossover, mutation, and selection operators in Genetic Algorithm (GA), Tabu operator in Tabu Search (TS), Lévy flights and elitism operators in Cuckoo Search (CS), Random walks or Lévy flight operators in Flower Pollination Algorithm (FPA), and attractiveness operator in Firefly Algorithm (FA), to name a few. In general, all meta-heuristic algorithms use an operator/mecanism search either explicitly or implicitly, in which supposed to enhance the capability of intensification or diversification of the search process.

Mutation and elitism operators are often used for diversification. Mutation operator is analogous to biological mutation. In GA, mutation is a small random change in offspring solution to maintain and introduce diversity in the population of solutions. Mutation operator...