Modification of Bacterial Foraging Optimization Algorithm using Elite Opposition Strategy

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Abstract— **This research work presents the modification of Bacterial Foraging Optimization Algorithm (BFOA) using the elite opposition strategy. The BFOA uses a random search strategy which affect it convergence performance due poor diversification in the search process and the possibility of Oscillatory behaviour towards the search process. The Elite Opposition BFOA is developed to provide more search space so as to enhance more exploitation. The Elite Opposition BFOA (EOBFOA) and the BFOA have been tested using twelve standard benchmark functions (Unimodal and Multimodal benchmark functions). From the simulation result obtained, the EOBFOA outperform BFOA by obtaining better global minimum solution**.

Keywords— **bacterial foraging optimization, elite opposition, benchmark test function, chemotaxis.**

I. Introduction

Optimization is the process of finding the best solution to certain problems base on either finding the maximum or minimum solution with in a certain boundary using a particular objective function. In the world of optimization, traditional optimization methods have been applied in finding the best solution around a specific domain, however the traditional methods (gradient base methods) experience difficulties in finding global optimum [11]. Technically, optimization algorithms can be classified into deterministic and stochastic optimization methods. The deterministic algorithms usually have better solution for a particular optimization problem when the same set of initial values are use at the initial stage of the algorithms. However, such method usually engaged in local search process and easily trapped in local optima. The stochastic optimization methods mostly use a random search process that can enable it escape from local optima and search for a good solution after certain number of iterations [6].

In 2002, Passion was inspired by the foraging behaviour of Escherichia Coli, and propose the Bacteria Foraging Optimization Algorithm (BFOA). The field of BFOA at present has attracted the attention of different researchers' in solving global optimization problem [4]. The BFOA based on social behaviour of the E.Coli bacterial has gain popularity and wider application in solving optimization problem ranging from robot coordination, distributed optimization and control [1]. One of the main challenges of BFOA is its poor convergence capability over multimodal and rough fitness application compared to other evolutionary algorithm such as Genetic Algorithm (GA) and Differential Evolution (DE) [12].

An Adaptive Bacterial Foraging Algorithm (ABFA) was applied in colour image enhancement using fuzzy entropy as an objective function. The ABFA technique optimized the objective function by varying the step size of the bacteria colony. The loss of unnecessary information from the image is reduce by placing constrain during the minimization of the entropy. The ABFA was also compared with the existing image enhancement technique (histogram equalization) and the ABFA outperformed the histogram equalization technique [10]. A multilevel Co-operative Bacterial Foraging Algorithm was applied in colour image segmentation that involved the combination of bacterial chemotaxis, cell-to-cell communication and adaptive scheme for the modification of the Bacterial Foraging Algorithm. A standard test image was used to evaluate the performance of the Co-operative Bacterial Foraging Algorithm with the traditional BFOA. The Co-operative Bacterial Foraging Algorithm outperformed the traditional BFOA in terms of finding a better threshold in less processing time [15].

Bacterial Foraging Optimization Algorithm was modified by varying the population of the bacteria for the purpose of image compression and applying it in fuzzy vector quantization to enable the reduction in average distortion estimation between reconstructed image and training image. The modified BFOA called the BFVPA ensure that the population size of the BFOA scale through variation in the stages of chemotaxis, swarming, elimination and communication sensing in the iteration process. BFVPA