Genetic Algorithm Performance with Different Replacement Strategies in Solving Dejong Function

Munish Sharma[1] Pradeep Kumar Dimri[2]
[1,2]Department of Electronics & Communication Engineering
[1,2]YMCA University of Science and Technology

Abstract— A genetic algorithms is an evolutionary algorithm which can be used in many optimization problems. De jong function is one of major optimization problems which is used for optimization. Genetic algorithm has many operator i.e. initialization, selection, crossover, mutation, replacement. A good replacement method can provide a optimize value of any function. In this paper two replacement methods are implemented on dejong function and result has been compared.

Key words: Genetic Algorithm, Selection, Weak Parent Replacement, Random Replacement

I. INTRODUCTION

Genetic algorithms are categorized under evolutionary algorithms [1]. Genetic algorithms are powerful and widely applicable stochastic search and optimization method based on the concept of natural evaluation (Darwin's theory) that follows the principal of survival of the fittest[2]. Basic steps of genetic algorithm [3] is

- Define fitness function
- Generate initial population
- Evaluate fitness of each chromosome
- Selection
- Crossover
- Mutation
- Replace old population by new generation
- Convergence check

The cycle of genetic algorithm continues until the optimal solution is achieved[4].There are many replacement method which are used in gentic algorthim. But in these paper two replacement methods is discussed ie random replacement, weak parent replacement.

A. Random Replacement:

The children replace two randomly chosen individuals in the population. [5]

B. Weak Parent Replacement:

In weak parent replacement, a weaker parent is replaced by a strong child. With the four individuals only the fittest two, parent or child, return to population. This process improves the overall fitness of the population when paired with a selection technique that selects both fit and weak parents for crossing, but if weak individuals and discriminated against in selection the opportunity will never raise to replace them.[5]

II. PREVIOUS WORK ON REPLACEMENT STRATEGY

In this section paper are given which are studied for implementation, and also those paper are given which is related to this topic.

Manuel Lozano, Francisco Herrera, José Ramón Cano proposed a paper," Replacement strategies to preserve useful diversity in steady-state genetic algorithms" In this paper, author propose a replacement strategy for steady-state genetic algorithms that considers two features of the candidate chromosome to be included into the population: a measure of the contribution of diversity to the population and the fitness function. In particular, the proposal tries to replace an individual in the population with worse values for these two features. In this way, the diversity of the population becomes increased and the quality of the solutions gets better, thus preserving high levels of useful diversity. Experimental results show the proposed replacement strategy achieved significant performance for problems with different difficulties, with regards to other replacement strategies presented in the literature.

Christine L. Mumford proposed a paper "Simple Population Replacement Strategies for a steady-State Multi-Objective Evolutionary Algorithm". In this paper explores some simple evolutionary strategies for an elitist, steady-state Pareto-based multi-objective evolutionary algorithm. The experimental framework is based on the SEAMO algorithm which differs from other approaches in its reliance on simple population replacement strategies, rather than sophisticated selection mechanisms. The paper demonstrates that excellent results can be obtained without the need for dominance rankings or global fitness calculations. a simple steady-state approach, which sequentially selects every individual in the population to serve as the first parent once, and pairs it with a second parent that is selected at random (uniformly). A single crossover is then applied to produce one offspring, and this is followed by a single mutation. Each new offspring will either replace an existing population member, or it will die, depending on the outcome of the chosen replacement strategy. This paper will investigate different replacement strategies. Further-more, the experimental results clearly indicate which of the population replacement techniques are the most effective Anu proposed a paper "Improved Performance of Replacement Strategies in GA". In this paper she said that Genetic algorithm is blind global search technique based on population and exploiting objective function. Genetic algorithm works on set of individual, not on single solution. After applying reproduction and mutation operator's replacement strategy is executed. This paper discusses various replacement strategies to help in selecting suitable replacement class (generational and steady state), which we apply over the basic steps i.e. selection, crossover, mutation. Steady state replacement helps in enhancing the performance of genetic algorithm as it propitiates useful diversity.

Noraini Mohd Razali, John Geraghty proposed a paper ,"Genetic Algorithm Performance with Different Selection Strategies in Solving TSP". A genetic algorithm (GA) has several genetic operators that can be modified to improve the performance of particular implementations. These operators include parent selection, crossover and mutation. Selection is one of the important operations in the

GA process. There are several ways for selection. This paper presents the comparison of GA performance in solving travelling salesman problem (TSP) using different parent selection strategy. Several TSP instances were tested and the results show that tournament selection strategy outperformed proportional roulette wheel and rank-based roulette wheel selections, achieving best solution quality with low computing times. Results also reveal that tournament and proportional roulette wheel can be superior to the rank-based roulette wheel selection for smaller problems only and become susceptible to premature convergence as problem size increases.

A. Benchmark Function:

This section will briefly present used functions in the performance analysis of various replacement method in GA. De Jong constructed a test environment of five problems in function minimization[6]. His work translated Holland's theories into practical function optimization. The function used as a benchmarking function is sphere model ie.

$$f_1(x) = \sum_{i=1}^{n} x_i^2 \qquad -5.12 \le x_i \le 5.12$$

III. Result and Observation

This section will focus on computational experiment that use two GA replacement schemes discussed in this paper to obtain optimal solution for dejong function. The algorithms are coded in MATLAB version 2009b. The performance of GA is tested at DE jong function with number of parameter .For all experiments, the GA procedure employed a combination of arithmetic crossover and uniform mutation for producing offspring at every generation. The chromosome size used in this implementation is set to 2, while the selection method used is roulette wheel . The objective of the experiment is to investigate the performance of GA with different replacement method in terms of number of generations to come out with the optimal solution for Dejong.

Graph 1 and graph 2 shows the best result obtained from weak parent replacement .Matlab code is run with different replacement strategy. It is clearly shows that GA with weak parent replacement always gives the highest solution quality (i.e. minimum value) for which dejong function tested.

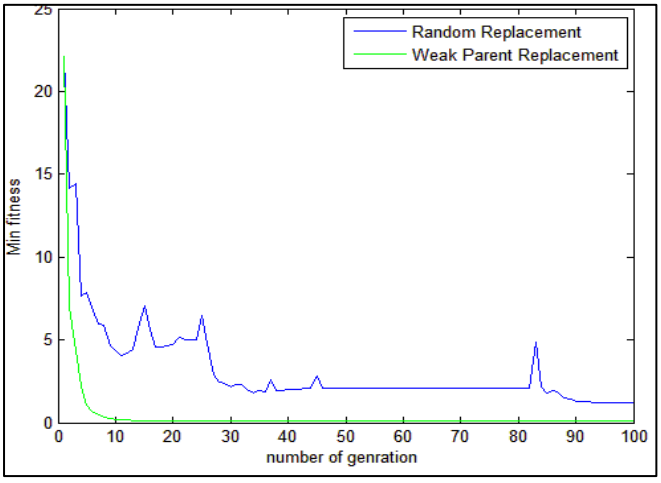

Fig. 1: Graph 1

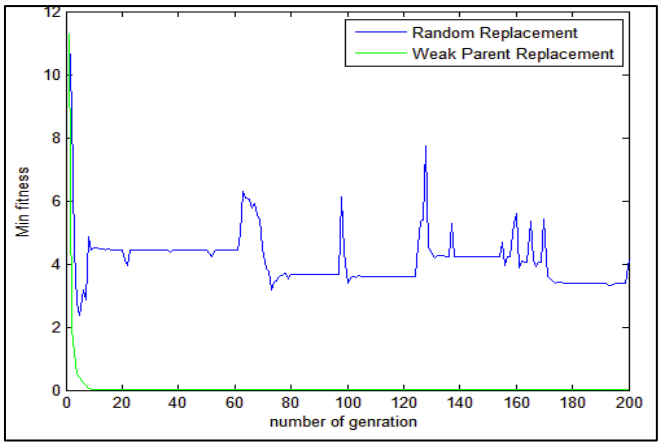

Fig. 2: Graph2

IV. Conclusions

In this paper we have described two types of replacement strategy in the GA procedure to solve de jong function and compare their performance in terms of solution quality and number of generations to come out with the best solution. From the results of experiment on De jong function instances, it can be conclude that the optimized valued is got through with weak parent replacement rather than random replacement.

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