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Premature Convergence In Genetic Algorithm Using Ellite Selection Scheme: Review Paper

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Abstract*: The concept of premature convergence leads to the loss of diversity within the population. This loss will be caused by the selection pressure, the schemata distribution due to crossover operators and a poor evolution parameters setting. A major problem in GA is that classic GA have tendency to converge to local optima or diversity. Various techniques such as Elitist and DCGA will be used to avoid premature convergence in genetic algorithm. This method will overcome the problem of duplication of population. The measures to detect the premature convergence are in fact measures for level of population degeneration.*

Keywords: *Genetic Algorithm (GA), Premature convergence, Diversity, Population, Crossover.*

1. INTRODUCTION

Genetic Algorithm (GA) is adaptive heuristic based on ideas of natural selection and genetics. Genetic algorithm is one of the most known categories of evolutionary algorithm [1]. The GAs are powerful stochastic optimization methods presented first in the late 1960's and early 1970's by John Holland, 1973 [4]. The genetic algorithms and their hybrids were applied to various optimization problems because of their multiple advantages: free derivative characteristics, simple preparation of the optimization model, the parallel nature of the search etc. The initial requirement of a GA is a set of solutions represented by chromosomes called population. The solutions extracted from one population can be used to form a new population. This can be further expanded that the new population will be better than the old one. The best solutions are selected to form new offspring. These solutions are selected on the basis of their fitness i.e. the most suitable offspring will get chances to reproduce. A major problem in GA is that classic GA have tendency to converge to local optima [8]. This premature convergence is caused by several algorithmic features, particularly selection pressure and too high gene flow between population and population member. The premature convergence of a genetic algorithm arises when the genes of some high rated individuals quickly attain to dominate the population, constraining it to converge to a local optimum. The premature convergence is generally due to the loss of diversity within the population. This loss can be caused by the selection pressure, the schemata distribution due to crossover operators, and a poor evolution parameters setting [4]. This phenomenon occurs when the population of a genetic algorithm reaches a suboptimal state that the genetic operators can no longer produce offspring with a better performance than their parents [3], [6]. To avoid the premature convergence, in a genetic algorithm is imperative to preserve the population diversity during the evolution. The population diversity ensures avoiding the premature convergence [5], [7].

2. LITERATURE REVIEW

Deepti Gupta *et. al* [1] proposed that Genetic algorithm is a search & optimization method based on the Darwin's principle of Survival of the fittest. It is an abstraction of complex natural genetics and natural selection process. Genetic algorithm is based on the principle of natural selection for reproduction and various evolutionary operations as crossover and mutation. Two controlling factors that need to be balanced in the process of selection are Genetic Diversity and Selective Pressure. Population Diversity can be controlled by a means of ways as Fitness sharing, Deterministic crowding and so many other. In this paper the author was providing a brief knowledge about variety of methods maintaining population Diversity.

Elena Simona Nicoara *et. al* [2] described that the optimization by genetic algorithms often comes along with premature convergence bias, especially in the multimodal problems. In the paper the author propose and test two mechanisms to avoid

the premature convergence of genetic algorithms by preserving the population diversity in two different manners. These were the dynamic application of many genetic operators, based on the average progress and the population partial re-initialization. The mechanisms were tested by implementing them in the NSGA_II algorithm, applied to one of the most difficult job shop scheduling test problems, ft10. The comparative analysis between the new algorithm and the NSGA_II in the absence of the submitted mechanisms alongside with an elitist and the canonic genetic algorithm proved the usability of both proposed mechanisms.

Pei-Chann Chang *et. al* [6] observed the progress of the evolutionary process and when the diversity of the population dropping below a threshold level then artificial chromosomes with high diversity will be introduced to increase the average diversity level thus to ensure the process can jump out the local optimum. The proposed approach was implemented independently of the problem characteristics and can be applied to improve the global convergence behavior of genetic algorithms. The author eventually applied to this approach to solve Multi-Objective (MO) Traveling Salesman Problem (TSP) which were combined KroA with KroB, KroC, KroD and KroE to be trade-off problems. The result shows the solution quality to validate the adaptability of DDCGA for solving such problems.

3. NEW PROPOSED SCHEME

In earlier models two approaches were used such as the dynamic application of crossover and mutation operators and the population partial re-initialization. The proposed model comprise of two techniques such as Elitist and DCGA (diversity control oriented GA).

Using Elitist technique two of each family survive & will be included in the next population. This will rapidly increase the performance of GA because this prevents losing the best found solutions.

Further in DCGA hamming distance will be applied to check whether new population exists earlier or not. This method will overcome the problem of duplicacy of population.

We will optimize Travelling Salesman Problem (TSP). This problem deals in finding the shortest tour that passes exactly once through each vertex in a given graph.

To implement the proposed methodology MATLAB R2009a has been used as a software platform.

4. METHODOLOGY

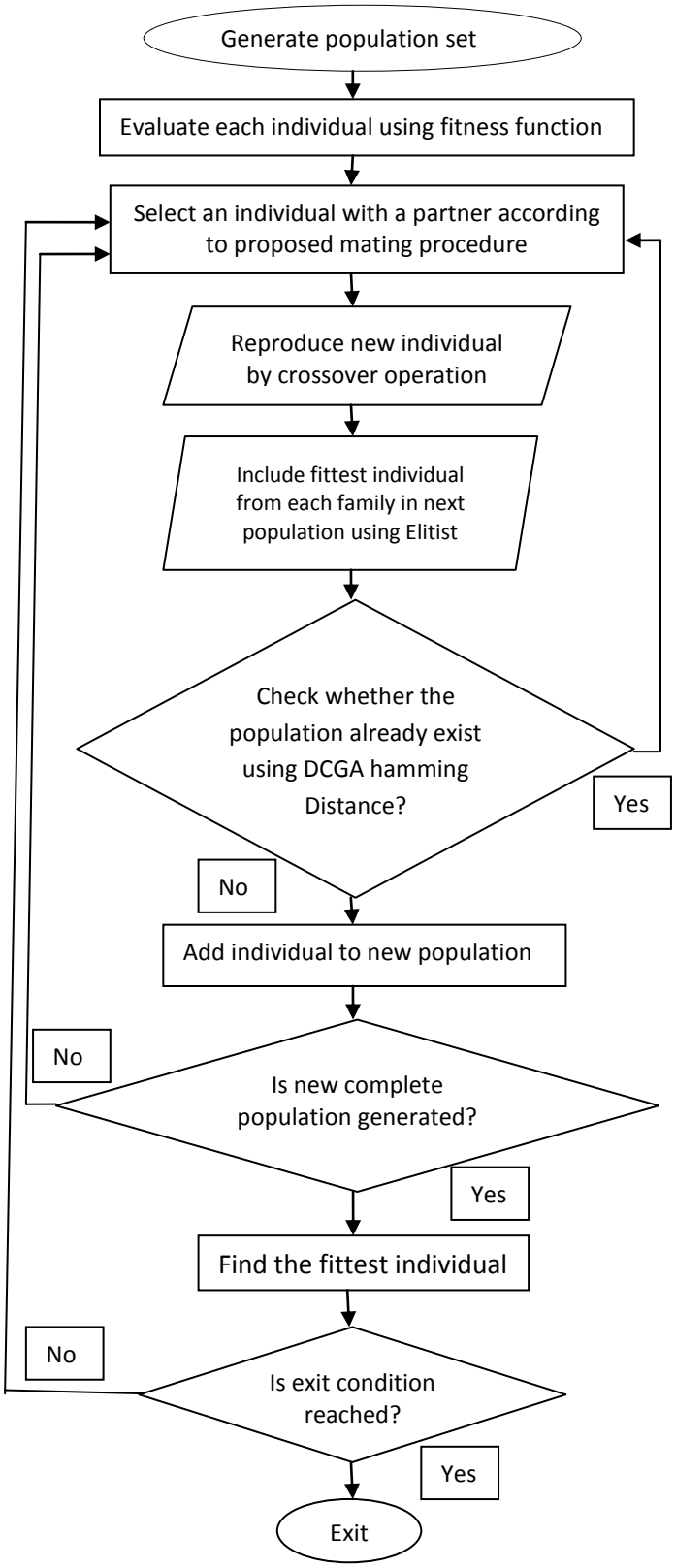

Figure 1: Flow Diagram of Proposed Method

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Various steps of proposed methodology are as follows:

1. Randomly generate the population set of individuals.
2. Evaluate each individual by a fitness function.
3. Set the contribution equally for each preference type for the first time.
4. Select an individual and its partner with the proposed mating procedure. The probability of choosing a preference type is proportional to its contribution.
5. Reproduce two new individuals for the next generation by crossover.
6. Using Elitist technique two of each family survive & will be included in the next population. This will
7. fitness value of the new individuals and their parental individuals. Calculate contribution of each preference type. This method will overcome the problem of duplicacy of population.
8. Repeat step 6 and 7 for the whole population.
9. Evaluate each new rapidly increase the performance of GA because this prevents losing the best found solutions.
10. Further in DCGA hamming distance will be applied to check whether new population exists earlier or not.
11. Compare the individual by the fitness function.
12. Repeat step 6 to 10 until it reaches the final generation.

5. CONCLUSIONS AND FUTURE WORK

In this paper we review many challenges regarding avoidance of premature convergence in genetic algorithm. Various kinds of techniques were already designed to avoid the problem of premature convergence. The genetic algorithm is an evolutionary algorithm used to optimize various problems. If the population set is converged earlier before reaching to final step then the problem of premature convergence occurred. This problem will create error in obtaining final output with higher efficiency. If premature convergence occurs in between the process of algorithm the output will be less efficient and will contain some errors which cannot be detected easily. The proposed work will be composed of combination of two techniques which will improve the result set and avoid the problem of earlier convergence of population.

In our future work, we work on the implementation of our proposed scheme which will be used to avoid premature convergence.

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