

# Implementation of Dejong Fun (Rastigin) by Genetic Algorithm and Local Search and Analyze the Performance

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## Abstract—

**G**enetic algorithm that has been used in a no. of NP hard optimize problem such as travelling salesman problem, Knapsack problem etc. performance of genetic algorithm depend on the type of element such as crossover, selection, mutation, replacement used in it. Replacement operator decides which are replaced by removing or replacing some offspring. Genetic algorithm mainly lead to the convergence that makes them or finding the global optimal solution. Genetic algorithm extension is hybrid algorithm that incorporates the local search technique within the genetic operation so as to prevent the convergence. In this paper author is analysis the effect of hybridization of local search with replacement operator on the performance of genetic algorithm. Implementation by using MATLAB code on problem – Benchmark Dejong’s Rastrigin Function (F4). The graph clearly shows that the hybrid algorithm is converging towards optima more quickly than the conventional algorithm.

**Keywords—** genetic algorithm, hybridization, genetic and local search algorithm, Dejong faction

## I. INTRODUCTION

Genetic algorithm were invented by John Holland in 1960s and developed in 1975. Genetic algorithm is applied to search or optimization algorithm is based on Darwinian principles of natural selection. It is a technique depends on the method of natural genetic to find the best solution to optimization and search problem. It combines principle of the fittest with a random information exchange among artificial chromosomes [1]. During the process of optimization a chromosomes contains a large number of group that completely specified a candidate solution. For find the best solution of optimization select the higher fittest value and lower value will be ignore. So, Genetic algorithm survival of fittest among a population of artificial chromosomes and it stop when the number of generation specified is met or there is no change in maximum fitness value.

## II. HYBRID GENETIC ALGORITHM

Hybridization is refers that inclusion of problem-dependent in a search algorithm. The performance of genetic algorithm is depends on mechanism for balancing objective. Exploitation is the best solution found so far and Exploration the search space for promising solution. The power of genetic algorithm is ability to combine both process such as exploitation and exploration. Local search on the genetic algorithm population can maintain diversity and reduce problem like genetic drift [1] ] some local optimization algorithm for good balancing between global exploration and local exploitation so algorithm can produce solution with high accuracy. Genetic algorithm is very fast to locate the region when the global optimum lies, but it takes long time to find the exact local optima. A combine of genetic and local search method are applied, that can search for finding global optima. A local search within a genetic can improve the performance on condition that their achieve the optimization goals. Hybrid capture the best of both genetic algorithm and Local search scheme their need [2] and this opportunity depends on the design of hybrid genetic algorithm. Ant colony optimization model was used for search space and local search method to improve the quality of solution that produced by genetic algorithm to solve a real world design problem [3]. Before the algorithm start the location is to be determined. It should be point in the search space which seems for free local search exploitation. It suggest to finding by utilizing GA or related strategy. The results depend on the initial population. Evolutionary local search algorithm become competitive is a simple genetic algorithm with local search method, where the no. of variable is higher than or equal to 100. Local search algorithm find solution with less no. of accepted and evaluated flips on these test.

## III. GENETIC AND LOCAL SEARCH

Hybrid Genetic algorithm is based on the view of genetic algorithm and method of local search. It contains various ways in which a local search can be in-corporate in genetic algorithm. The purpose of incorporation is as follow:

### A. Capability enhancement:

In the genetic algorithm can combined with method of local search in many several ways to optimize the search process. The local knowledge of problem and overall search ability will be enhanced when the genetic algorithm is combined with the searching algorithm. The enhancement can be in the terms of quality and efficiency. In genetic

algorithm major concern is design efficiency in terms of time required to find solution of desired quality. Population size is a most important in genetic algorithm. It determined the memory size and speed in genetic algorithm and affects the speed of search in case of parallel process of genetic algorithm. The gambler's ruin model was used to estimate the population size of genetic algorithm was shown [4]. This model was used to show population size depend on two parameters, which can be affected by local search. The two parameter show the standard deviation of population and the signal difference between best and second best building block. If a local search method is incorporated in such way to reduce the standard deviation of the population and to increase the signal difference between the best and second best chromosomes the resulting hybrid can be efficient with small population size. The combined effect of probability of learning strategy and local search on the population size requirement of hybrid is shown [5].

#### **B. Optimizing and control parameters:**

Genetic algorithm is a key factor in the determination of the exploration and exploitation trade off. The behavior of genetic algorithm and adapt control parameters to improve the search performance. To show the knowledge in non-specific way by the process of fuzzy logic enables on knowledge i.e. not clearly defined or understood. Fuzzy logic a suitable choice for adapting the control parameter of genetic algorithm.

### **IV. HYBRID DESIGN ISSUE**

1. Local search and Learning
2. Balance between global and local.

#### **C. Local Search and Learning:**

It used the local knowledge for improve a solution and give a chance of an individual to propagate into next generation. Due to the local search is same within the genetic and the role of learning with the process of evolution the local search is show as a learning process. There are two basic models are use the local knowledge for hybrid algorithm: Lamarckian evolution and Baldwin approach. Hybrid genetic algorithm is the most important point of the local search, knowledge gained by the global algorithm during local search. [5]. This information used by the Lamarckian or Baldwin approach. The Lamarckian approach to the inheritance mechanism and it inherits the characteristic by learning process. The Lamarckian approaches used the local search method and the fitness of an individual. In the Baldwin learning process produce best result for gain the chance to pass on next generation with the help of help the adaption environment [6]. In these approach effect of local search on improve the fitness value.

#### **D. Balance between global and local:**

According to hybrid theory, solved optimization problem of quality solution in two ways [7]. Global search method guided the search to the attraction from the local search will lead to desired solutions. In the genetic local hybrid the main role of GA is to browse the search space to find the region lies to the global optima [8]. The main role of local search is to information gathered by genetic algorithm. So combine of genetic and local search to find the local optima get the best exploring capability of genetic algorithm.

### **V. HILL CLIMBING**

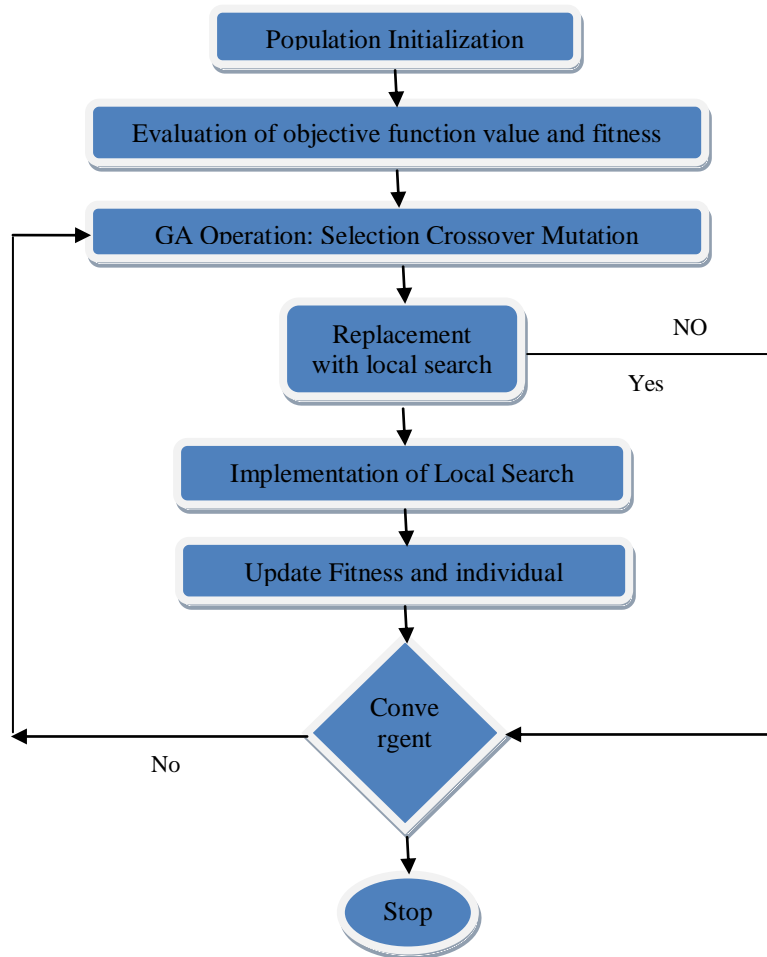
Hill climbing method use for the property of GA such as exploration capabilities, parallelism and the local exploitation of GA. Using the hill climbing method as an accelerator genetic algorithm produce the better solutions. GA uses the result of hill climbing working with an initial guess corresponding to the individual when evaluating the fitness individuals. During reproduction and crossover mutation for the production of the next generation. Hill climbing genetic algorithm found new solution termination works on it. Hybrid method of genetic algorithm makes selection based fitness at the end of individual life and this is done by hill climbing method. Hill climbing method using the genetic operator for enhances the local exploitation properties of genetic algorithm. In the hill climbing finding the better individual by genetic replacement operator. Dejong function solves genetic algorithm with replace the all process. At last, results provide by the larger improvement of total performance. It works well when not the local optima in the search space. The advantages of hill climbing is easy to implement and good solution very quickly [9].

### **VI. PROPOSED WORK**

In this proposed work we discuss about hybrid genetic algorithm technique. In these diagram show that related to hybrid and local search algorithm.

HGA approach is combined a local search and a genetic algorithms. The combination process is start from GA with small iteration to be effective in computational time. The main consideration of area to find the solution is very fast with the help of these type of process the genetic algorithm. The process of HGA start from the starting population parameter value and find the function value by using genetic algorithm objective function.

Step 1: Population Initialization: It is the process of generates the initial population of N pop chromosomes here N pop is the population size. Heuristic and random method can be used for initialization the population. Random method can generated the N pop \* N parameter value lies between 0 and 1. Heuristic method requires some knowledge about the parameter and chromosome is generated randomly.



HGA Technique

Step 2: objective function: objective function value is associated with the chromosomes the output is passed to the objective function, a fitness value is find and assign to each chromosome based on its objective value.

Step 3: GA operation: by the process of selection, crossover and mutation in the execution of a genetic algorithm new generation is produced after the one process is complete and best chromosome is carry by the next generation is no guarantee. If the conditions are satisfied then the genetic algorithm is stop. Genetic algorithms stop with an optimal solution if the objective function value is low and stop without an best solution if the max number of generation has been reached.

Step 4: Local search process: local search process is performed with replacement operation. It is based on the objective value after the genetic operation. Many options can be taken after the genetic algorithm operation. If genetic algorithm process is convergent then terminate this process otherwise return to the genetic algorithm operation. Local search is carried out if the local search is update and required the fitness of individual. If the local search process is convergent then terminates otherwise continue genetic operations. The process is continue when the convergence is meet.

## VII. IMPLEMENTATION AND OBSERVATION

In this section of paper code of Matlab has been developed for Dejong function 4 such as Rastrigin Function. This function is a non-linear multimodal function. Due to large space and its large no. of local minima is solved the difficult problem. Use this function we determined the effect on the performance of genetic algorithm. Plot the function with different population size and show the result by graph and table.

Parameters are:

1. Random Initialization
2. Value encoding
3. Population size
4. Arithmetic crossover
5. Uniform mutation
6. Crossover probability
7. Mutation probability
8. Generation of gap of 50 starting from 50 to 500.

Function definition

$F4(x)=$

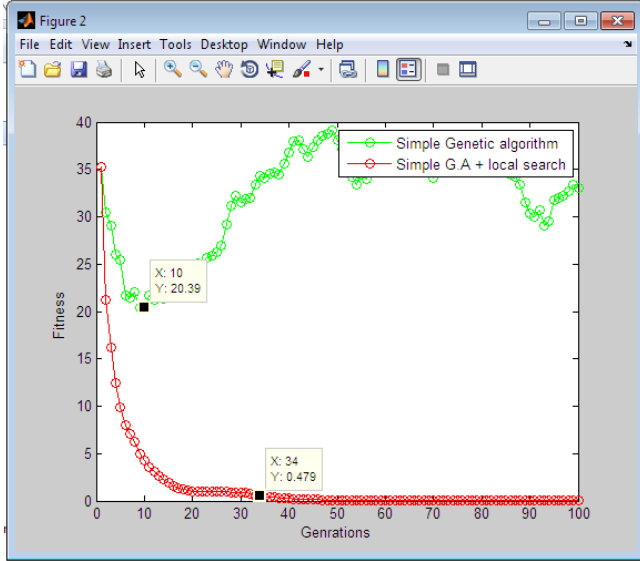
$$10 \cdot n + \sum_{i=1}^n (x_i^2 - 10 \cdot \cos(2 \cdot \pi \cdot x_i)) \quad -5.12 \leq x_i \leq 5.12$$

$F4(x) = 10 \cdot n + \sum_{i=1}^n (x(i)^2 - 10 \cdot \cos(2 \cdot \pi \cdot x(i)))$ ,  $i = 1:n$ ;  $-5.12 \leq x(i) \leq 5.12$

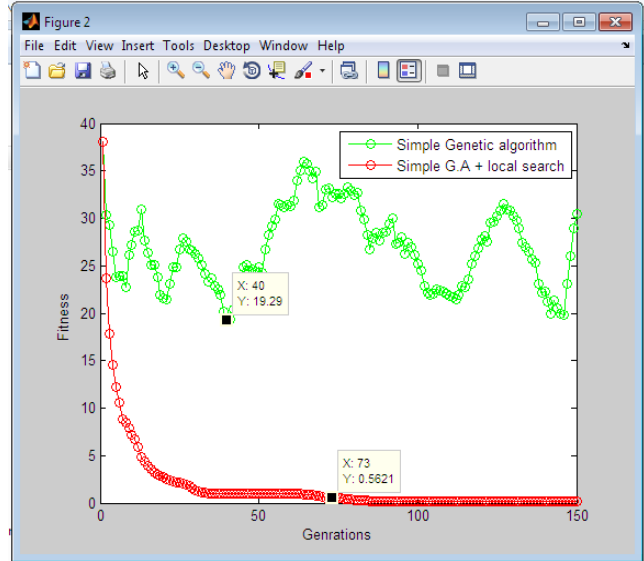
Global minimum:

$F4(x) = 0$ ,  $x(i) = 0$ ,  $i = 1$  to  $n$ .

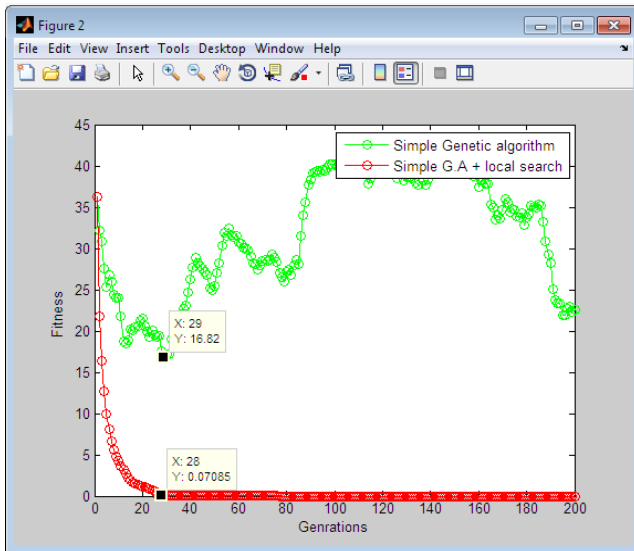
Graph are plotted between min fitness and no. of generation



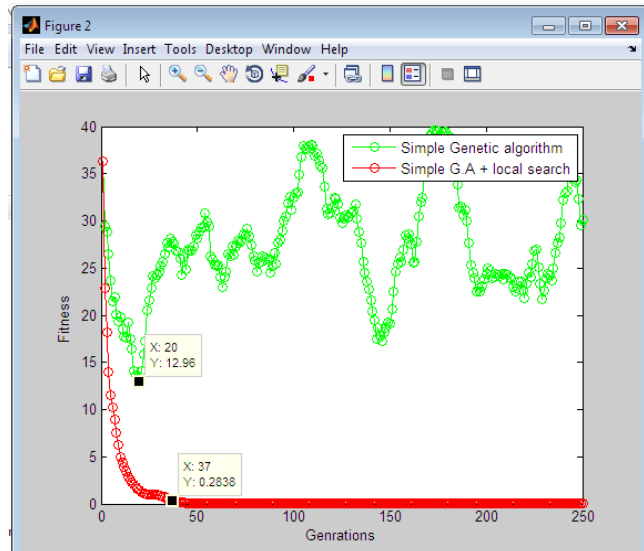
Dejong Function 4 (100 Generation)



Dejong Function 4 (150 Generation)



Dejong Function 4 (200 Generation)



Dejong Function 4 (250 Generation)

No of Generation	Genetic Algorithm (min)	Hybrid Genetic algorithm (min)
100	20.39	0.479
150	19.29	0.5621
200	16.82	0.07085
250	12.96	0.2838

### VIII. CONCLUSION

Genetic algorithm refers to a parameter of technique search based on the procedure of natural genetic to find solution of optimize and search problem. In this paper we implement the fourth function of dejong is rastrigin function and determine the performance of genetic algorithm by the effect of local search. Local search is performed with the replacement operation. Result shows by graph and tables. Graphs are plotted between no. of generation and minimum fitness. The performance of genetic algorithm depend on the two objective i.e. exploration and exploitation. Genetic algorithm is combined with local search algorithm having local knowledge of problem and ability of search. The enhancement can be in terms of efficiency and quality. In this paper we discuss Lamarckian and Baldwin these are use the local search in hybrid technique and improve the fitness value of individual.

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