Implementation of Dejong Function (Rastrigin) by Genetic Algorithm

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Abstract - Genetic algorithm is optimization and search technique that generates the solution to optimization problem using technique by natural evolution. This paper present experimental result of most important benchmark function i.e. dejong function (Rastrigan) by genetic algorithm. This result shows genetic algorithm provides optimal solution.

Keywords— genetic algorithm, selection, crossover, Dejong function

I.   INTRODUCTION

Genetic algorithm [1, 2] is an optimization and search technique. It was invented by John Holland in 1960's. Genetic algorithm provides the optimal solution for an optimization problem [3]. Genetic algorithm are applied to many field such as neural network, fuzzy logic etc [4]. Genetic algorithm works on individual no. of operation and they applied for solve some optimization problem. Genetic algorithms combine principle of fittest chromosomes for exchange the information among a population. The Genetic algorithm refers to the family of evolutionary algorithm with genetic programming, evolution strategies, and evolutionary programming. Evolutionary algorithm can be consider a class of optimization technique. In the optimization Process chromosomes consist of that find the candidate solution. The particular higher fitness value be survive and produce a better generation and lower value will be ignored. The main principle of genetic algorithm is better is an individual and higher is the chance of being parent.

Working of genetic algorithm- A genetic algorithm creates an initial population. It consist of chromosomes that are given a random collection of genes. The step involved genetic algorithm are:

1.   Create an initial population of chromosomes.
2.   Evaluate the fitness of each chromosomes that makes the population,.
3.   Based on the fitness, select chromosomes that will make.
4.   Cross over or mate the selected chromosomes to produce the offspring.
5.   Randomly mutate some of the genes of chromosomes.
6.   Repeat step 3 through 5 until new population is generated.
7.   Algorithm ends when best solution has not changed for a preset number of generations.
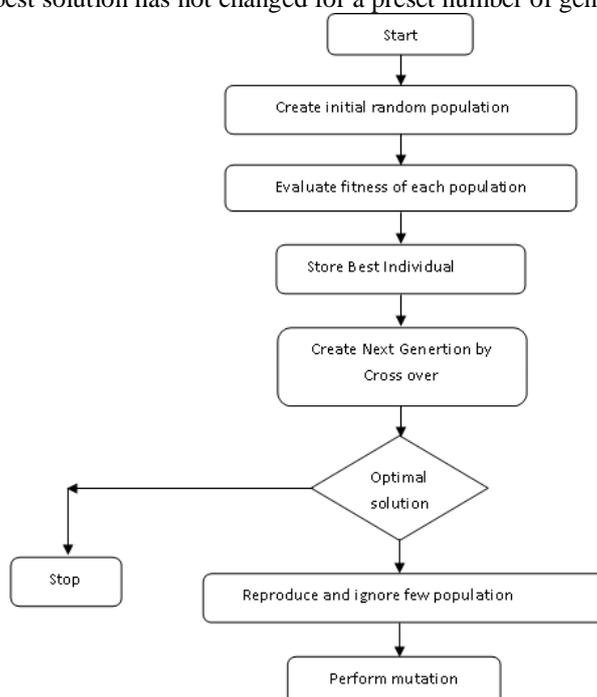
Flow chart of genetic algorithm

II.   RELETED WORK

De Garis Proposed iterative scheme [5] to involve a sequence fitness function. A randomly initialized population is evolve by Genetic algorithm using the fitness of resulting population is used as the initial population for a GA using the second fitness and so on. Sivaraj, R. et.al [6] proposed the boost performance of genetic algorithm by selected initialization. Its depends upon the individual chosen in the initial population. If the poor individual is select from initial population, it takes longer execution time and weak optimal solution.

Bramlette, M.F.[7] proposed to a improve the initialization procedure of GA in 1991. The initial population takes by the best n randomly chosen individual. Ramsey, C.L. suggest based on initialization approach by include in initial population of genetic algorithm [8]. Gupta, Deepti et. Al. [9] Present an overview of method of maintaining of genetic algorithms. It is based on the principle of natural selection for reproduction and various operation such as crossover and mutation.

Jadaan et al. [10] compared the result of GA between roulette wheel and rank based roulette wheel selection method by using the different mathematical fitness function and found that rank based outperformed proportional in number of generation to come out with the optimal solution. Zhong et al. [11] compared the roulette wheel with selection and size equal 6 at general test function and conclude algorithm with tournament selection is more efficient in convergence than proportional roulette wheel section method.

Julstrom [12] investigate compute time efficiency of two types of rank based selection probabilities linear and exponential ranking probabilities and compared with tournament selection. He concluded that tournament selection is preferred over the rank based selection method because tournament selection is faster than sorting the population to assign the rank based probability.

III.   IMPLEMENTATION AND OBSERVATION

In this section of these Matlab code has been created for Dejong function 4 such as Rastrigin function. In these problem author discuss dejong function which is one of the NP hard problem used for a benchmark for optimization.

Dejong Function 4: Dejong function 4 is also called as Rastrigin Function. It is based on the function 1 sphere model with addition of cosine modulation for produce local minima. Rastrigin function is non-linear multimodal function. Due to large space and large number of local minima is solved the difficult problems. Draw the function with different population size and show the results by graphs and tables.

Parameter used for implemented:

- ❖   Random Initialization
- ❖   Value encoding
- ❖   Population size
- ❖   Arithmetic crossover
- ❖   Uniform mutation
- ❖   Crossover probability
- ❖   Mutation Probability

Function Definition:

F4(x)=

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

F4(x) =10.n+sum(x(i)^2-10.cos(2.pi.x(i))), i=1:n; -5.12≤x(i)≤ 5.12

Global minimum:

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

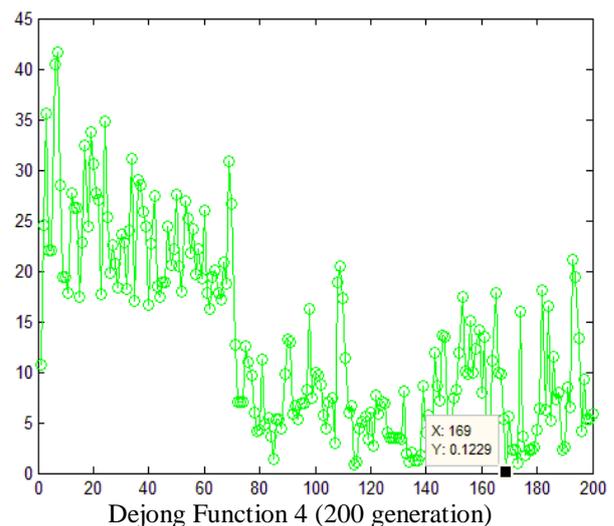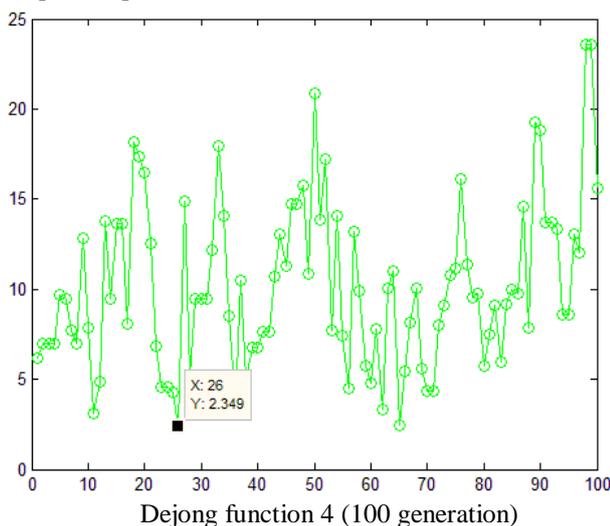Graphs are plot between minimum fitness and number of generation.

Dejong function 4 (100 generation)

Dejong Function 4 (200 generation)

Table I

Genetic Algorithm	Minimum value
100 Generation	2.349
200 Generation	0.1229

IV. CONCLUSIONS

Genetic algorithm is a technique of search based on the procedure of natural genetic and selection to find out the best solution of search problems. Genetic algorithm is solve the problem step by step by using various operator. Genetic algorithm mainly depends on the selection, crossover, mutation, replacement. Genetic algorithm can find out the near optimal solution. In this paper we discuss the dejong function 4 Rastrigin function of multimodal function and author show the result by using Graph and tables.

REFERENCES
[1] J. Holland, " *Adaptation in natural and artificial system*", University of Michigan Press, Ann Arbor, 1975.
[2] S.N. Sivanandam and S.N Deepa, "*Introduction to Genetic algorithm*", 1st edition Springer-Verlag Berlin Heideberg, 2008.
[3] Wei-Der Chang, "An Improved real coded genetic algorithm for parameters estimation of non linear systems" Mechanical systems and signal processing 20 (2006) 236-246, 2006.
[4] K.F.Man, K.S. Tang, S.Kwong, "*Genetic Algorithms: Concepts and Designs*, Springer", London, 1999.
[5] De. Garis, H. 1990, "*Genetic programming: building artificial nervous systems using genetically programmed neural network modules*", Proc. of the 7th international conference on machine learning. 132-139., Morgan Kaufmann.
[6] R. Sivaraj, T. Ravichandran, R. Devi priya, 2012, "*Boosting Performance of genetic algorithm through Selective initialization*", European Journal of Scientific Research ISSN 1450-216x vol.68 No.1, pp.93-100.
[7] Bramlette, M.F, " 1991, " *Initialization, Mutation and Selection method in genetic algorithm for function optimization*", proc. of the 4th international conference on genetic algorithm, pp-100-108,Morgann Kaufmann.
[8] Ramsey, C.L"1993, "*Case-Based Initialization of Genetic Algorithms*," Proceeding of 5th international Conference on genetic algorithm, pg-84-91.
[9] Deepti Gupta, Shabina Ghafir, "*An Overview of methods maintaining Diversity in Genetic Algorithm*", an International Journal of Emerging Technology and Advanced Engineering (Volume 2, Issue 5, May 2012).
[10] O. A. Jadaan, L. Rajamani, C. R. Rao, 2005, "Improved Selection Operator for GA," Journal of Theoretical and Applied Information Technology.
[11] J. Zhong, X. Hu, M. Gu, J. Zhang, 2005 "*Comparison of Performance between Different Selection Strategies on Simple Genetic Algorithms*," Proceeding of the international Conference on Computation Intelligence for Modelling, Control and automation, and International Conference of Intelligent Agents, Web Technologies and Internet Commerce.
[12] B. A. Julstrom, 1999, "*Revisiting Rank-Based Probabilities and Tournaments*", Department of Computer Science, St. Cloud State University.