

Design of Digital Filter by Genetic Algorithm

Sudhir A. Kadam, Mahesh S. Chavan



Abstract: This paper relatively less difficult words it may be said that during Genetic Algorithm (GA) an evolutionary technique solves problems and the final end result is the pleasant fittest answer is evolve. A brief description of the herbal increase is mentioned to knowledge GA. In nature all living organisms essentially include cells. Each cell includes a hard and fast of chromosomes. Each chromosome, in flip, is a string of genetic fabric and serves as a model for the entire organism. A chromosome is essentially a collection of genes, in which each gene can be described as a block of genetic cloth and encodes a particular protein. In other phrases it may be said that each gene encodes a trait. These settings are known as alleles. Each gene has a selected role in a chromosome and that function is named as locus. As complete set of genes is referred to as a chromosome, like smart a genome includes a entire set of chromosomes. The great greatest fee of the enter entities performed the usage of genetic algorithm technique.

Index Terms: Scaling, elitist model, operators, reproduction.

I. INTRODUCTION

Genetic Algorithm is an algorithmic technique that takes up a standard fitness function, followed by selection, crossover and mutation stages that yields optimized results. From these stages of operation, it is noticeable that it forms a genetic cycle. The average number of searches is fixed in each generation as the probabilities are constant. The Genetic Algorithm gives a standard convergence rate which helps in dealing with complex problems [1]. Suppose there is a population of mosquitoes that is killed by ALLOUT. So now the algorithm takes male mosquito with highest immunity female mosquito with highest immunity.

Reproduction between 1 & 2 now the child mosquito developed is immune to ALLOUT. Now developing a new population of the genetically more improved and strong breed of mosquitoes is what genetic evolution is all about. Now the same concept applied in algorithmic processes is what is known as genetic algorithm. Optimizing of IIR filter this paper on Genetic algorithm can be used in optimization of Digital IIR filter. It is more durable algorithm technique that is capable of designing IIR filters of any order capable of achieving more effective phase and magnitude response [2].

Filtering can be defined as a process with which a frequency spectrum or frequency band of a signal can be adjusted according to desired specifications given by the developer.

Digital filters find varied application in processes like speech recognition, secure communication, radar processing, image enhancement and biomedical processing so great attention is required for efficient designing of a digital filter.

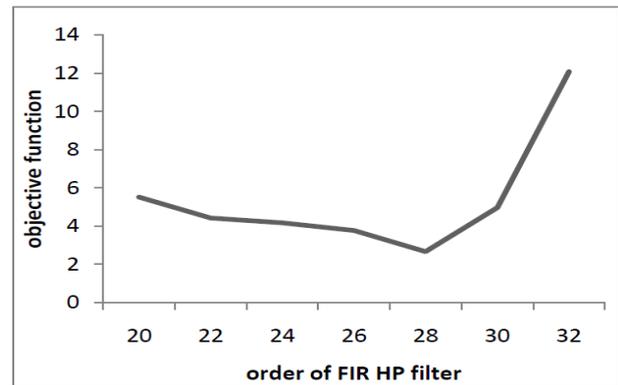


Fig. Order of Filter versus Desired Objective function [3]

Digital filters are gaining popularity as they can implement high performance circuits in digital platform. Under software control, we can easily vary the attributes of a digital filter. As a result, there will be need of optimization algorithms that are used to map out the digital filters which can comply with the fixed instructions.

II. ALGORITHM FOR GENETIC ALGORITHM

A. Initialisation

The Population is a subset of solutions in the current generation. It can also be defined as a set of chromosomes it depends on the nature of the problem, it has so many possible solutions. The initial population is generated randomly, in the search space and from that we will found optimal solution [4].

B. Selection

In this process of selection of individuals in Genetic algorithm from randomly generated population pool, the individuals are selected depending upon the fitness criteria which forms newer generations of fitter individuals and this process continues until no further convergence is possible. Various selection algorithms select the best solutions.

The suitability function marks the desired fitness standard that has to be maintained while selection of individuals for newer generations. The fitness function may vary depending upon the complexity of problem. For example, the Mosquito problem discussed earlier in which the population of mosquitoes immune to ALLOUT is found out with respect to the standard fitness function which is to be given by the developer at the time of problem solving.

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* Correspondence Author

Prof. Sudhir Adhikrao Kadam*, dept. E&TC Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune, India.

Prof. Dr. Mahesh S. Chavan, Professor & Dean, KIT's College of Engineering, Kolhapur India.

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Now depending upon the value of the fitness function fed by the developer, various selection criteria of Genetic Algorithm is decided and also the worth of solution achieved is determined by the value of fitness function.

C. Genetic operators

Now using the genetic operators the next generation population pool is created. The new pool of population consists of individuals selected through combination of genetic operators [5].

For each new solution, “parent” solutions are first selected from the pool of population which upon crossover and mutation develops a “child” solution inheriting the characteristics similar to that of the parent. Hence, a new solution is generated having characteristics similar to that of the parent solutions. Now, newer and fitter individuals from pool of new population is selected (i.e. new parents) which produces new child solutions and this process continues until no convergence is possible and suitable size of new population is achieved. However, it is found in some researches that reproduction methods involving more than two parents produce higher and fitter quality of genes (chromosomes).

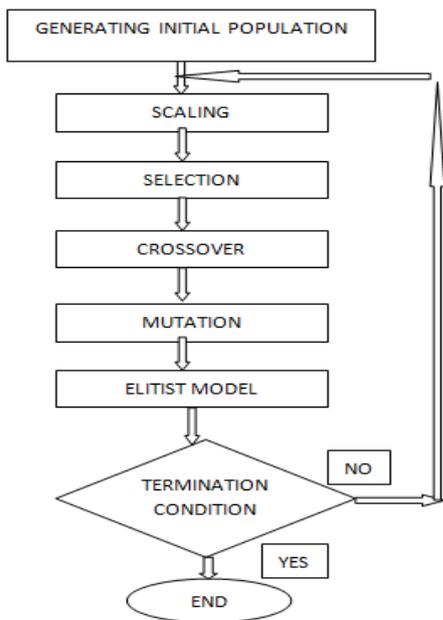


Fig. Flow chart showing various steps in working of Genetic Algorithm

D. Heuristics

Heuristic operators help in making the calculation speed faster and algorithm more durable. Besides the main genetic operators, heuristic operators can make algorithm analysis simpler and even faster. The heuristic operators help in avoiding recombination between solutions that are quite similar and hence, helps in maintaining population variance and reduces untimely convergence to an undesired solution (less optimum solution) [6].

E. Termination

The generation of newer and more fitter individuals continues until a termination statement or condition is achieved. Given below are some of the examples of termination conditions:

- A solution fulfilling the least amount criteria.

- Set unchanging number of generations achieved.
- Assigned budget i.e. time or money reached.
- Further convergence of newer generations could not provide any better optimum results.
- Automatic or Non-Automatic Examination

III. OPTIMIZATION RESULT

In this result we get to know about the change in characteristics of each passing generation with the help of the fitness function. The starting generations have the highest fitness function values, with each passing year this value decreases due to mutation in the chromosomes [7]. After some time, this value comes to a constant. Here in this graph as we can see there are 200 iterations representing the number of generations, we see the decrease in the fitness value [8].

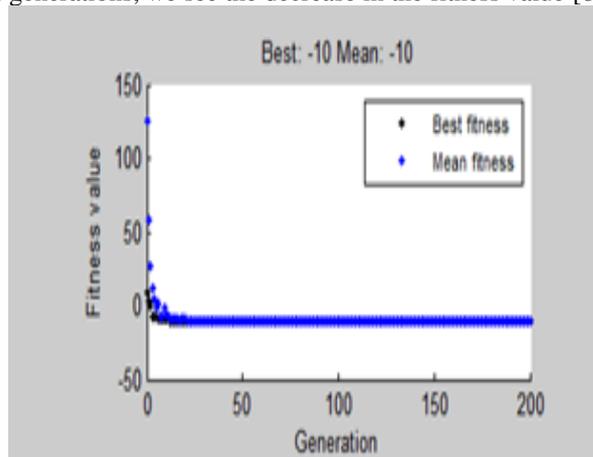


Fig. The number of generations and their changing characteristics. The best individuals amongst the selected population. We select any two variables and find out the best and the fittest individual.

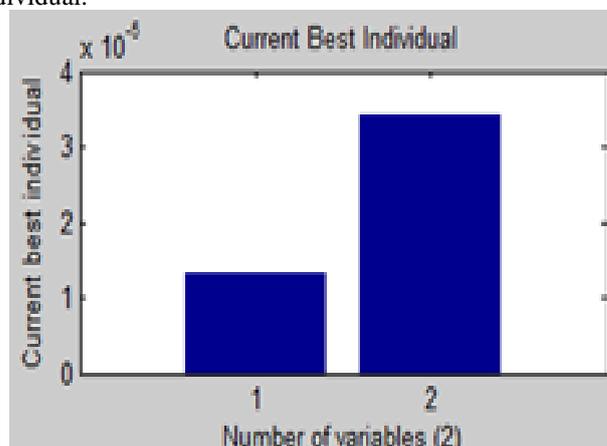


Fig. the current best individuals

Table - I

Current best	3		3.46
	2		
	1	1.34	
	0	1	2
		Number of variables	

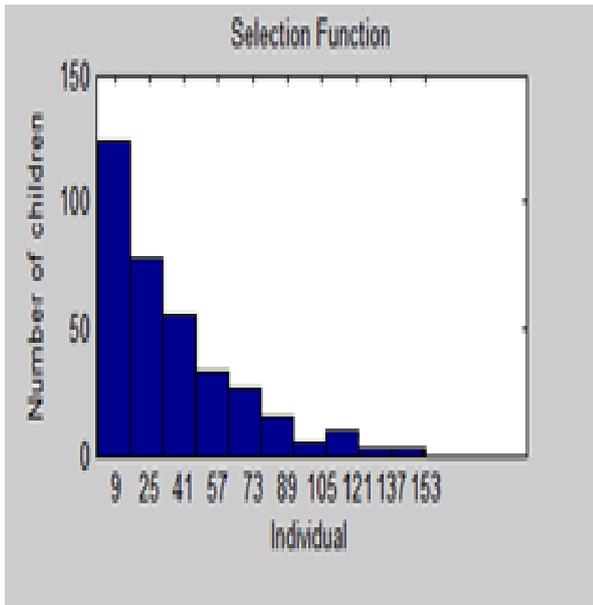


Fig. Selection Function

Table - II
Selection function

Number of Child	Selection function				
150	126				
100		78	52		
50				41	27
0	9	25	41	57	73
	Individual				

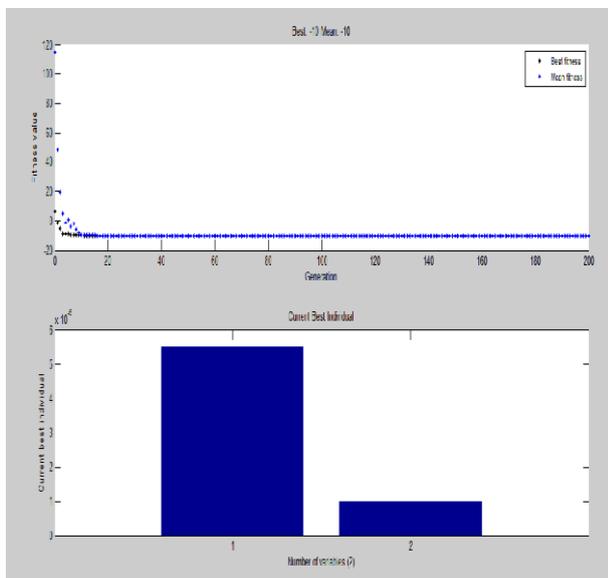


Fig. Result on MATLAB showing number of iterations

IV. CONCLUSION

It is basically explaining the science behind the reproduction of different species. Genetic Algorithm also explains how with the change in different habitats, different species adapt to the changes that come across in different habitats. The optimized results obtained by simulation using Optimization Tool in MATLAB software is fed to the filter codes to get the desired optimization of the IIR Digital Filter.

After running the simulation, the process with the help of optimization tool, we get to the conclusion that, this method which is proposed optimization of digital filter design is very much durable, accurate and has greater efficiency than other methods.

So, to summarize, this paper tells us about the present and future developments in making efficient genetic algorithms, for various optimization designs and techniques. It tells us about the variants of genetic algorithms and the theoretical and practical aspects of it as well, while giving a brief look on the potential applications which have use genetic algorithm as their basis.

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AUTHORS PROFILE



Prof. Sudhir Adhikrao Kadam ME (E&TC), Published more than 15 international papers, Research scholar of Department of Electronics Engineering, KIT's College of Engineering, Shivaji University, Kolhapur. Also member of IAENG. Working in dept. E&TC Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune, India.



Prof. Dr. Mahesh S. Chavan, Ph. D. (Electronics & Communication Engineering). Also Published papers more than 25 International journals; He has Professional Memberships of ISTE, IEEE, CSI, ISI, and BSI. They are guiding for 08 Ph.D students at Professor & Dean, KIT's College of Engineering, Kolhapur India. Also Awarded Best IETE Journal Paper ward – 2000.