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FIR FILTER DESIGN USING GENETIC ALGORITHM

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Abstract - For the design of Low pass FIR filters complex calculations are required to calculate the filter coefficients. Mathematically, by substituting the values of pass band, transition width, pass band ripple, stop band attenuation and sampling frequency in any of the methods like window method, frequency sampling method or optimal method we can get the values of filter coefficients h(n).In this paper a low pass FIR filter has been designed using artificial neural network. The optimization of the network has been done using genetic algorithms. The proposed approach has been compared with Kaiser window method. The result shows that the filter designed using ANN optimized with GA requires lesser iterations for the performance goal meeting

I. INTRODUCTION

Genetic algorithm is one of the best and at the same time one of the simplest evolutionary algorithms. Genetic algorithm by itself contains all the basic evolutionary algorithm construction blocks. Therefore, the study of genetic algorithm is also a basis for the study of other evolutionary algorithms.

Genetic algorithm is used as an **optimization algorithm**. This means that it is one of the so-called optimization methods for searching optimums (global maximums or minima). In the following sections, some expressions that have just now been used will be defined: algorithm, optimization, optimum, etc.

There are several definitions of the algorithm; the most common and simple one is that this is a sequence of precisely defined steps which eventually lead to a solution to the given problem. Historically, the algorithm was invented very early for the realization of the simplest works, as well as complicated procedures, such as constructing the pyramids in the old Egyptian times. Algorithms follow us everywhere we go, whether at brushing our teeth, cooking lunch, or washing a car, etc. However, algorithms are in most cases said to be mathematical processes which describe the course of a working task step by step.

Algorithms consist of a series of construction blocks or simple commands. It could be said that the complication of the algorithms lies in their simplicity. Since they consist of simple commands (steps), they are difficult to be designed. Namely, man, as an intelligent creature who is capable of performing unusually complex operations, is not used to work with the simple mind maps that are required by algorithms. The main problem of us, the designers of algorithms, and consequently of algorithms themselves, is that the details that we take for granted can be easily overlooked.

Genetic Algorithm

Advantages:

It can solve every optimization problem which can be described with the chromosome encoding. It solves problems with multiple solutions. we can solve multi-dimensional, non-differential, non-continuous, and even non-parametrical problems. Structural genetic algorithm gives us the possibility to solve the solution structure and solution parameter problems at the same time by means of genetic algorithm. Genetic algorithm is a method which is very easy to understand and it practically does not demand the knowledge of mathematics. Genetic algorithms are easily transferred to existing simulations and models.

Disadvantages:

Certain optimisation problems cannot be solved by means of genetic algorithms. There is no absolute assurance that a genetic algorithm will find a global optimum. It happens very often when the populations have a lot of subjects the genetic algorithm cannot assure constant optimization response times.

Genetic algorithms are stochastic search methods and there are no deterministic rules to set the operators and options of a genetic algorithm to obtain the best algorithm considering convergence speed and the goodness of the obtained results. For every problem, corresponding to the nature of the problem, the operators and options are set differently to give the best algorithm. Here we explain the genetic algorithm which we have used in the proposed technique. Every operator and option has been chosen to have the best algorithm. These selections have been done by solving an example by genetic algorithm with different kinds of operators and compare the speed of convergence and the goodness of obtained answers. The goodness criterion of an answer is determined by calculating its minimax error. As shown in [1] varying probabilities of crossover and mutation in different evolution stage improves the performance of the GA by preventing premature convergence and speeds up the convergence. We vary these two parameters by ±20%. The objective function is formulated according to the minimax error criterion,

To minimize the hardware cost and reduce the power dissipation, the information related to the hardware complexity is added to the fitness function as an optimizationcriterion. The fitness function is then defined as

Optimal Design of FIR Filter using Genetic AlgorithmThe genetic algorithm loops over an iteration process to make the population. Each consists of the following steps:

SELECTION: The first step consists in selecting individuals for reproduction. This selection is done randomly with a probability depending on the relative fitness of the individuals so that best ones are often chosen for reproduction than poor ones.

REPRODUCTION: In the second step, offspring are bred by the selected individuals. For generating new chromosomes, the algorithm can use both recombination and mutation.

EVALUATION: Then the fitness of the new chromosomes is evaluated

REPLACEMENT: During the last step, individuals from the old population are killed and replaced by the new ones.The algorithm is stopped when the population converges toward the optimal solution

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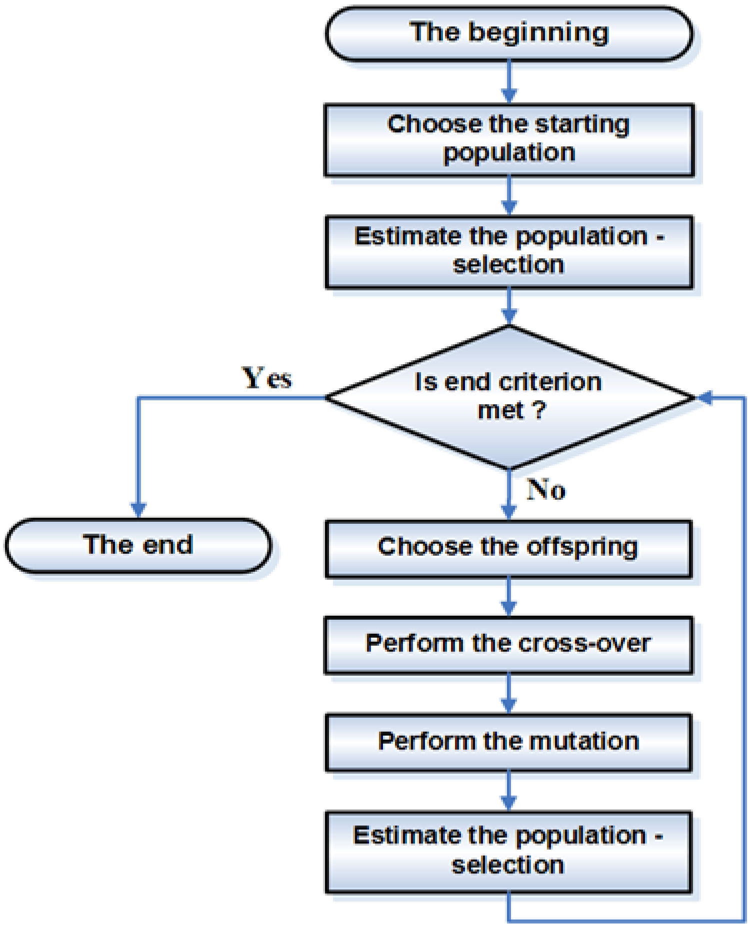

DESIGNING TECHNIQUES OF FIR FILTERS

methods for FIR filter design
(1) The window method
(2) The frequency sampling technique
(3) Optimal filter design methods

A digital FIR filter is characterized by the following z-transfer function

$$H(Z)=\sum_{0}^{N-1} h(n)z^{-n} \qquad (1)$$

The frequency response of filter is

$$H(e^{jw})=\sum_{0}^{N-1} h(n)e^{-jwn} \qquad (2)$$

where h(n) is discrete time domain impulse response and N is the number of coefficients.

For filter design we have to minimize the error between the ideal filter response and actual filter response

Let E(W) be the error

$$E(w)= W(w)[H(w) - L(w)] \qquad (3)$$

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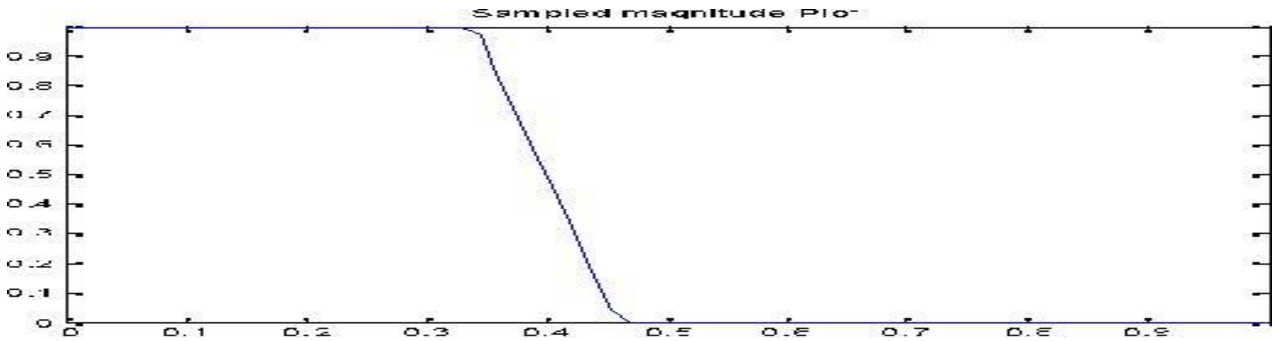
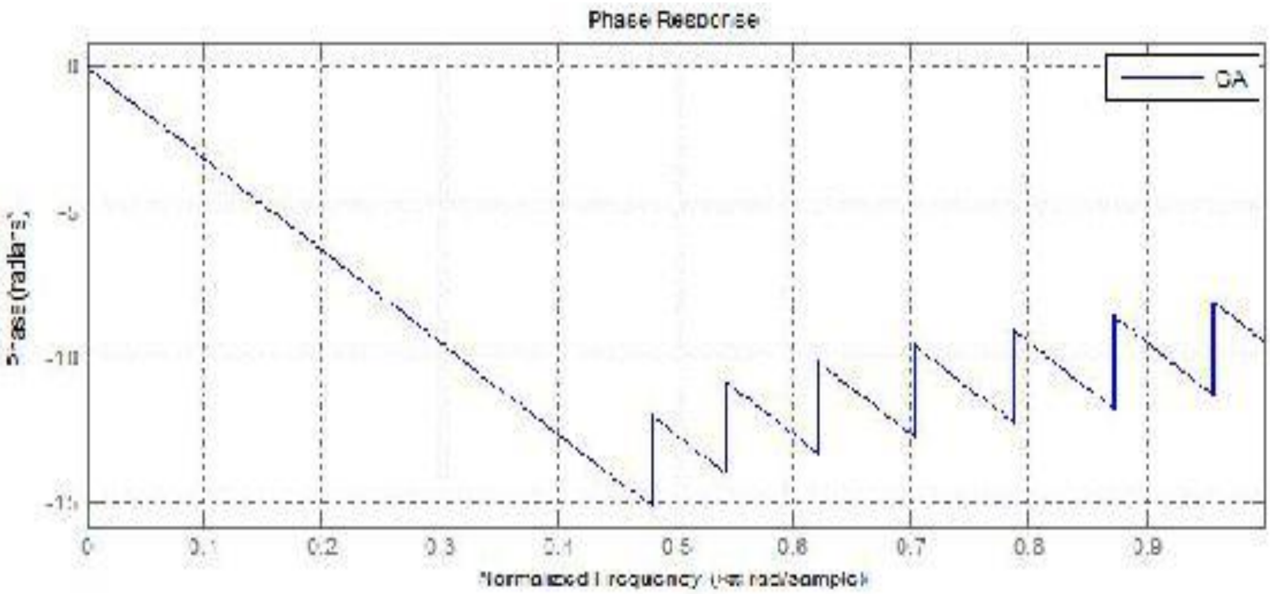
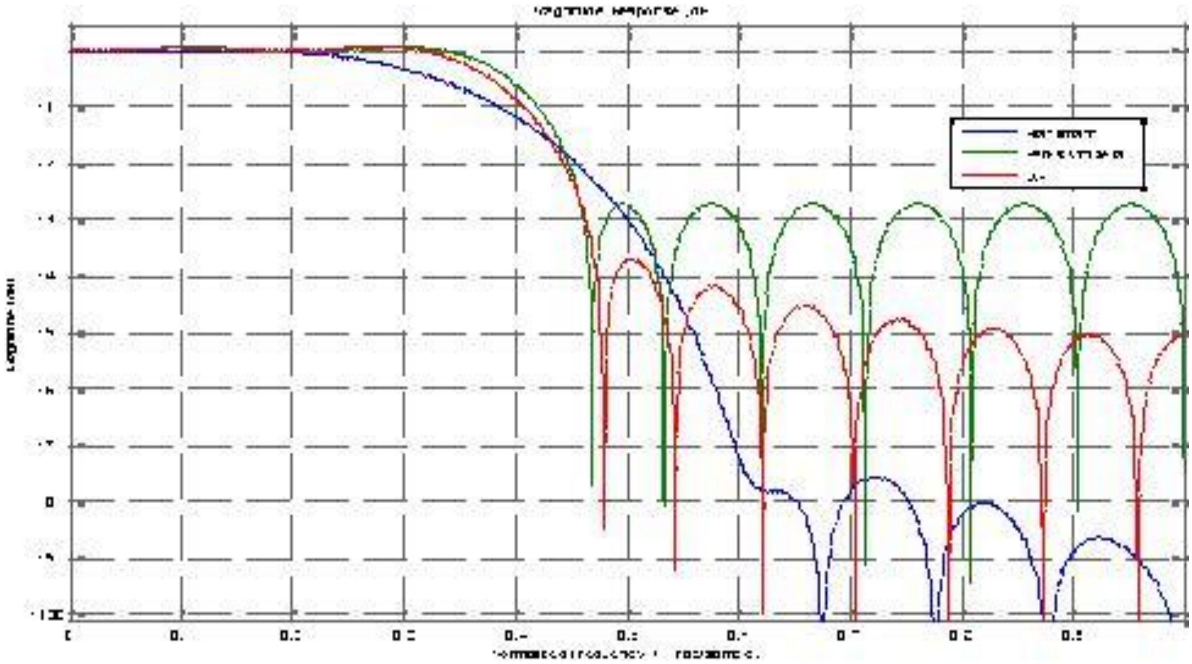
W(w) is the weighting factor & L(w) the response of the ideal filter
The method applied through MATLAB is to design a low pass FIR filter with ideal magnitude response, zero phase and small phase variation. Consider that a low pass FIR filter is to be designed with the initial conditions described in Table 3

Filter type	Low Pass
Order of filter	31
No. of sample point	65
Stop band frequency	0.458
Pass band frequency	0.341
Population Number	100
Generation Number	30
Crossover Probability	0.6
Mutation Probability	0.01







Comparision of different technique

	pass band	stop band	transition band
Blackman Window	flat with small ripples	large ripples	very small.
Parks McClellan	small ripples	very large ripples	width is very small
Genetic Algorithm	small ripples	very small ripples	width is very small

REFERENCES

[1] Rabiner Lawrence R., “Techniques for Designing FiniteDuration ImpulseResponse Digital Filters”, IEEE Transactions on Communication Technology, Vol. com 19, April 1971
[2] McClellan James H. and Thomas W. Parks, “A Unified Approach to the Design of Optimum FIR LinearPhase Digital Filters”, IEEE proceedingcircuit theory, Vol.20, pp. 697 701 Nov 1973.
[3] L. R. Rabiner, M.T. Dolan and J.F. Kaiser, “Some Comparisons between FIR and IIR Digital Filters”, Vol-53, Feb.1973.
[4]SelesnickIvan W. and C. Sidney Burrus, “Some Exchange Algorithms Complementing the ParksMcClellan Program for Filter Design”, Oct 1995

