Survey Paper on Designing of FIR Filter using Genetic Algorithm

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Abstract— filtering is the fundamental aspect of digital signal processing.it involves manipulation of signal by passing or blocking certain part of signal. Digital filters are used in numerous application of control systems. this paper presents efficient design algorithm for FIR filter using genetic algorithm.this algorithm provides the flexibility in control of parameters such as population size,number of generations,crossover probability and so on.

Key words: FIR(finite impulse response)

I. INTRODUCTION

Filters are the heart of many design problems. They are used to separate or combine different frequencies, as in frequency converters or multipliers, or in multiplex communications. Nowadays digital filters can be used to perform many filtering tasks and replacing traditional role of analog filters.digital implementation allow to achieve certain characteristics not possible with analog implementation.The electromagnetic spectrum has to be shared, filters are used to confine the radiation from high-power transmitters within assigned spectral limit, conversely, other filters are used to protect receivers from interference outside their operating range. Digital filter is very important tool in digital signal processing field.This is used for the separation of signals that have been combined and the restoration of signals that have been distorted by some way. [1].

Genetic algorithm can be successfully employed for cost function minimizing or maximizing. The design of quantized digital FIR filters, being an optimization problem over a discrete coefficient space. Genetic algorithm optimization methods have emerged as a powerful approach to solving the more difficult optimization problems[3]. As a stochastic algorithm, GA can be used to solve complicated problem with a huge search space, the discrete search space is partitioned into smaller ones. Each ofthe small space is constructed surrounding an optimum continuous solution with a floating passband gain. This increases the chances for the GA to find feasible solutions, but not scarifying the coverage of the search space. This algorithmtend to require a large amount of computation, italso offers certain unique features with respect to classical gradient-based algorithms.

FIR filters are often used in many phase-sensitive applications because they can always be designed to have linear phase. They are inherently stable due to its poles which lie at the origin[2].

II. GENETIC ALGORITHM

Genetic Algorithm is based on Charles Darwin's principle of "Survival of the fittest".at the first, a set of coefficient chromosomes is randomly selected.after that these chromosomes are encoded as binary strings called genotypes. Genetic operators such as crossover and mutation are applied on each individual genotype chromosome to produce new generation of offspring chromosomes. Corresponding to each genotype, there is a decimal equivalent,which is called phenotype, used to evaluate cost function. According to the problem under consideration, each individual in the population is assigned, by means of a cost function,which is a measure of its goodness. Best fitted chromosomes,called elite chromosomes are transmitted as it is to the next generation. With each generation, better solutions are obtained. The genetic algorithmn comprises three genetic operations reproduction, crossover and mutation.these three operationis are applied again and again, starting from an initial population of individuals.only good individuals remain in the population and reproduce, while the bad individuals are eliminated from the population Finally, the population will consist only of the best individuals fulfilling the design specification.with the use of natural selection and genetic operators, mutation and recombination, chromosomes with better fitness are found.Genetic algorithm offer a generational improvement in the fitness of the chromosomes.There are many ways to encode the chromosome such as binary encoding, permutation encoding, and value encoding. In binary encoding every chromosome is a string of bits, 0 or 1. In permutation encoding, every chromosome is a string of numbers, which represents number in a sequence.IIR Filters are infinite response filter, they have impulse response of infinite duration. Permutation encoding is used only for ordering problems. In the case of value encoding, every chromosome is a string of some values. Values can be anything connected to problem, from integer numbers, real numbers or characters. According to Darwin's theory of evolution the best ones should survive and create new offspring. There are many methods for the selection of the best chromosomes,for example-roulette wheel -selection, Boltzman selection, tournament selection, rank selection, and steady state selection. There are four types of crossover Operation : single point crossover, two-point crossover, uniform crossover and arithmetic crossover[4].

Basic steps of genetic algorithm are-

A. POPULATION

each bit is encoded as a gene and a string of genes are called as chromosome and a set of chromosomes is called population. First step to start with is to initialize the population is called as initial population. Let each solution in the population of m such solutions xi, i=1, 2, .. ., m, be a string of symbols {0, 1} of length l. Typically, the initial population of m solutions is selected completely at random, with each bit of each solution have a 50% chance of taking the value 0[4].

B. Evaluation

Each chromosome has to be assessed and to assign a value called fitness value, larger the fitness value, the probability

will be more to select it for reproduction. Fitness is the measure of goodness of a chromosome.

C. Selection

The individual chromosomes which have best fitness values are selected and proceeded for next step called reproduction where blending of the both parents would be carried to process new offspring[5]. Two regularly utilized methods are „roulette wheel" & „tournament" selection Over roulette wheel, every individual will be allocated a sector size proportional to their fitness evaluated The wheel is then spun and the individual inverse to the marker turns into a standout amongst those as parents[3].

D. Reproduction

Two chromosomes which are selected based on their fitness value from the population undergo a process called reproduction to produce offsprings. Parents who have better fitness values have superior possibilities to be selected for production of fine offsprings[4].

E. Crossover

By Choosing a random point which is called crossover point and Splitting the parents at this crossover point and Creating children by trading their tails is called crossover process. Crossover refers to replacing some of the genes of one parent with that of the other parent. Crossover fraction decides the amount of genes replaced.crossover is important random operator function of the crossover operator is to generate new 'child' chromosomes from two 'parent' chromosomes by combining the information extracted from these parents. the probability for crossover ranges typically from 0.6 to 0.95.

F. Mutation

Mutation is the random changes done to a chromosome in order to get a good fitness value. Mutation reintroduces the genetic diversity into the population. Mutation includes choosing a subset of genes randomly.

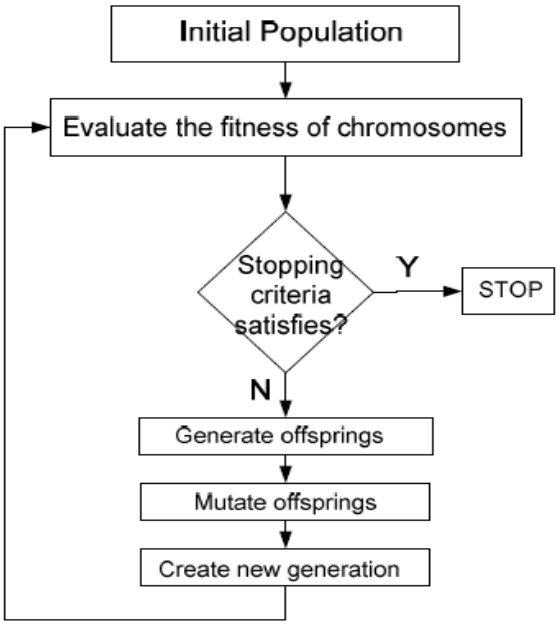

Fig.1: Typical flow of a genetic algorithm

1) Step 1:
Initial population has been set which is set of chromosomes and the chromosomes are the string of genes.

2) Step 2:
Fitness of chromosomes is evaluated each chromosome has to be assigned a fitness value which is the measure of goodness of a chromosome.

3) Step 3:
Check whether the desired fitness value has been achieved or not. If the desired value of fitness function has not been achieved then the process is stopped.

4) Step 4:
Crossover process is applied to generate new offspring using the two parents.splitting of parents has been done at the crossover point.a new child chromosome is created using two parent chromosome.

5) Step 5:
Mutation is applied to the offspring,in this process of mutation random changes has been done in a chromosome in order to get better fitness value.

6) Step 6:
New generation has been created based on the new fitness value.

III. CONCLUSION

Optimisation using a genetic algorithm offers an alternative to linear programming for primitive cascade synthesis, and extends the technique to medium order FIR filters. The proposed technique achieves the optimum number of coefficients required to get the desired frequency response the design algorithm provides flexibility in control the genetic parameters such as population size, number of generations, crossover probability and so on. Filters with binary, integer or real coefficients can be easily handled by the proposed method.

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