ISSN: 2277-5528
Impact Factor: 2.745 (SIJF)

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

OPTIMIZATION OF LINEAR ARRAY TO REDUCED SIDE LOBE LEVEL BY GENETIC ALGORITHM

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Abstract

In this paper linear antenna array is synthesis by change the position of the element as well as by adjusting the current allocation. An optimization technique genetic algorithm is used to reduce the side lobe level as well as to steer the main beam in specific direction. Various results are presented for reduction of side lobe level. This application used in smart antenna. Smart antenna has become very powerful technique for improving the frequency spectrum, for eliminating the multi-access interference an increase the system capacity.

Keywords- Array Pattern (AP), Genetic Algorithm (GA), SLL (Side Lobe Level) , Beam Forming , Beam Steering.

I. INTRODUCTION

Antenna arrays have wide application in the fields such as radar, sonar and communications. Antenna arrays may be arranged in any manner like linear, planer, circular, cylindrical, spherical, etc. A most popular type of antenna array is the linear array, which can produce sufficient narrow beam, and most importantly radiation pattern calculation is relatively easy compared to that of other configurations. The characteristics of antenna array can be controlled by geometry of the element and array excitation like: amplitude control, phase control, position control, both amplitude and phase control or by changing the type of radiation elements in the array. for the better result, these variations can be used alone or combination of them can be used but then the calculations will be very complex to be solved with analytical methods. Therefore, global optimization methods such as genetic algorithm (GA), particle swarm optimization (PSO) and simulated annealing (SA) have been used in array synthesis for improving the system capacity.

II. UNIFORM LINEAR ANTENNA ARRAY

we have taken the array of isotropic element with uniform spacing between them. To achieve the desired SLL and minimum desired value of FNBW, two-step strategy has been adopted.

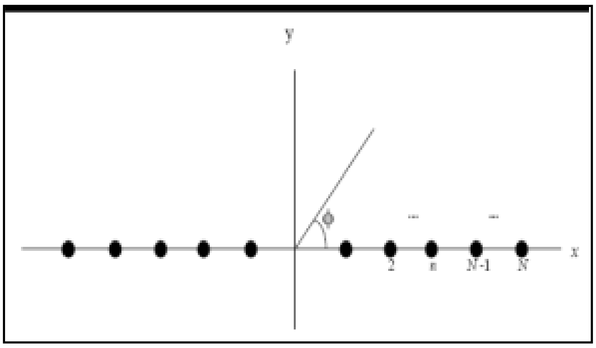

Fig.1: Symmetrically placed linear array

III GENETIC ALGORITHM

Genetic algorithm is an optimization algorithm method that works on the principle of survival of fittest it is an search algorithm which is implemented using computer simulation. To evaluate the fitness function there are various parameter for selection like crossover mutation, population selection, number of generation. the combination of GA and other optimized methods should be presented continuously. The characters of GA are simple thinking, easy-implement and obvious-application effect, so it is very suitable for the synthesis of the large and complex array antennas.

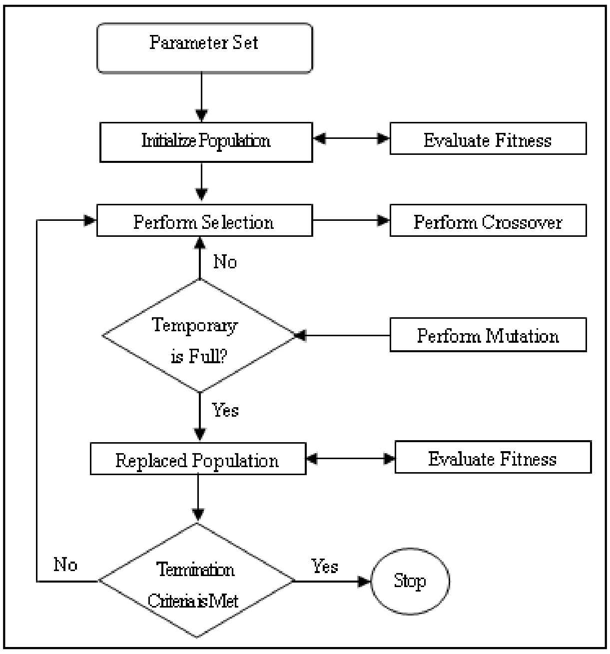

Fig. 2: Program flow graph of GA

The various parameters of GA is as follows

Crossover type and crossover rate, Mutation type and mutation rate, Population size, Selection procedure, Number of generations.

- ***A. Crossover:*** **T**his is an exchange of substring denoting chromosomes, for an optimization problem. It may be a single point cross over, two point cross over, cut and splice, uniform crossover or half uniform crossover.
- B. **Mutation** the modification of bit strings in a single Individual.
- C. **Selection –** evaluation of the fitness criterion to choose which individuals from a population will go on to reproduce.
- D. **Number of generations –** the maximum number of generations that the genetic algorithm can evolve into, before terminating.

III.A GA MODEL TO ARRAY ANTENNAS SYNTHESIS

Here , the relationship between GA and a antenna parameters about array antennas must be identified before using the GA. The array elements are replaced by a series of codes during the procedure which encoded in GA. The array parameters to be optimized are current amplitudes and phase values, one part of them correspond to amplitudes of incentive current and other part correspond to the phase values of incentive current. If every array element of incentive is expressed as $I_{n}e^{j\beta_n}$ the corresponding relationship between GA and antenna parameters can be shown in table I.

Table I: Relation Between Antenna And GA Parameters

GA	Antenna array
Gene	Bit string (I_i, β_i)
Chromosome	One element of array
Individual	One array
Population	Several array

After encoding of GA a radiation element can be expressed as two genes. One of them indicates amplitudes and the other indicates phases. So *N*-element array is a chromosome composed by 2 *N* genes. That is to say, one chromosome can be represented an individual. And a population is composed of a lot of chromosomes. If the size of population is fixed to *M, M* individuals can be generated, that is, *M* arrays.

The relationship between *M* arrays as the population scale and GA model is shown in Table-II.

Table II: GA Model to Antenna Array

Element	Element 1		....	Element N		fitness
Gene	Gene 1	Gene 2	....	Gene 1	Gene 2	
Array 1	011	110	…	010	011	
Array 3	110	111		111	000	
....						
Array n	111	100		110	011	

The task of GA is finding the optimized individual, and if an individual can be inherited depending on the sizes of the fitness. With satisfied the conditions, the highest fitness of individual can be output Range of values to an optimizing parameter is from $Umin$ to $Umax$. And the parameter can be indicated by the length l to binary code, so there are $2l$ kinds of different encodings, for example:

000000……000000	=	0	$Umin$
000000……000001	=	1	$Umin + \delta$
111111……111111	=	$2^l - 1$	$Umax.$

The accuracy (δ) of the encoing is:

$$\delta = Umax - Umin/ 2^l - 1 \qquad (1)$$

IV. RESULT AND DISCUSSION

Here various antenna array are with equally spaced with d=0.5 λ is arranged in linear manner . we have plot the various radiation pattern and then applied the Genetic algorithm via various GA parameter to find the null position and reduced the side lobe level . the simulation results are presented below.

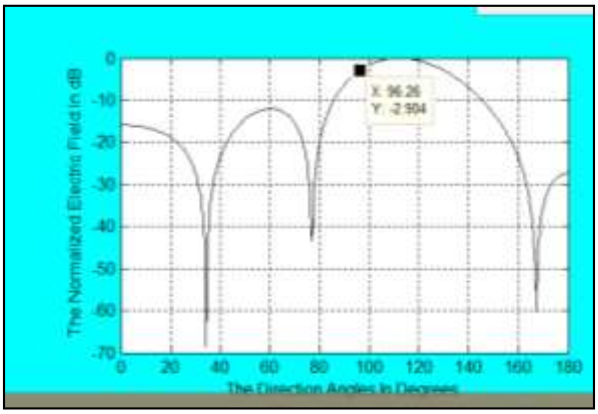

Fig. 3: Reduced SLL by 31 DB

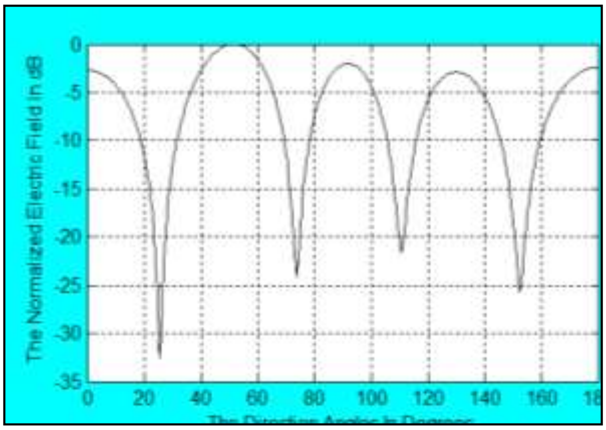

Fig. 4: Reduced SLL by -4 DB

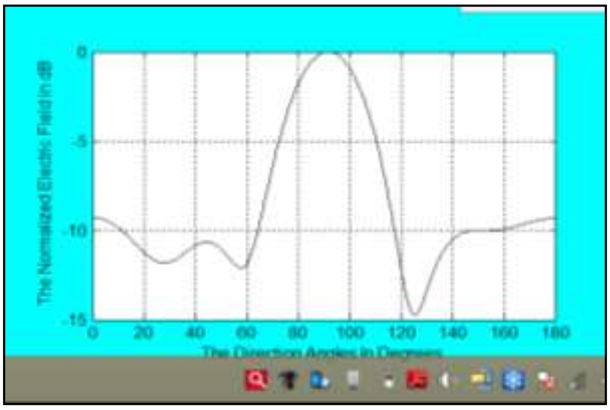

Fig. 5: Reduced SLL by 31 DB

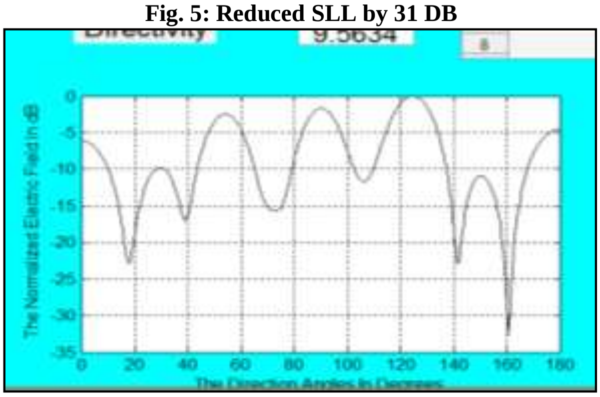

Fig.6: Reduced SLL by 31 DB

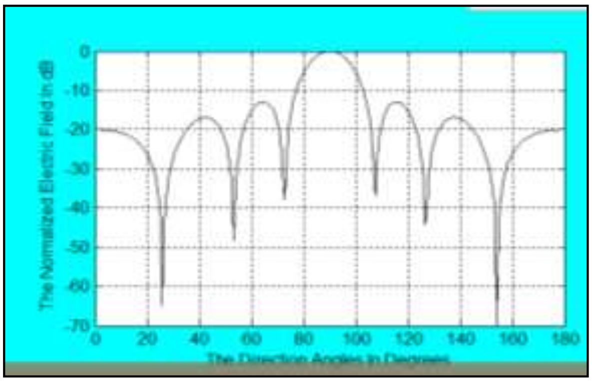

Fig.7: Reduced SLL by -20DB

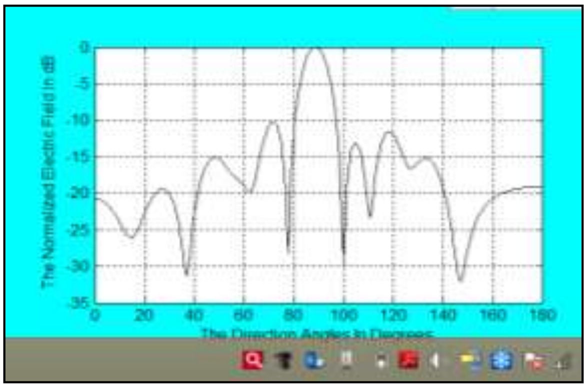

Fig.8: Reduced SLL by -19 DB

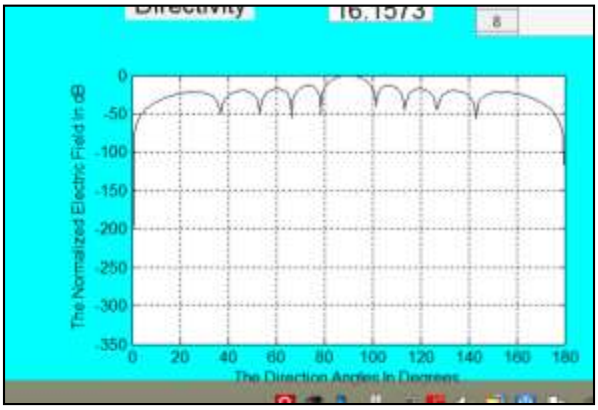

Fig. 9: Reduced SLL by -20DB

V. CONCLUSION

The use of GA in the synthesis of non-uniform linear array for the purpose of suppressed side lobe and null placement in certain directions has been are adapted .GA has shown superior performance to control the side lobe suppression. The minimum value of SLL at null positions has been obtained using GA. Also, side lobe level in suppressed regions, is comparable or less than those obtained using other methods. More control over the pattern can be achieved by using GA, not only for location, but also the excitation amplitude and phase of each element in the array. Further, use of GA can also explore for application to planar and circular synthesis.

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