



Algorithm and Software Development for MSA Design Using GA

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Abstract— This An algorithm is developed for designing microstrip antenna using genetic algorithm. Using the designed algorithm , a software has developed which is capable to provide the design parameters for microstrip antenna and gain. The software is an application software which is successfully tested for microstrip antenna. The software has functionally tested . It can run on any platform and giving the results as are the simulation in matlab. The Software is helpful in designing wireless sensor network applications. The result also shows good agreement with earlier reported results.

Keywords— Algorithm, genetic algorithm, application software, microstrip antenna.

I. INTRODUCTION

As seeing the copious advantages microstrip antenna[1] in various field It has decided to develop a novel algorithm and to design a functioning software which will be helpful in the research field for students and in wireless sensor networks. In antenna design engineering, the implementation of Genetic Algorithms[2,3] is able to segment into several research areas. Antenna array design, and performance improvement are the major applications. Many researchers employed GAs in antenna array design. In addition most of the recent, research in antenna design has done. . The Software for accurately design microstrip antenna, within minimum time and cost with added features, is in booming demand today in the field of wireless communication[4]. The software or a computer program that helps to design rectangular and U slot loaded MSA[5] at any resonating frequency within its design limitations. The use of Genetic algorithm made it a potential program. The parametric study can also be carried out by the proposed program. It performs the task autonomously and intelligently in response to calculate the bandwidth and gain[6] of rectangular and U slotted MSA. The parameter passing is on hit and trial basis the GA searches the various results to design the MSA.

Though many software are present today like EM simulator software, IE3D to design micro strip antennas but they are very much time consuming ,complicated and are less user friendly. The proposed MSA design software will add a new chapter in this world for designing rectangular and U slotted micro strip antenna. Which is capable to generate various design parameters accurately within a second. It is a Graphical User Interface based user friendly software. It is very simple to use for specific proposed shape antenna. The software is based Genetic algorithm and development on java platform. Genetic Algorithm is a class of search techniques that use the mechanisms of natural selection and genetics to conduct a global search of the solution and this method can handle the permittivity, shape and the dimensions for U slot and the rectangular micro strip antenna. According to the probability of mutation, the chromosome are chosen at random and any one bit chosen at random is flipped from “0” to “1” or vice versa[fig.1]. After mutation has taken place, the fitness is evaluated. Then the old generation is replaced completely or partially. This process is repeated. After a while all the chromosome and associated fitness become same except for those that are mutated. At this point the genetic algorithm has to be stopped The Genetic Algorithm program, for the optimization of micro strip antenna using this program. The bandwidth variation is analyzed[7] by changing the substrate material at the frequency range 4 GHz to 6 GHz by introducing the U slot in the patch. The results are simulated with matlab and pre reported results .

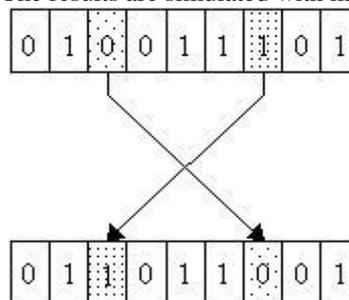


Fig. 1 Binary crossover

II. THE GENETIC ALGORITHM

A GA starts with guesses and attempts to improve the guesses by evolution. A GA will typically have five parts:

- (1) a representation of a guess called a chromosome,
- (2) an initial pool of chromosomes,

- (3) a fitness function,
- (4) a selection function and
- (5) a crossover operator and a mutation operator.

A chromosome can be a binary string or a more elaborate data structure. The initial pool of chromosomes can be randomly produced or manually created. The fitness function measures the suitability of a chromosome to meet a specified objective. The selection function decides which chromosomes will participate in the evolution stage of the genetic algorithm made up by the crossover and mutation operators. The crossover operator exchanges genes from two chromosomes and creates two new chromosomes. The mutation operator changes a gene in a chromosome and creates one new chromosome. GA has well-defined steps, a basic algorithm[8] for a GA is as follows:

The pseudo code for GA is:

```

Initialize (population)
Evaluate (population)
While (stopping condition not satisfied) do
{
Selection (population)
Crossover (population)
Mutate (population)
Evaluate (population)
}
    
```

The algorithm will iterate until the population has evolved to form a solution to the problem, or until a maximum number of iterations have taken place (suggesting that a solution is not going to be found given the resources available).

The paradigm of GAs described above is usually the one applied to solving most of the problems presented to GAs. Though it might not find the best solution. more often than not, it would come up with a partially optimal solution.

III. PROPOSED APPROACH

As shown in fig.2 the steps and the paradigm are as under given

```

Begin
Initial population(h, fr, εr, flow, fhigh, R)--x
Evaluate population—calculate parameters for input—m
While(C + E + H < L)
{
    
```

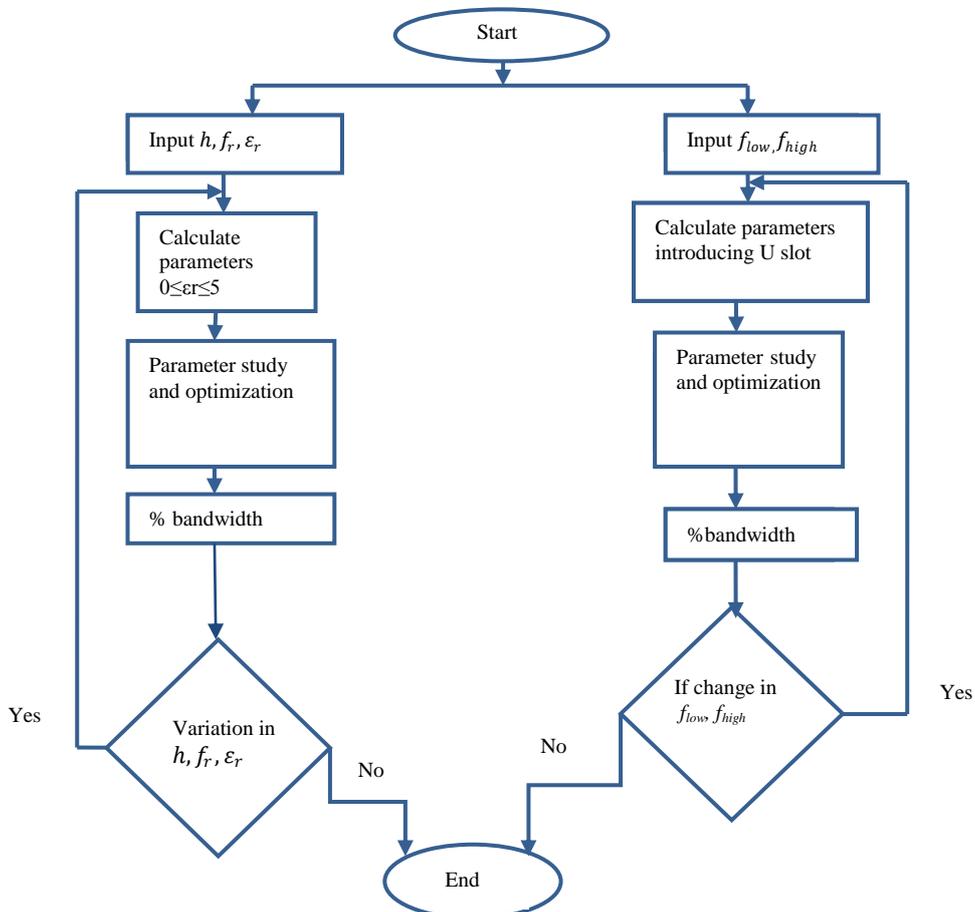


Fig.2 The flow diagram for MSA GA

```

Selection(population)
Crossover(population)
Mutate(population)
Evaluate(population)

```

}
As shown in fig.2 the steps and the paradigm are as under given

```

Begin
Initial population(h, fr, εr, flow, fhigh, R)--x
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While(C + E + H < L)
{
Selection(population)
Crossover(population)
Mutate(population)
Evaluate(population)
}

```

According to the algorithm
We can formulate

$$G = P(n) \times X(X + 22)$$

Let number of fixed parameters = 22
Number of variable parameter, x=6
the probability of right results= P(n)
where n= no. of right results
n may vary 10 to 100
x may vary 1 to 6
P(n)= 10 to 80

for data satisfying the condition that Random number <0.8. This is because crossover probability is 80% and crossover is carried out only if its corresponding random number is less than this probability.

The minimum Generations

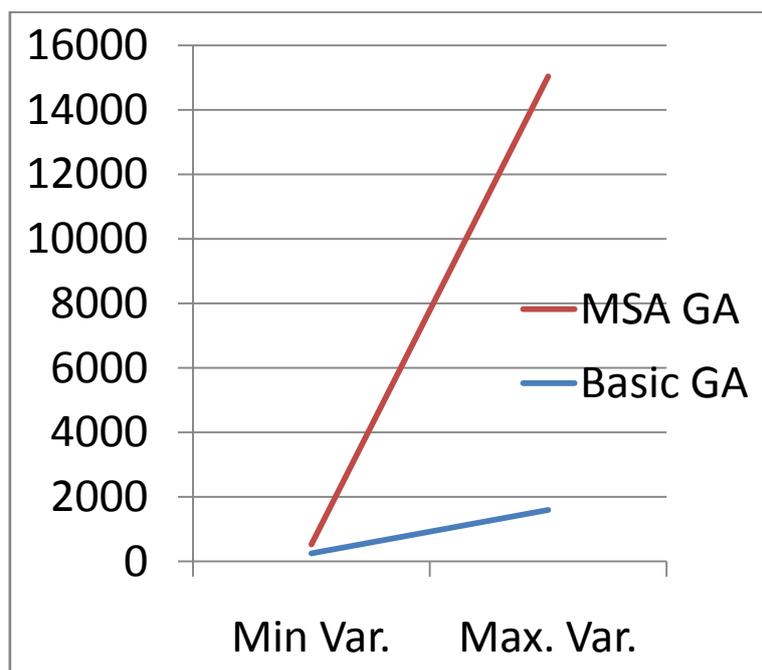
$$G(\min) = 10 * 1(6+22) = 280$$

The maximum generations

$$G(\max) = 80 * 6(6+22) = 13440$$

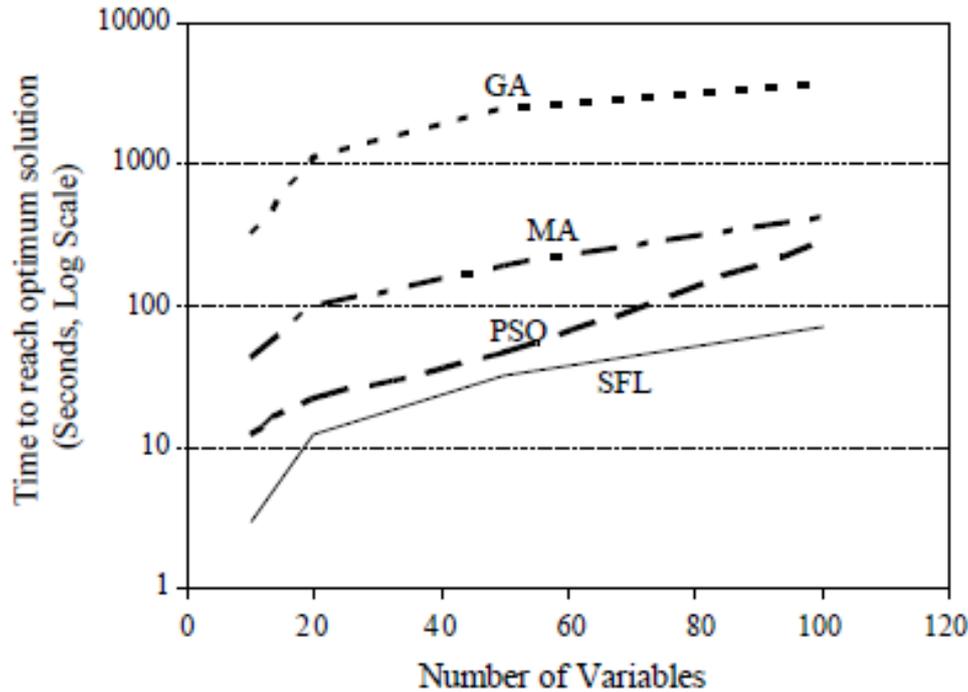
Though the initial input parameters are the scientific parameters and may be taken random as per their precision value for calculating other values.

The basic genetic algorithm may provide 250 to 1500 results while the proposed algorithm is proving 13440 generations. Hence we the algorithm developed for the application is giving the maximum results (graph-1) and capable to design the antenna accurately.



Graph1: Comparison of Genetic Algorithm and the algorithm for microstrip antenna

While the comparison of other evolutionary algorithm[9] shown in graph 2 shows comparatively low optimal solutions.



Graph 2: comparison of various algorithms

IV. DEVELOPMENT OF SOFTWARE USING MICROSTRIP ANTENNA GENETIC ALGORITHM(MSA GA)

The software has developed in Java. It implements the above said algorithm. A java applet has made to make it is Graphical User Interface based. The genetic algorithm approach makes it powerful. It is very user friendly. The concept used to design MSA GA is as follows:

```

h = h/1000;
fr = fr * Math.pow(10,9);
flow = flow * Math.pow(10,9);
fhigh =fhigh * Math.pow(10,9);
W = 2*Math.PI*fr;
lmd = c/fr;
w = (c/(2*fr))*Math.sqrt(2.0/(er+1));
ee = ((er+1)/2)+((er-1)/2)*Math.pow((1+(12*h)/(w)),(-0.5));
dl = ((0.412*h)*(ee+0.3)*((w/h)+0.264))/((ee-0.258)*((w/h)+0.8));
l = (c/(2.0*fr*Math.sqrt(ee)))-(2.0*dl);
G1 = 0.00836*(w/lmd);
Rin = 1/(2*G1);
y0 =(1/Math.PI)*(Math.acos((Math.pow(Rf/Rin,0.5))));
Bw=3.77*(((ee-1)/(Math.pow(ee,2))*(w/l)*(h/lmd)));
C=0.3*w;
E=F=lmd/60;
D=((c/((flow)*Math.pow(ee,0.5)))-(2*(l+2*dl-E));
Weff=D-2*F;
Eff=((er+1)/2)+((er-1)/2)*Math.pow((1+(12*(h/Weff))),(-0.5));
Dl =((0.412*h)*(Eff+0.3)*((Weff/h)+0.264))/((Eff-0.258)*((Weff/h)+0.8));
L= l-(2.0*Dl);
H= l-E+2*Dl-((1/(Math.pow(Eff,0.5)))*((c/fhigh)-(2*C+D)));
G2 = 0.00836*(w/lmd);
ppRin = 1/(2*G2);
ppy0 =(1/Math.PI)*(Math.acos((Math.pow(Rf/ppRin,0.5))));
BW=3.77*(((Eff-1)/Math.pow(Eff,2))*(w/L)*(h/lmd));
    
```

The user Interface of the designed software is has shown below(fig. 3).

Normal patch readings		U-slot patch readings	
* Height (mm)	<input type="text" value="10"/>	* Lower frequency (GHz)	<input type="text" value="4"/>
* Dielectric Constant	<input type="text" value="2.2"/>	* Higher frequency (GHz)	<input type="text" value="6"/>
* Resonant Frequency (GHz)	<input type="text" value="5"/>	* Slot Width[D] (mm)	13.046923894351956
* Wire Resistance (ohm)	<input type="text" value="50"/>	* Slot width[E=F] (mm)	1.0
* Width (mm)	23.717082451262847	* Slot Height[C] (mm)	7.115124735378854
* Effective Dielectric Constant	1.8437404934362118	* PP Effective Dielectric Constant	1.7742041576350303
* Delta Lamda (mm)	4.628512223712784	* PP Delta Lamda (mm)	4.050158684933308
* Length (mm)	12.83682334127835	* PP Length (mm)	4.736505971411734
* Input impedance (ohm)	151.30515120422868	* Checksum (mm)	10.992990898144924
* Feed point location (mm)	3.9159825848411445	* Height of slot from base (mm)	2.8778661627660713
* Bandwidth (MHz)	1440.698511637489	* PP Bandwidth (MHz)	3869.1145911771787

Fig. 3 The Graphical user interface for MSA design.

V. FUNCTIONAL TESTING

The software is tested (fig. 4) using black box testing methodology. As complete testing is not possible. So we will take some values and analyze them. Then the values will be simulated with simulation software.

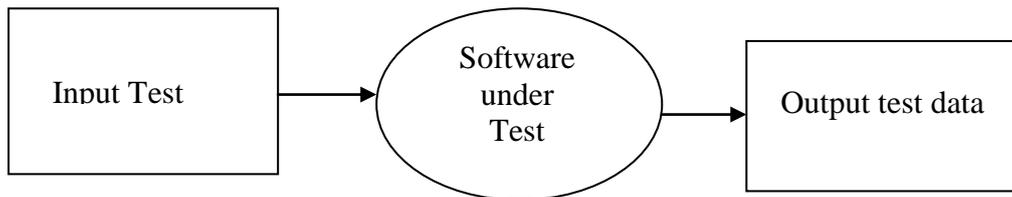


Fig.4 Testing of Software

VI. RETURN LOSS FROM SIMULATION

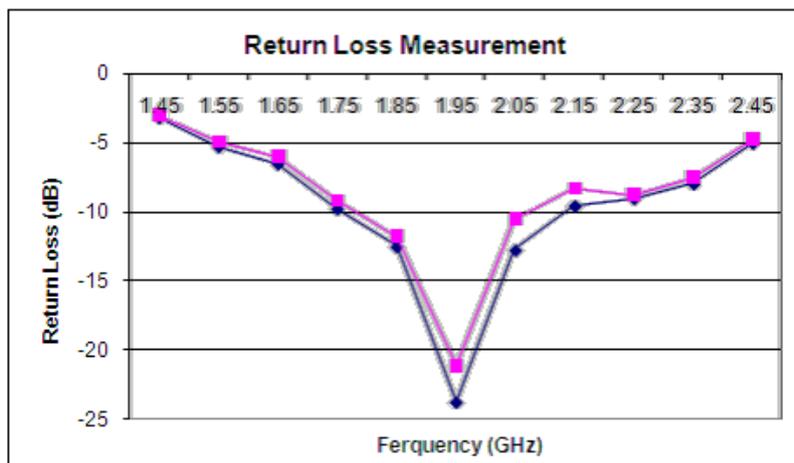
The reflection coefficient (ρ) of the antenna is given as

$$\rho = \frac{Z_{in} - Z_0}{Z_{in} + Z_0}$$

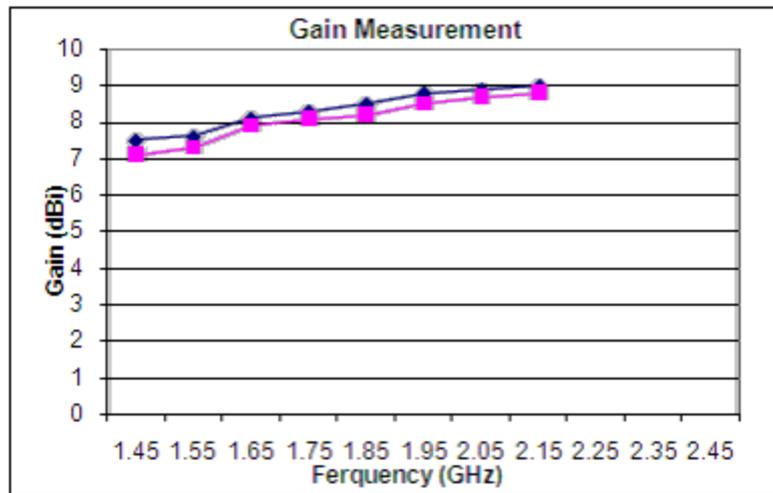
where Z_0 is the characteristic impedance of the coaxial feed line (50 ohm).

Therefore, the return loss (RL) (Graph 3 and Graph 4) of the antenna is given as

$$RL = 10 \log_{10} \frac{1}{\rho^2}$$



Graph 3: Return loss of the antenna



Graph 4: Gain measurement of the antenna

VII. CONCLUSION

The proposed micro strip antenna design agent has a number of attractive features including:

It execute on any platform, the Java Run Environment made it easier to access for the user. ,It analyze a micro strip antenna structure using different dielectric layers., Simultaneously two types of antennas can design., Easy to use which will promote student interest and learning in the field of antenna design., Slot coupled antennas can be modeled and design., It can be used for parametric study of micro strip antenna., It has controlled integration accuracy.

This paper presents the successful development of algorithm and a software using java technology for microstrip antenna using genetic algorithm.

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