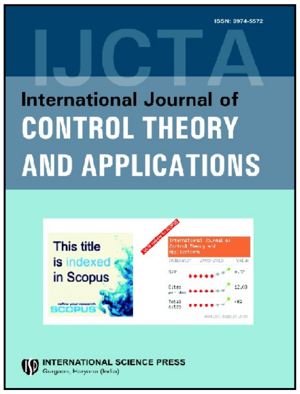

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Matlab Based RF MEMS Switch for Reconfigurable Antenna using GSO Algorithm with ANN: A Survey

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Abstract: This paper presenting the study and use of Gravitational Search Optimization (GSO) algorithm with Matlab for designing RF MEMS Switch. The RF-MEMS technology which is continuously growing and MEMS for reconfigurable antenna it is very interesting and most valuable issues for optimization designing. It is investigated relationship between different designing parameters and the device performance for designing a MEMS device. The structure of antenna is determined by selecting the optimal dimensions for example beam length and beam width of the antenna, Torsion arm length, Switch thickness, Holes and Gap are used. To optimize the dimensions, GSO algorithm is proposed with artificial neural network that will reduce the errors and produce optimal output at the end. The implementation of the proposed method will be done by Matlab 2013b and the performance will be analyzed with existing methodologies.

Keywords: RF MEMS, Reconfigurable antenna, Gravitational, Optimization GSO, Matlab.

1. INTRODUCTION

Neural networks play a vital role in the applications of wireless communications [5]. The very first preferred shape for antenna design purposes was the Sierpinski gasket, which later on converted into a reconfigurable antenna (RA) by introducing radio frequency micro electromechanical system (RF MEMS) switches [3].

There are various shapes of RF-MEMS switch like, H-shape, S-shape, spiral, log-periodic to achieve different wireless and aerospace applications. The feed-forward back-propagation (FFBP) algorithm of artificial neural network is used to optimize the switch. The optimized results of RF switch depends upon the physical parameters, dielectric as well material of substrate and beam [1].

Paras Chawla *et al* [3] have proposed a mathematical neural approach/artificial neural network (ANN) for the design of a swastika-shaped reconfigurable antenna as a feed forward side. Planar antenna up to the second iteration was simulated using finite element method-based HFSS software. The developed ANN algorithm was used for optimizing the antenna to be carried out by exchanging repetitive simulations, which provide reduced processing times. Paras Chawla et al [4,5] have proposed the designing and analysis of reconfigurable antenna devices. The pull-in voltages lies between 1.912 to 2.125V at 8GHZ and voltages lies between 22.812 to 23.125Vat

10GHZ. The switching speed of microsecond were measured which is well suited for reconfigurable micro strip antenna. For the RF-MEMS switch a feed-forward back-propagation (FFBP) algorithm was used for getting the changes in some parameters The reconfigurable antenna was used to do the changes in real time in the relevant circuital characteristics and radiation properties. the reconfigurable antenna which are having different multiband are used in radar and wireless applications[6].

2. OBJECTIVE AND SCOPE OF THE STUDY

There are number of strategies that are being proposed by different researchers, scientists and several optimization techniques is used to optimize the design parameters. Hence in this work we are going to propose the following:

I. To design efficient MEMS for reconfigurable antenna identify the optimal parameters.

II. To optimize the dimensions, GSO algorithm is proposed with artificial neural network that will reduce the errors and produce optimal output at the end.

3. PROPOSED APPROACH

The design is determined by optimal selection of dimensions, which represent the length and width, of the antenna structure. Designing parameters like Length of beam, Width of beam, Torsion arm length, Switch thickness, Holes and Gap are used. The basic aim of this research is to find out the optimal parameters for designing of efficient MEMS for reconfigurable antenna. For getting the optimum result we are using the Matalb with the GSO algorithm with Artificial Neural network. The proposed Diagram is shown in the following figure 1.

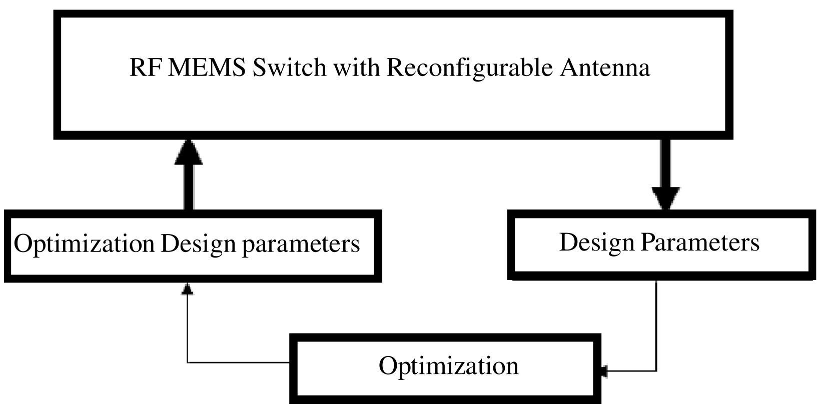

Figure 1: Diagram of Proposed approach

NEURAL NETWORKS ARCHITETURE

I. Feed-Forward Networks*:* In Feed-forward ANNs the signals are travel only in one way from input to output. There is no feedback (loops) i.e. the output of any layer does not affect that same layer.

II. Feedback Networks: With the help of loops in the network the signals can travel in both the directions in the feedback network. Feedback networks are very strong complicated. Feedback network has the dynamic behavior.

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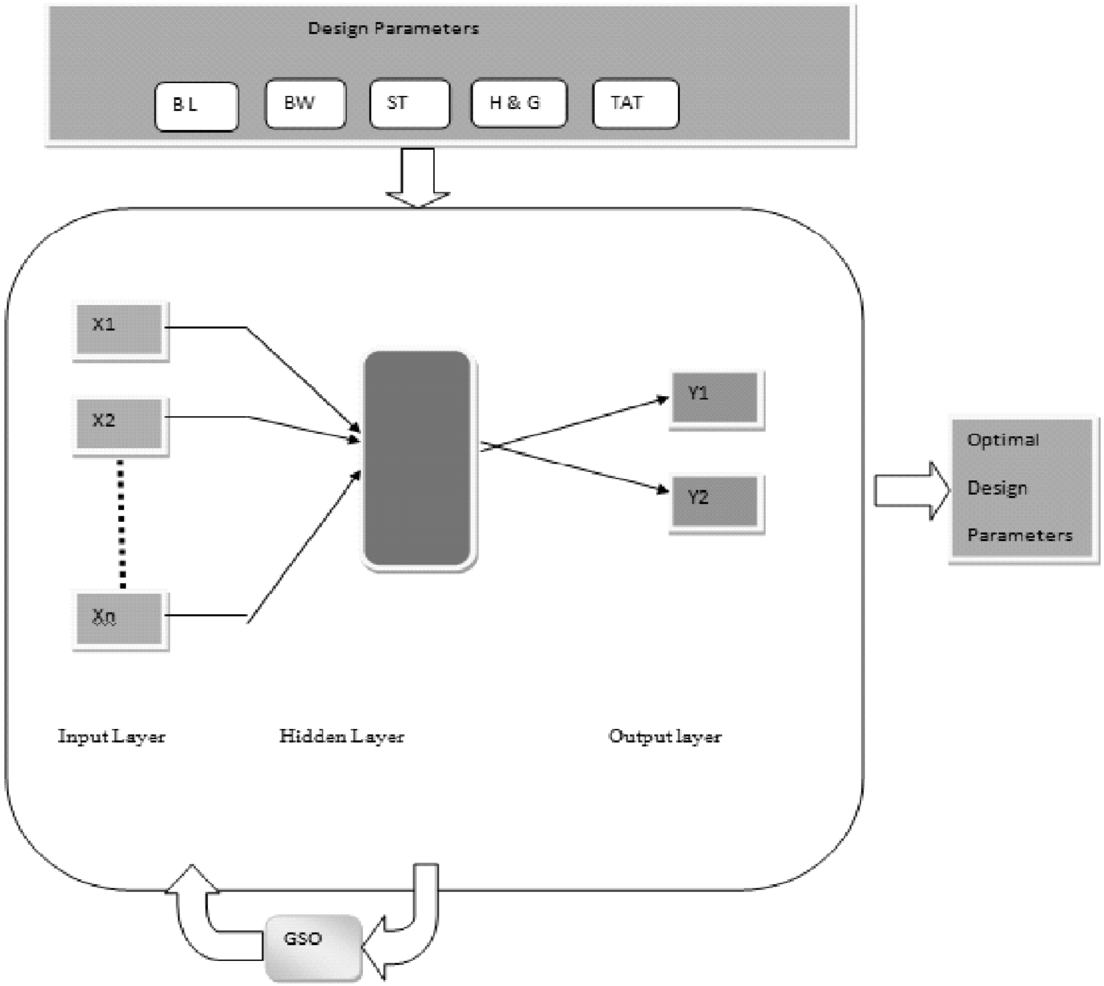

Figure 2: Feed Forward ANN Proposed Structure

Figure 2 shows the feed forward ANN proposed structure in which an artificial neuron is a device with many inputs and one output. A sophisticated neuron has the inputs 'weighted', the effect that each input has at decision making is dependent on the weight of the particular input. The weight of an input is a number which when multiplied with the input gives the weighted input. These weighted inputs are then added together and if they exceed a pre-set threshold value, the neuron fires. In any other case the neuron does not fire. For distributing the input signals x_i to neurons in the hidden layer. Each neuron j in the hidden layer sums up its input signals x_i after weighting them with the strengths of the respective connections w_{ij} from the input layer and compute its output Y_j as a function of the summation

$$Y_j = f(\Sigma\, W_{ij}\, x_i)$$

And where f can be a simple threshold function. Parameters of the model are allowed to change [2].

4. EXPECTED PERFORMANC ANALYSIS

The design parameters such as beam length, beam width, length of Torsion arm, thickness of switch, Holes and Gap are used and the above data's have to be collected for analyzing the system and evaluation purpose.

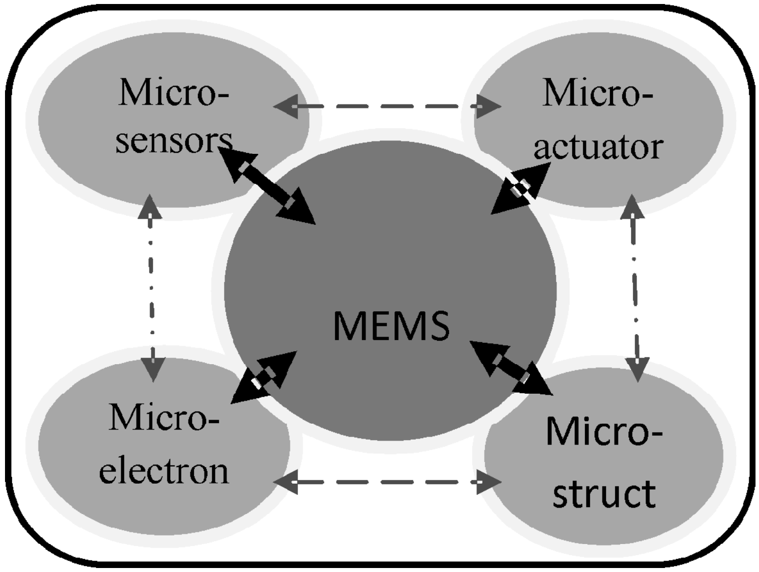

Figure 3: Components of MEMS

Figure 3 shows the components of MEMS which consist of mechanical microstructures, micro sensors, micro actuators and microelectronics, all integrated onto the same silicon chip.

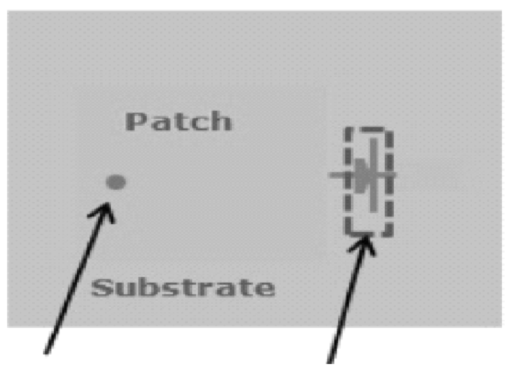

Figure 4: Schematic layout of RF-MEMS Switch with reconfigurable antenna

In the above figure 3 substrate is of silicon material and for designing the switch different physical dimensions and material constant are used shown in the following table number 1.

Table 1
Parameters for Switch Designing

S.No	*Parameters*	*Values*
1	Beam length	20µm
2	Beam width	4 µm
3	length of torsion arm	50µm
4	Thickness of switch (t)	0.7 µm
5	Holes	1.0 µm & 20 holes

cond. table 1

S.No	*Parameters*	*Values*
6	Gap (g0)	2.3 µm
7	GoldYoung's modulus (E)	57 GPa
8	Poisson's ratio for gold (v)	0.35
9	Modulus of sheers (G)	E/{2(1+v)}
10	Moment of inertia x-axis (Ix)	wt3/12
11	Moment of inertia z-axis (Iz)	tw3/12
12	Moment of inertia polar (Ip)	Ix + Iz
13	Torsion constant (J)	0.413 Ip

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Table 2
The distinguish Performance of different switches are shown in the following table [7, 8]

Parameter	RF-MEMS	PIN-DIODE	GaAs FET	EMR
Voltage (V)	20-80	±3-5	3-5	3-24
Current (mA)	0	0-20	0	15-150
Power Consump. (mW)	0.05-0.1	5-100	0.05-0.1	<400
Switching time	1-300 µs	10-100ns	1-100ns	>1ms
Cup (series) (fF)	1-6	40-80	70-140	-
Rs (series) (Ω)	0.5-2	2-4	4-6	<0.1
Cutoff Freq. (THz)	20-80	1-4	0.5-2	0.005
Isolation(1-10GHz) (dB)	>40	>35	15-25	>40
Isolation (<10 GHz) (dB)	25-40	20-35	<20	-
Loss (1–10 GHz) (dB)	0.05-0.2	0.3-1.2	0.4-2.5	<0.3
Loss (>10 GHz) (dB)	0.1-0.2	0.7-2	>2	-
Power Handling (W)	<1	<10	<5	10
3rd order Int. (dBm)	+66-80	+27-45	+27-45	>60
Life cycles	>10^8	10^9	10^9	0.5-5*10^6
Size	small	small	Very small	large

The Figure 5 shows the expected simulation result of the switch. In the up state position the insertion loss is of -0.035dB at 3.0 GHz and -0.07dB at 7.5GHz In down state the position the isolation loss is -9dB at 3.5GHz and -17dB at 8GHz .the graph is drawn between the frequency in GHZ V/S insertion and isolation loss in dB.

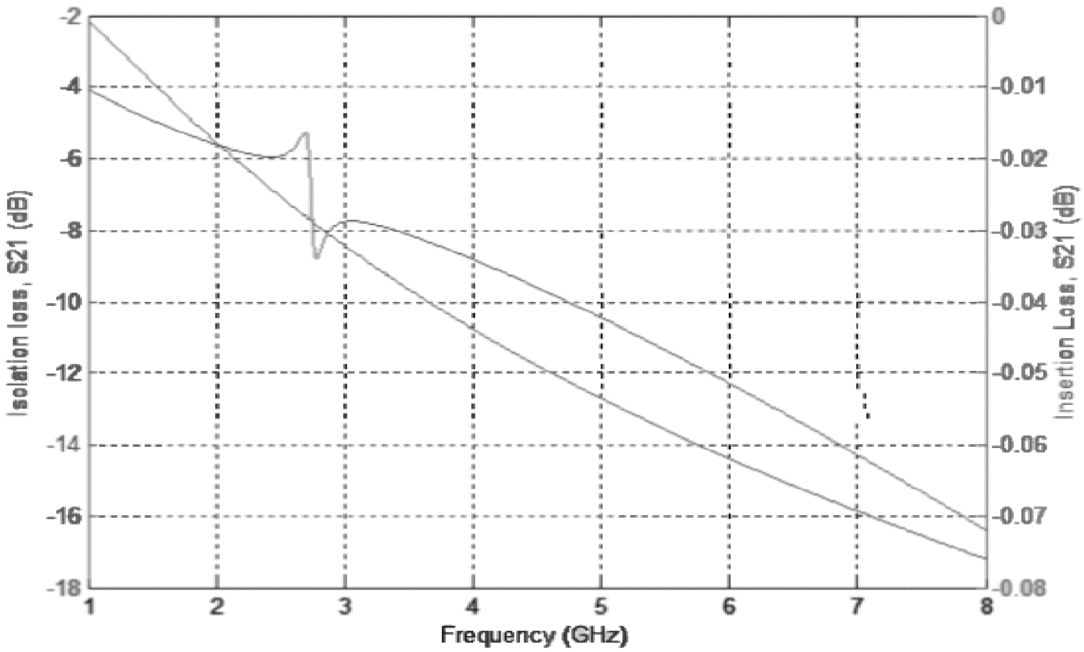

Figure 5: Expected result of simulation parameters like Isolation loss and insertion loss versus Frequency of switch in on- and off state

5. CONLUSION

From the above study we will be able to get the possible outcome of the work with remarkable efficiency which is able to use for designing and optimizing of the RF MEMS for reconfigurable antenna. With the help of the estimated methodology we are expecting the consistency of the performance under various circumstances and practical scenarios. Finally, the performance will be compared in detail with the existing system to prove our system efficiency and to improve the design parameter. With the help of existing methodologies we analyzed the performance of the proposed system and the implementation will be done by using Matlab 2013b to show the system effectiveness. The optimization problem can be solved by using adaptive or hybrid optimization algorithms for designing of antenna.

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