

FAULT DETECTION IN ANALOG CIRCUIT USING NEURAL NETWORK

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ABSTRACT

Many studies have been presented for the fault diagnosis of electronic analog circuits. The fault detection using neural network is more efficient than other technique because it has good robustness, strong learning ability and adaptability. neural network need to feed data For initializing the training of neural network. There are the inputs-outputs specified to the neural network. The data for the training and testing set is collected from the Simulator and the transient response of the circuit is used for this purpose. The training inputs corresponding to the fault free circuit include effects due to Component tolerance within specified limits and for faulty circuits, obtain by Injecting hard and soft faults to the circuit.

Keywords: Analog Circuits, Fault Detection, Neural Networks, Transient Response, Hard Faults, Soft Faults

I. INTRODUCTION

Although the technology has become so much advanced in designing of analog & mixed signal integrated circuits but still testing of analog circuit exists with a major problem due to the reason of the limited internal nodes & non-linearity of outputs which includes noise & changes in the specifications of the components value. The basic method used for testing is functional testing where the specifications of the circuit are tested, which is also not known with enough precision.

A fault is basically the change in value of an element with respect to its standard value that results failure of the circuit. The most common fault in electronics circuit is:

- 1) Soft fault
- 2) Hard fault

Soft fault is the fault introduce due to out of specification of element.

Hard fault is introduced due to either open or close circuit.

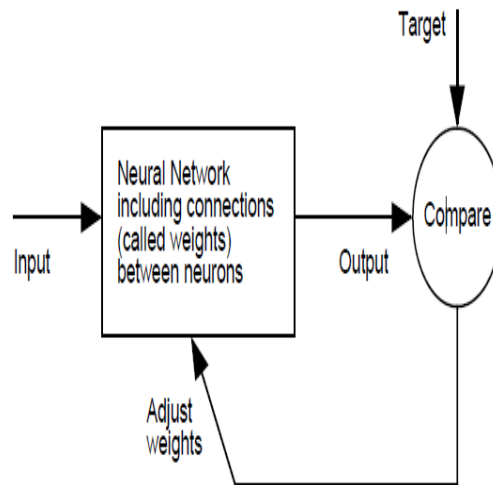
This paper introduces a new method for testing analog circuit using Artificial Neural Network.

An Artificial network consist of a pool of simple processing units which communicate by sending signals to each other over a large number of weighted connections.

There are two basic reasons why we are interested in building Artificial Neural Networks (ANNs)?

Technical Viewpoint : Some problems such as character recognition or the prediction of future states of a system require massively parallel and adaptive processing.

Biological Viewpoint : ANNs can be used to replicate & simulate components of the human (or animal) brain, thereby giving us insight into natural information processing.



Figuer1. Flow Diagram for Working of Neural Network

II. TRAINING SET DESIGN

The selection of the features for testing analog circuit is of great importance. We have used a multistage tuned amplifier in this project. Multi stage amplifier include band pass filtering component with in amplifier circuitry. There are several tuning schemes in use staggered tuning where each amplifier stage is tuned to a slightly different frequency.

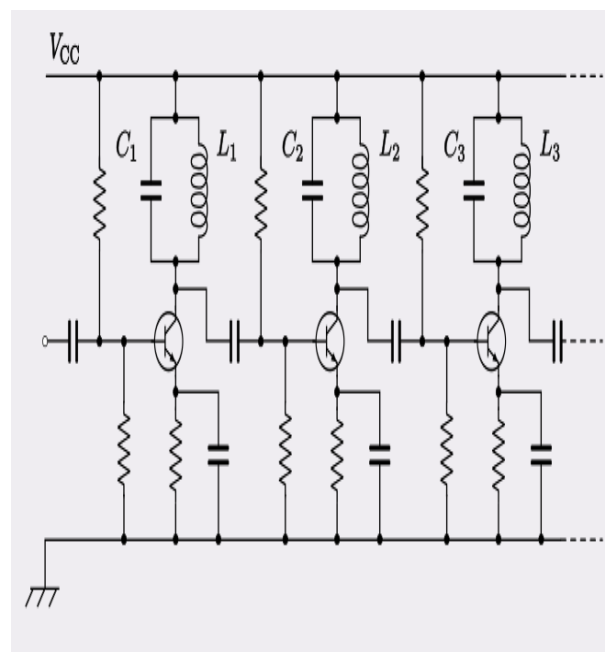


Figure 2.Tuned Amplifier Circuit

There are the input-outputs specified to the neural network. The data for training & testing set is collected from the PSpice simulator, multisim&matlab of the circuit is used for this purpose. The frequency responses of the circuits are used for this purpose. We can measure multiple faults as well.

III. MULTISIM SIMULATION

Reading taken from the fault free circuit through the multisim simulation software .the input voltage is fixed 5V and output is taken by varying the frequency

TABLE 1 : Simulation Result for Fault Free Circuit

<i>frequency (khz)</i>	<i>Input voltage</i>	<i>Output voltage</i>	<i>Gain</i>	<i>Gain in db</i>
1.1	5 v	8.39	1.678	2.2479
1.3	5 v	12.165	2.433	3.8614
1.5	5 v	15.623	3.1246	4.786
1.7	5 v	9.987	1.9974	3.0046
1.9	5 v	7.889	1.5778	1.9805
2.1	5 v	6.067	1.214	0.842

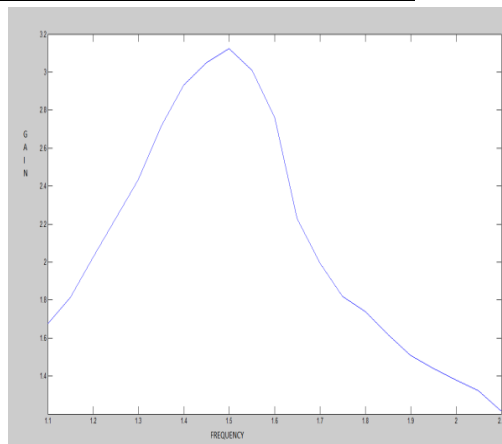
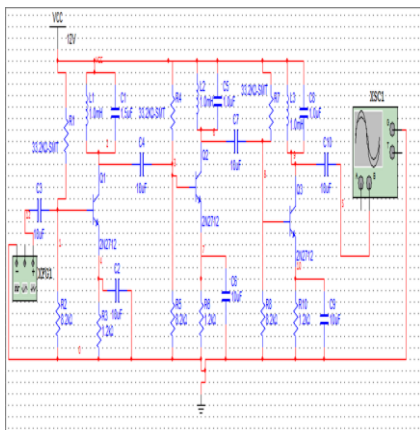


Figure 3.Simulation Circuit

Figure 4.Frequency Response of Fault Free Circuit

The output of fault free circuit after simulation is compared with the the output of faulty circuit for detection of fault in the circuit

Table 2.Simulation Output After Introducing Hard Fault

Frequency	Input voltage	Output voltage	Gain	Gain in db
1.1	5 v	10.278	2.0556	3.129
1.3	5 v	10.588	2.1176	3.258
1.5	5 v	13.47	2.6944	4.3039
1.7	5 v	9.815	1.963	2.929
1.9	5 v	9.798	1.9596	2.921
2.1	5 v	10.677	2.1354	3.2947

3.1 Neural Training Using Matlab Coding for Training

```
clc;
Clear all;
P=[1.1 1.3 1.5 1.7 1.9 2.1];
T= [1.678 2.433 3.1246 1.9974 1.5778 1.214 ];
Net = newff(P,T,5);
Y=sim(net,p);
P lot (P,T,P,Y,'o')net.trainparam.epochs=50;
Net= train(net,P,T);
Y = sim(net,P);
Plot (P,T,P,Y,'o')
Z=Y-Y;
```

IV. EXPLANATION OF CODES

The MATLAB command newff generates a MLPN neural network, which is called net.

Newff (input,output,number of layer)

After initializing the network, the network training is originated using train Command. The resulting MLP network is called net1. Epochs =determine when will the stop the number of iteration

4.1 Storing of Standard Data for Make Generalised System

4.1.1 Data Stored by Using Programming in Matlab

Let's take a example if we have standard output [1 2 3 4 5]

```
clc;
closeall;
clear;
p=[1 2 3 4 5];
q= input('central frequency of circuit')
for I=1:5
if (p(I)-q(I)<(0.11*p(I)))&(p(I)-q(I)>(-1*0.11*p(I)))
fprintf('noerror\n')
else
fprintf('error\n')
end
end
```

V. CONCLUSION

- Artificial Neural Networks are an imitation of the biological neural networks, but much simpler ones.
- The computing would have a lot to gain from neural networks. Their ability to learn by example makes them very flexible and powerful furthermore there is need to device an algorithm in order to perform a specific task.
- Neural networks also contribute to area of research such neurology and psychology. They are regularly used to model parts of living organizations and to investigate the internal mechanisms of the brain.
- Many factors affect the performance of ANNs, such as the transfer functions, size of training sample, network topology, weights adjusting algorithm, ...

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