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ARTIFICIAL NEURAL NETWORK FOR SYNTHESIS AND OPTIMIZATION OF QUAD CIRCLE SLOTTED TEXTILE ANTENNA

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ABSTRACT
Using Multilayer Perceptron feed forward back propagation (MLPFFBP-ANN), it is possible to determine the bandwidth of a Flexible antenna. This is accomplished by utilising the technique. In order to put the neural network model into action, the numerous training processes of MLPFFBP-ANN are utilised. All of these procedures are designed to train the neural network. It is the responsibility of the CST software to collect the data that is ultimately utilised for the purpose of training and testing the neural network. When contrasted with the outcomes that were accomplished through the utilisation of CST software, the outcomes that were accomplished through the utilisation of MLPFFBP-ANN were discovered to be quite good. The outcomes that were achieved via the use of CST and the outcomes that were obtained through the utilisation of MLPFFBP-ANN are well aligned.

Keywords: MLPFFBP*, Broad band, Bandwidth, ANN.*

1. INTRODUCTION
It is possible to use the Neural Network models for optimisation that is both efficient and precise, and these models can be generated within the range of training [1-5]. There is a model of the ANN that has been built for the flexible antenna, and it can be shown in Figure 2. Utilising the feed forward network allowed for the successful completion of the task of calculating the bandwidth of the flexible antenna. The MLPFFBP model is used for the work that is being discussed here [6-10]. The network was built with three different layers named as input, hidden and output layers. After receiving input variables, Artificial Neural Networks multiply those values by weights that they have learned. After that, the product of these numbers is utilised as inputs to a "hidden" layer that functions as learned features when it is applied. One of the most well-known algorithms is known as back propagation which is shown in figure 3. In order to determine whether or not the MLPFFBP ANN-based model that has been proposed for the design of the flexible antenna is useful, the goal of this study is to evaluate its effectiveness. The neural network will automatically adjust its weights during training and threshold values in order to reduce the amount of error that exists between the outputs that are predicted and those that are sampled. This is done in order to maintain the highest possible level of accuracy. Computing the adjustments is the responsibility of the back propagation algorithm, which is responsible for the computation.

MLPFFBP technique, which is given in this work, was developed with the intention of conducting an analysis of the bandwidth of microstrip antennas. Additionally, the CST software is utilised by the artificial neural network (ANN) in order to generate both training and test data. This computational electromagnetic (EM) simulator is built on the Method of Moment as its base. It has been discovered through analysis that a feed position is very important parameters and by varying the feed position, the several data of bandwidth of proposed flexible antenna is calculated which is utilised in training of ANN network. Once the return loss has been determined, the feed point that is selected as the ideal one is the one in which the return loss is the greatest negative, which is defined as being less than -10 dB. This provides the optimal feed point for the system [11-19]. This is accomplished by the adjustment of the probe feed coordinates.

A jeans substrate is used to design the proposed antenna in order to achieve the goal of providing a wide bandwidth of 85.25%. Since this antenna is capable of covering the frequency range from 4.83 GHz to 12.0 GHz, it is an excellent choice for usage in applications involving WLAN, WiMax and broad band application.

2. ANN Model & Network Architecture

A representation of the architecture of presented antenna that is currently under consideration for utilisation can be found in Figure 1. The dimension of the substrate of flexible antenna is Ls× Ws h is placed above the ground plane. For the purpose of data creation, the CST software is utilised to simulate the frequency domain response of the antenna for a variety of different patch dimensions. This information is then used to create data. For the purpose of training and testing an artificial neural network (ANN), the CST software is utilised to produce data sets that can be used for training and testing. The configuration of a coaxial probe feed microstrip antenna is illustrated in Figure 1, which is an example of the configuration. Modifying the length of the feed of the proposed geometry in relation to the proposed geometry has resulted in the generation of both the training data and the test data for the MLPFFBP algorithm. Figure 2 is a representation of the Levenberg-Marquardt technique, which depicts both the performance and the training of the technique. As can be seen in Figure 3, the MLPFFBP model has been constructed with the help of the textile antenna. When it comes to determining the bandwidth of the microstrip antenna, the MLPFFBP Artificial Neural Network has proven to be an extremely effective tool. Through the utilisation of these networks, it is possible to arrive at an approximation of a generic function. If there are enough neurons in the hidden layer, it is able to approximate any function with a finite number of discontinuities, which gives it an arbitrarily good performance. This is because the hidden layer has sufficient neurons.

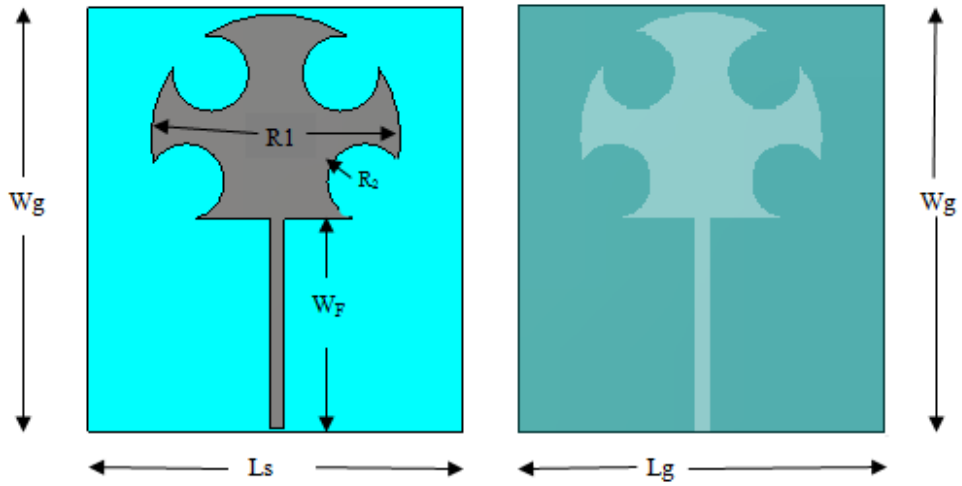

Fig.1 Geometry of proposed Microstrip antenna

Table 1 Design parameters of presented antenna

Parameters	**Value (mm)**
Ground Length(L_g)	69.08
Ground Width(W_g)	78.24
Substrate Length(L_S)	69.08
Substrate Width(W_S)	78.24
Patch Radius (R1)	23
Small circle radius (R2)	7
Feed Length (W_F)	28.6

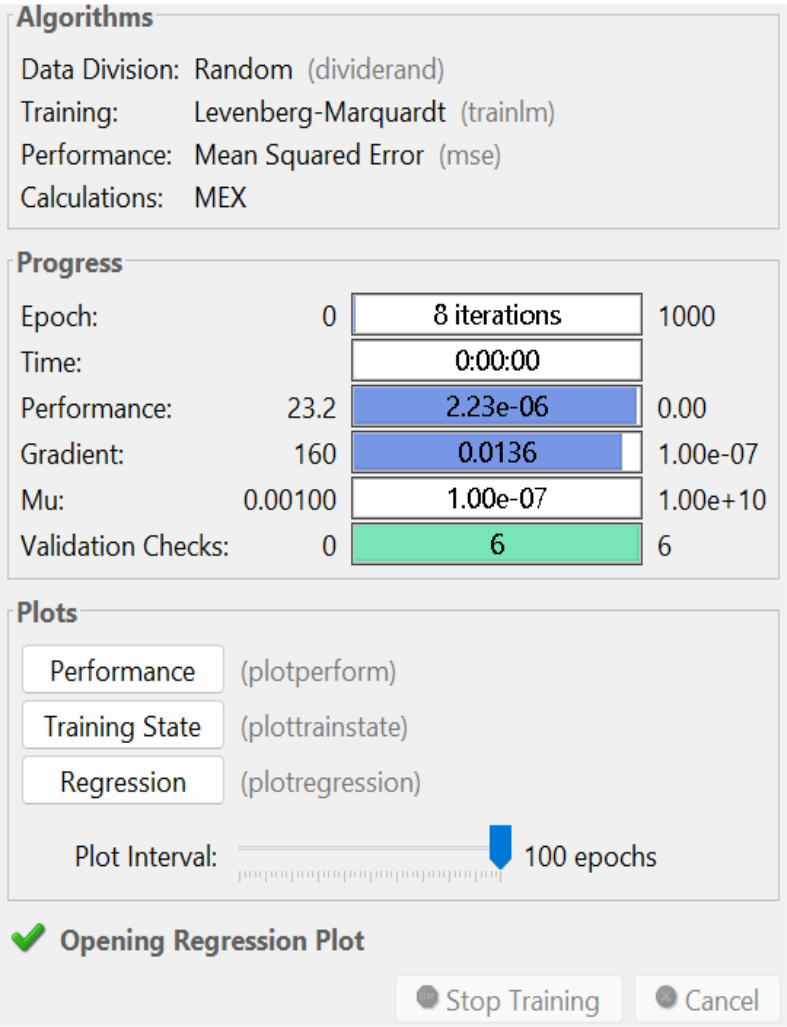

Fig. 2 Performance & Training MLPFFBP with LM as training algorithm

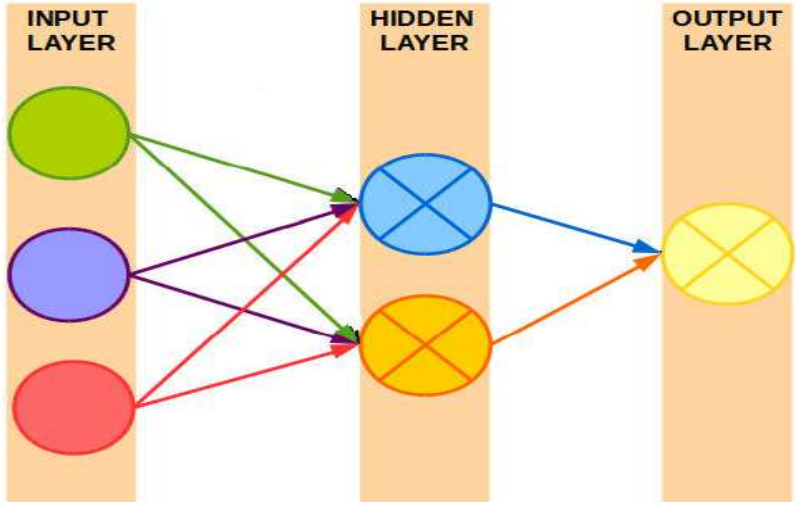

Fig. 3 Three Layer MLFFBP Network Architecture

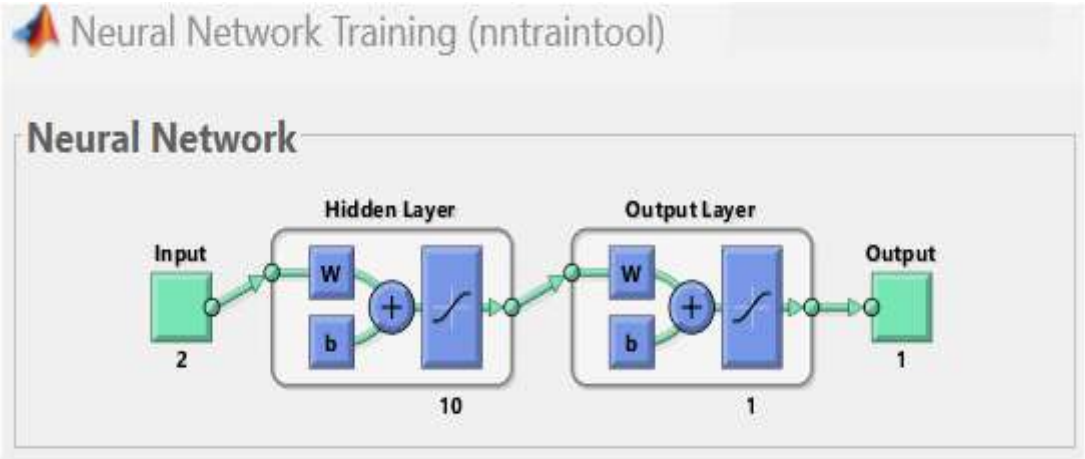

Fig. 4 Three Layer Multi Layer Perceptron Feed Forward Back Propagation Network Architecture

3. RESULT AND DISCUSSION

The return loss (S11) of the proposed flexible antenna is illustrated in Figure 6 while the frequency band and simulated bandwidth using CST software is shown in table 2. The width of the ground plane is varied and corresponding results in the form of band width has been utilised for training the ANN network. During the training process the length and width of the patch are kept at the same values. The table makes it abundantly evident that the findings produced from the CST and ANN tool have a solid agreement, and as a consequence, they have provided an accurate result. According to the results of the inquiry, the simulation with Artificial Neural Network calls for a total of twenty epochs to be completed. There is a relationship that is inversely proportionate between the distance from the centre of the neuron and the outputs of the Gaussian transfer function that is contained within the neuron that is hidden within the layer. This relationship exists from the perspective of the neuron. A frequency range that runs from 4.83 GHz to 12.0 GHz is included in the antenna that has been suggested. This results in a band width that is 85.25% wide. MLPFFBP model is employed for the aim of modelling of the line feed flexible antenna. The results of this modelling are shown in table 1.

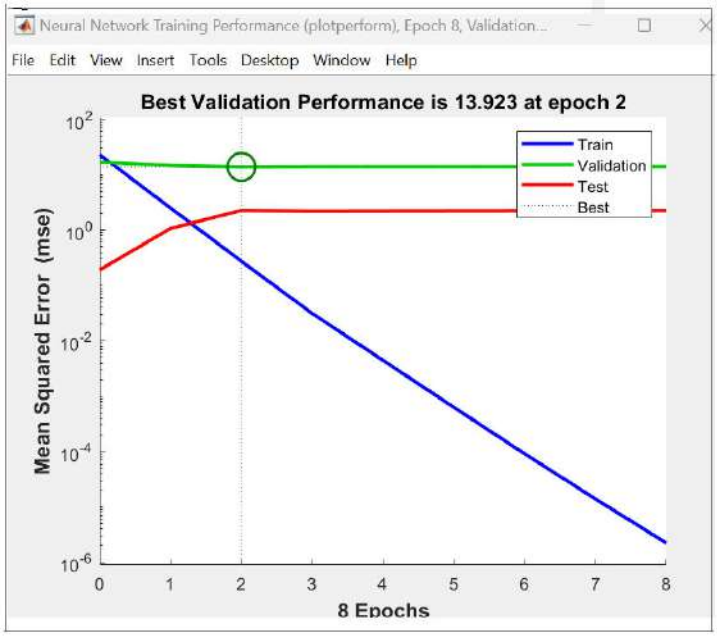

Fig. 5 No. of epochs to achieve min. mean square error level in case of MLPFFBP with LM as training algorithm

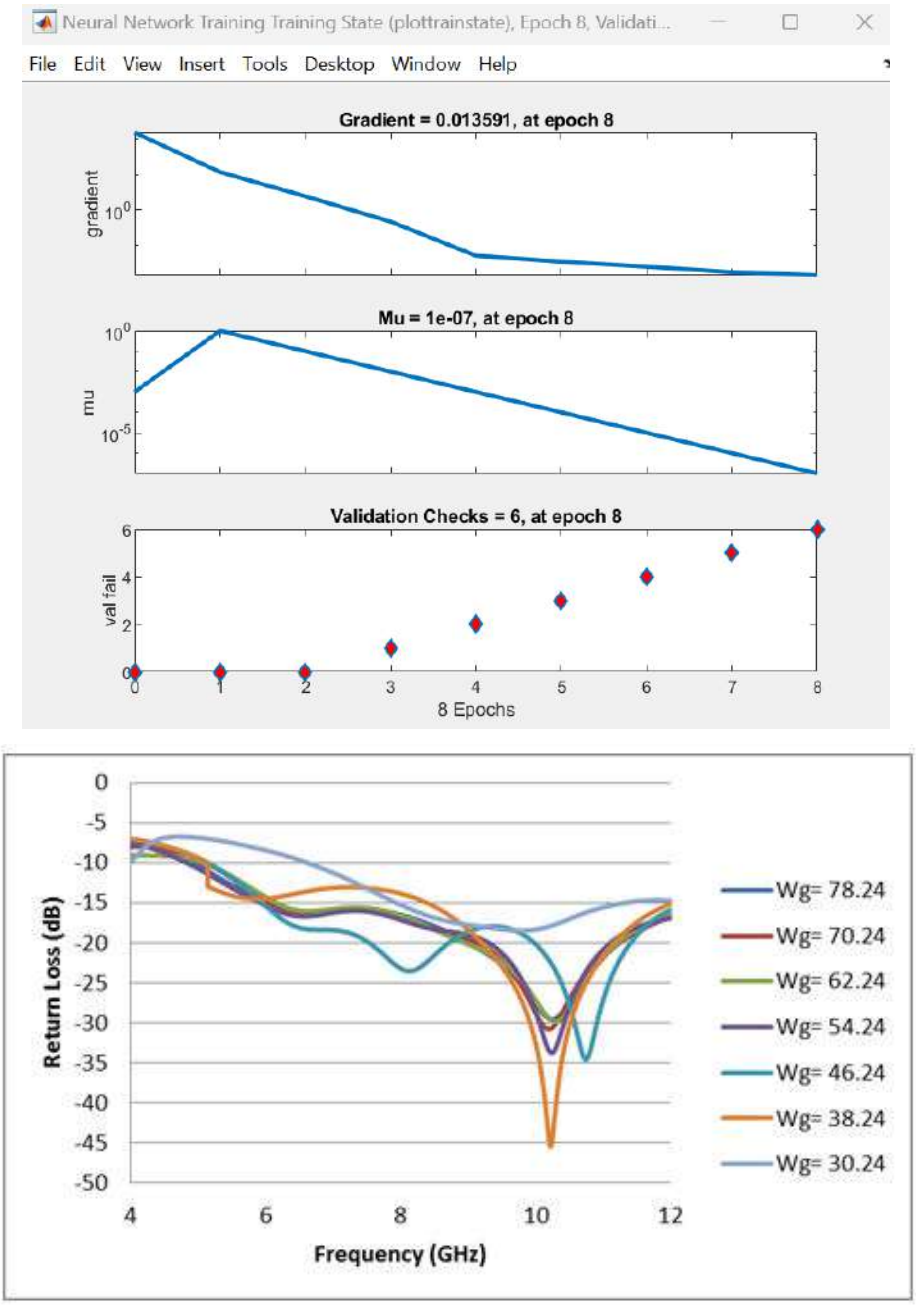

Fig. 6 Return loss (S_{11}) Vs Frequency plot with variation of Ground plane with of proposed flexible Antenna

Table 2 Comparison of result of CST and MLPFFBP-ANN

Length	Width	f_1	f_2	BW obtained Using CST (GHz)	BW obtained using MLPFFBP (GHz)
69.08	78.24	4.96	12	7.04	6.99
69.08	70.24	5.11	12	6.89	6.81
69.08	62.24	5.08	12	6.92	6.87
69.08	54.24	4.83	12	7.17	7.09
69.08	46.24	5.10	12	6.90	6.94
69.08	38.24	5.13	12	6.87	6.81
69.08	30.24	6.62	12	5.38	5.31

4. CONCLUSIONS

The technique known as MLPFFBP-ANN is utilised as a tool in this work for the aim of conducting an analysis of the frequency and bandwidth of the flexible antenna that has been suggested. The results that were obtained through the use of CST and MLPFFBP-ANN are in conformity with one another in a manner that is satisfactory. In addition to the data that was obtained through the CST software, the training and test sets have also been taken into consideration. A frequency range that runs from 4.83 GHz to 12.0 GHz is included in the antenna that has been suggested. This results in a band width that is 85.25% wide.

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