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Modification of Microstrip Patch Antenna Using Veselago Media

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Abstract – This research article is a result of a keen literature review. Author gone through various techniques to modify the patch antenna parameters and found implementing veselago media is best among other techniques. In this research paper a MPA was designed on the operating frequency of 2.4 GHz and after that veselago media was implemented to modify its result and found a marvelous change in the simulated result of the MPA. Previously return loss, bandwidth, directivity was found -11dB, 39MHz and 5.698dBi respectively. After implementing the veselago media result achieved are -30dB, 55.5MHz and 6.645dBi respectively.

Keywords – MPA, veselago media, bandwidth, permittivity.

1. INTRODUCTION

From last few decades Microstrip Patch antennas (MPAs) [1] are being used in different fields for communication purpose like ground to air communication, in case of aircrafts and spacecraft, satellites and missile communication. They are always preferred over other antennas because of their certain properties like- light weight, low cost, better performances, ease of installation and because of their low profile [2]. Although there are few disadvantages which MPAs suffers like- low efficiency, narrow bandwidth, less gain because of their small size and high return loss. Many researches till now have been done in MPAs to show better result and in removing all the disadvantages. Many designs have already proposed in enhancing all the disadvantages. In this paper also a design is proposed to enhance the return loss, bandwidth and directivity of the Inset-feed MPAs.

Several methods are there to modify the parameters of the antenna, like proximity feed technique in which a different feeding technique is used to modify the MPA [6], [15], defected ground structure [5] in which a defect in the ground is made to enhance the parameters, array of antennas [7], fractal antennas [14] and metamaterial [8]. Metamaterial is used in this paper to enhance the parameters of the proposed antenna. Veselago invented a material having negative permitivitty and permeability in 1968, it is known as metamaterial, a negative media or veselago media.

Later on several modifications has been made in this technique by pendy and group and other researchers. In this paper a new design of veselago media has been proposed and the parameters of the proposed antenna modified.

2. ANTENNA DESIGN & SIMULATION RESULTS

In the design process a rectangular MPA was designed initially in the CST software version 10 by using formulas listed in balanis [3]. Figure 1 shows the proposed rectangular MPA having patch length 28.56, patch width 36.85 and feed length 26.425mm. Patch was designed for the resonant frequency of 2.4GHz.

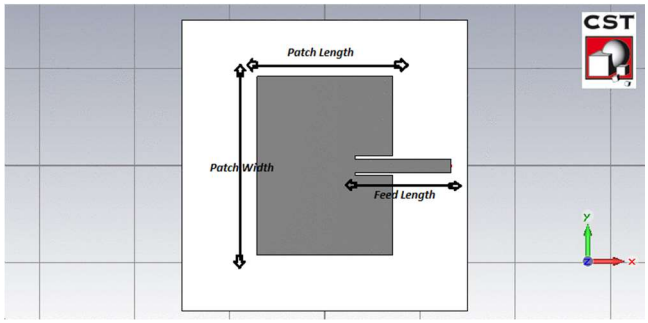
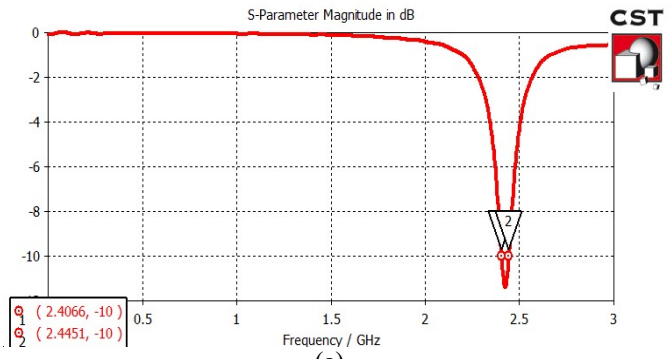
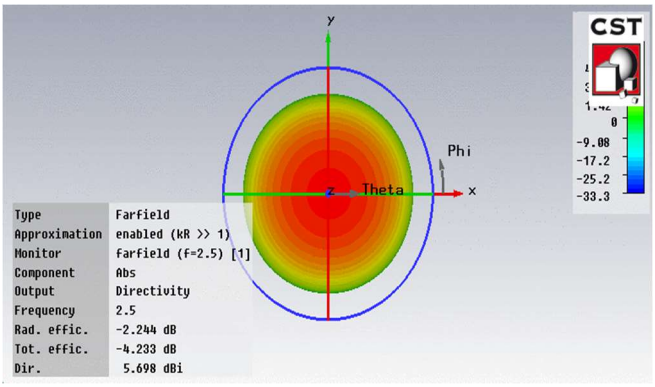


Figure.1 Designed MPA for operating frequency of 2.4GHz.

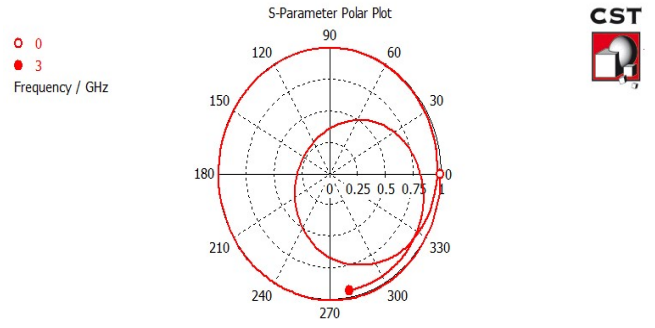
The simulation results of the patch are shown in fig.2.



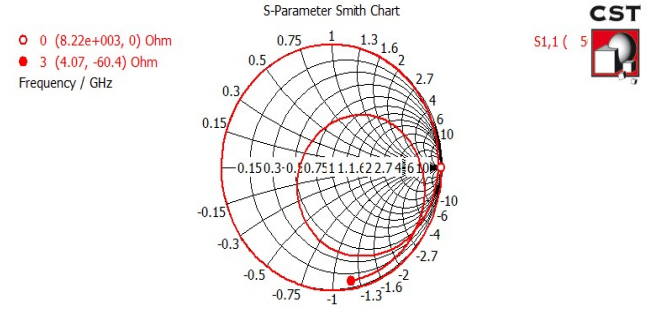
(a)



(b)



(c)



(d)

Fig. 2. Simulation results of patch shown in fig 1: (a) showing return loss and bandwidth, (b) showing radiation pattern and directivity, (c) polar plot, (d) smith chart

The simulated results shown in figure 2 represent return loss of -11dB, bandwidth 39MHz, directivity 5.698dBi. These results are not satisfactory and they must be modified, so fulfill the demand and to modify the parameter a veselago cover has been implemented, which is shown n figure 3.

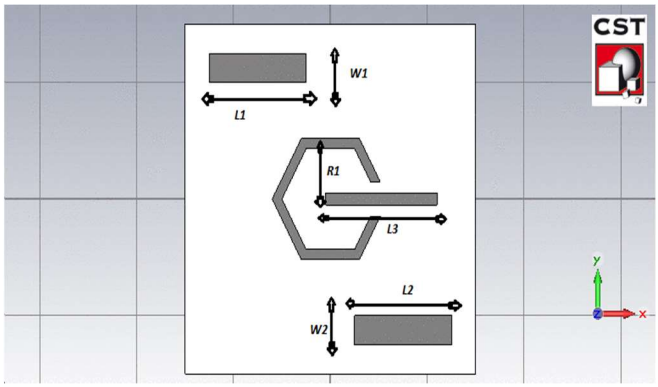
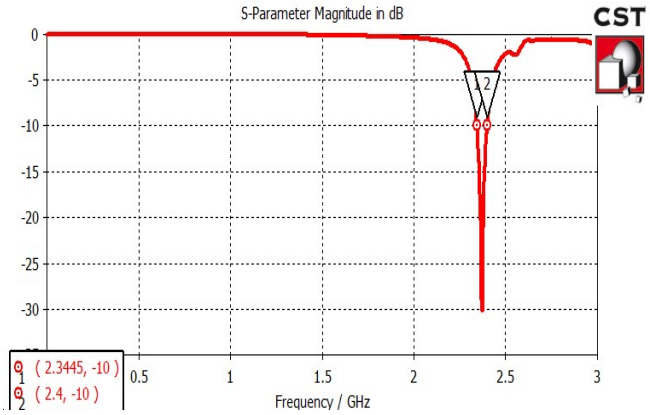
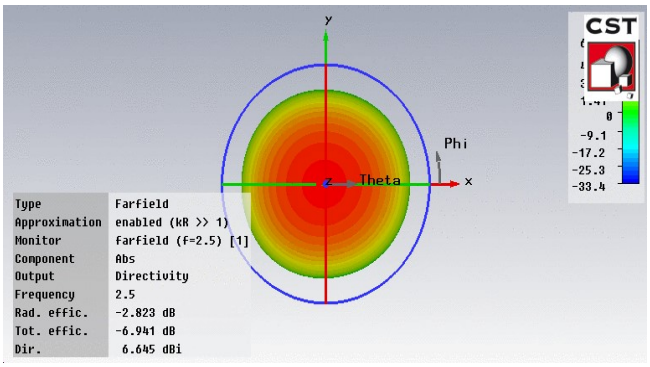


Fig. 3. Veselago cover implemented over MPA. (All dimensions are in mm)

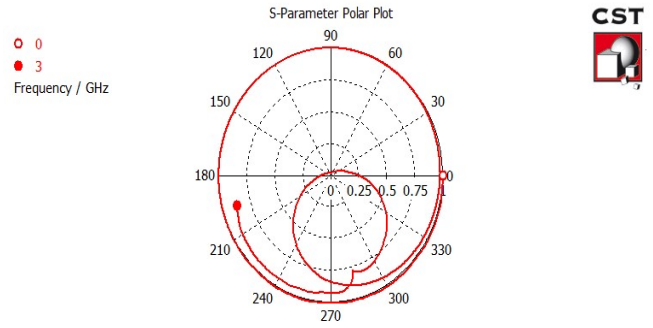
After implementing veselago cover, again simulation has been done and the result of the simulation is shown in figure 4.



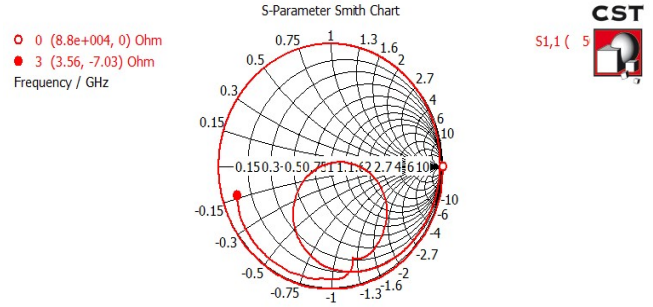
(a)



(b)



(c)



(d)

Fig. 4. Simulated result after modification: (a) showing return loss of the proposed design, (b) radiation pattern showing on operating frequency2.4 GHz, (c) polar plot, (d) smith chart.

After the simulation of modified antenna results has been compared and it appears that the implementation of veselago media, patch is now radiating with high directivity and grater bandwidth. After the simulation it has been found that the desired results have been achieved. Simulated result in figure 4 shows, return loss of -30dB, bandwidth 55MHz, directivity 6.64dBi. That proves the capability of veselago media when it comes to improve the patch results. It has also proved that the structure used here as veselago media is having permittivity and permeability both negative by using technique stated in [12].

3. CONCLUSION

Implementation of veselago media improves the result marvelously, it increased the return loss almost 200% and bandwidth almost 35% which is significantly large enough to operate in telemetry command monitoring of radars. This designed antenna will be useful in S band application with high directivity and better return loss. Further significant modification can also be done.

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