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REVIEW OF VARIOUS TECHNIQUES AVAILABLE TO MODIFY PARAMETERS OF MICROSTRIP PATCH ANTENNA

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***Abstract* – In this review paper, author have shown comparison of various techniques available to modify the parameters of microstrip patch antenna. MPA is generally used in modern communication devices. Study of literature of past few year shows that, the leading work on MPA is focused on designing compact sized broadband microstrip antenna. Author investigated various research paper published to modify the antenna parameters, and made a comparison chart showing the impact of techniques on antenna performance. This review article shows that which technique is better to follow if antenna performances need to be enhanced.**

Keywords – DGS, feeding, neural network, metamaterial, bandwidth, size reduction.

I. INTRODUCTION

The basic geometry of a patch antenna consists of a metallic patch printed on a substrate and a gound plane of same metal. Microstrip Patch Antenna is commonly used because of its low profile, low cost and ease of manufacturing. A patch antenna is made by etching metal on one side of dielectric substrate whereas on the opposite side there is continuous metal layer of the substrate which forms a ground plane [14]. Microstrip antenna comes in various shapes like rectangular, circular, triangular and other irregular shapes too; it also has various feeding techniques like coaxial feed, stripline feed and aperture feed. Due to its low size and its narrow bandwidth previously it was not having various applications, to overcome these problems various research papers has been published showing various techniques to improve the performance parameters of patch antenna. Some of them uses various types of feeding techniques [2], some of them uses another layer of substrate, some of them made changes in the ground plane and called it defected ground [3] some uses another structure over applying a substrate above patch and call it metamaterial [4], some uses array of 3 or 4 antennas and enhance the parameters. So there are numerous techniques available to enhance the parameters. Basically microstrip patch antenna is a narrowband device and in recent advancement of communication uses of mobile is increasing so to increase its bandwidth various researches has been published indicating various techniques.

Literature of microstrip antenna is very vast; due to various techniques a lot of research article, review papers and research papers were published. Numerous books were written over this topic. This article is prepared to describe, the basic characteristics of the patch antenna element and some recent advances in areas which are of major concern to wireless communication applications. These include broadbanding techniques, dual and multi-band designs, circular polarization and size reduction techniques. Due to space limitations, the topic of microstrip antenna array is not discussed.

II. TECHNIQUES USED TO ENHANCE PARAMETERS OF MICROSTRIP PATCH ANTENNA

Mostly rectangular patch antenna is preferred in various research publications due to its ease of calculation and good radiating results. The dimensions were calculated from the formulas listed in [6]. The rectangular patch antenna is most favorite among other shapes of patch antenna. Feeding techniques are different in different research articles. Like coaxial feed, stripline feed and aperture feed shown in following figures.

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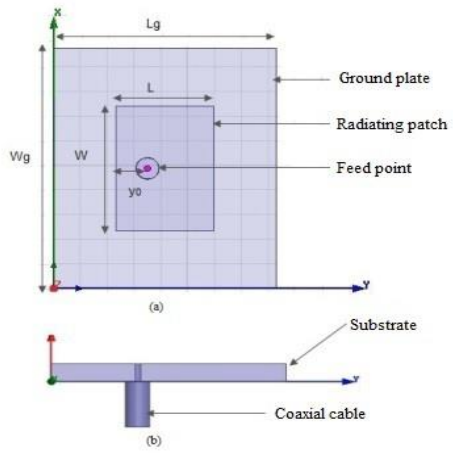


Fig. 1. Geometry of coaxial feed microstrip patch antenna [15]

(a) Top view (b) side view

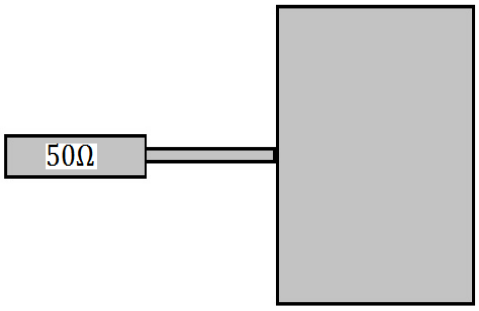


Fig. 2. Microstrip line feed [13]

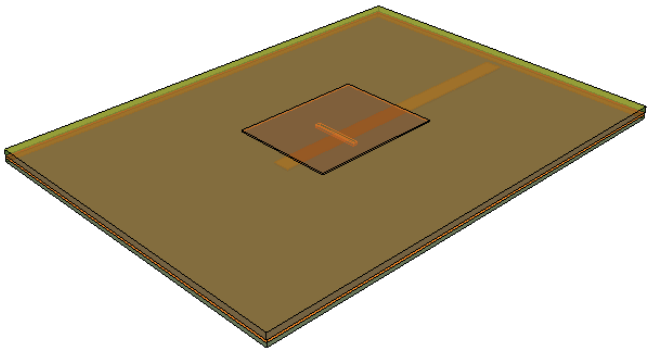


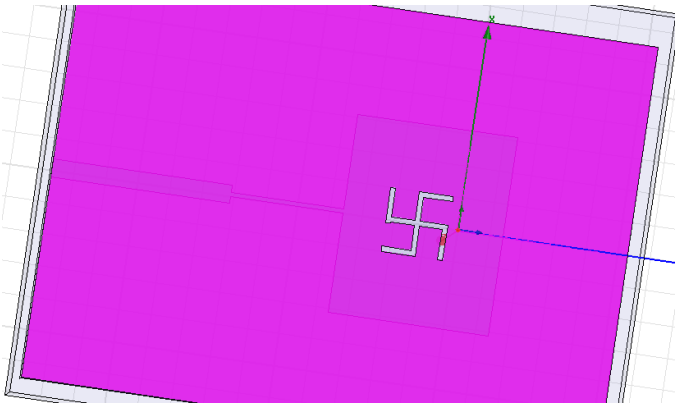
Fig. 3. Aperture Coupled Microstrip Patch Antenna, Transparent Structure: Bottom Layer: Microstrip, Center: Ground Plane & Slot, Top: Patch [11]

These are the three widely used feeding techniques to excite antenna, coaxial and stripline feed is comparatively used more than aperture feed. After patch designing parameters were analyzed and numerous modification techniques were incorporated over the designed patch. Following are the few of them discussed in this paper. One is defected ground structure (DGS), second is double negative material or metamaterial and other one is use of antenna in combination to enhance its parameter and is widely known as array of antennas.

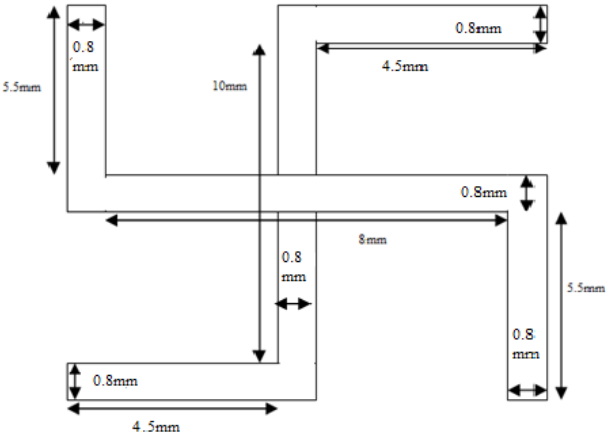
A. MPA WITH DGS

Defected ground structure (DGS) can modify guided wave properties to provide a band-stop or band-pass like filter and can easily define the unit element. The geometry of DGS can be single structure or few combined structures which are simpler and does not need a large area to implement it. DGS structure disturbs the shield current distribution in the ground plane, which influences the input impedance and current flow of the antenna.

DGS is realized by introducing a shape defected on a ground plane thus will disturb the shielded current distribution depending on the shape and dimension of the defect .The disturbance at the shielded current distribution will influence the input impedance and the current flow of the antenna. It can also control the excitation and electromagnetic waves propagating through the substrate layer



(a)



(b)

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Fig. 4. (a) One of the structures of DGS used to enhance the patch parameters [19]

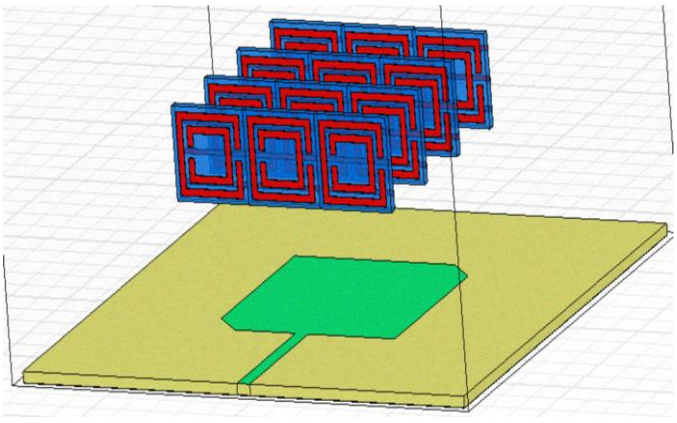
(b) Dimension of the proposed structure.

B. MPA WITH METAMATERIAL

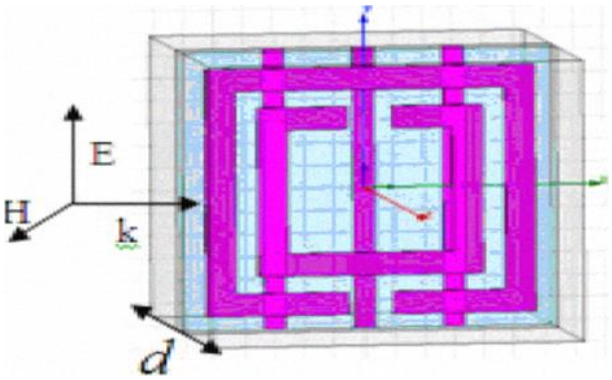
In The last few years, the focus was on the spurred devices and that was through the use of media have simultaneously negative permittivity and permeability values, which are referred to as left-handed media or double negative media (DNG) [6], [9]. There are many unusual properties of such media and lots of fascinating issues have been published since 1999 on the possible focusing applications. However, to our knowledge, few results concern with the evolution of the performances of antennas when such a medium is placed in its near environment.

After designing and simulating the antenna, ensuring that it operates at the desired frequency and recording its gain, The LHM is placed above the circularly polarized patch antenna so as to study its effect on the radiation characteristics. In this simulation, the boundary conditions were set to open space since the antenna would be operating in such conditions.

Subsequently, the simulation was done on varying distance between the LH MTM and the antenna to observe the gain of the antenna with LH MTM compared to the original gain obtained earlier without the LH MTM. Besides, the Return Loss (S II) was also obtained at the same time and been analyzed.



(a)



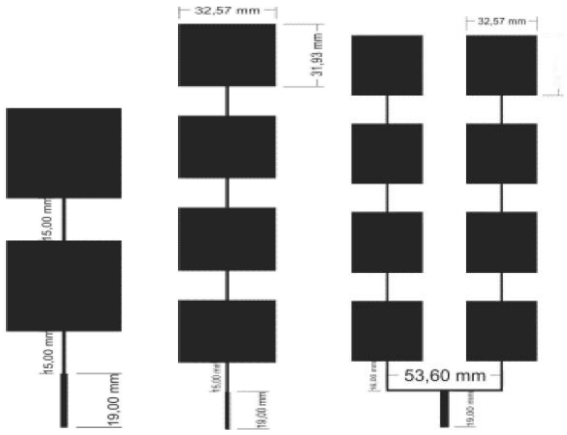
(b)

Fig. 5. (a) 3D View of the Integration of LH MTM to (CP) Patch Antenna Setup.
(b) A single unit cell of a negative index metamaterial. The split ring resonator (SRR) responds magnetically and the wire responds electrically to electromagnetic fields.[12]

C. MPA WITH ARRAY

The study of antenna array objective increases the directivity of the antenna as well as the gain. The greater the number of elements an array more is its directivity consequently will have a greater gain. The use of the array of antenna has increased much in the telecommunications by transmit their signals over long distances without the need for relay stations.

With the advancement of technology and constant launches of satellites and too increasing the number of aircraft it is necessary the use of antenna arrays for communications of these aerospace vehicles with the base stations that they are aggregated [16] [17].



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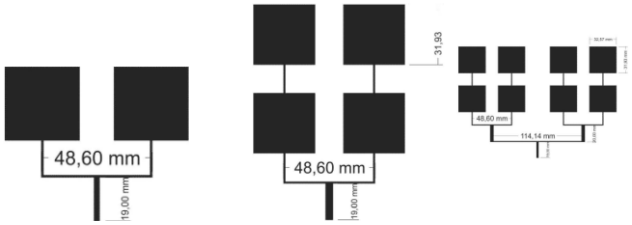

Fig. 1. Various types of array can be designed and analyzed. [3]

TABLE I: COMPARISON CHART

S. no.	Modification Techniques	Configuration	Remarks
1	DGS	Combination of U and L shaped Cut on the ground plane [19]	Miniaturization up to 80% has achieved.
		I shape slot in the ground plane [5]	Return loss improved from -27 to -46 dB.
		The rectangular Inset-feed microstrip patch antenna with dumbbell shape DGS [18]	The return loss has enhanced to a value of approx. -41 dB and bandwidth to a value of 57MHz.
2	Metamaterial	Coaxial feed microstrip antenna with SRR metamaterial [15]	The increment in gain is 7.6% and for directivity it is 4.5%.
		Stripline feed with SRR Metamaterial [12]	This LHM improves the gain well as reduces return loss of this patch antenna.
		Complementary Split-Ring Resonator (CSRR) is used instead of Split-Ring Resonator (SRR). [13]	The size of patch antenna reduced about 25% without increasing the substrate dimension.
3	Array	superdirective patch antenna array [7]	Directive gain of the antenna improved to a great extent
		Several rectangular antenna array geometries are investigated namely 2xI, 1x2, 2x2, 2x4 and 4x2 [3]	It has been observed that the antenna array gain is proportional to the number of the patch elements, accomplishing the main goal of this work.

After the comparison it has been observed DGS technique is far better than any other technique were used for modification, because not only it required any further calculation nor it require any addition to the current proposed patch structure. Only need to do is to make a defect in the ground plane.

III. CONCLUSION

Bandwidth enhancement and size reduction have becoe a major concern in designing of patch antenna. Many techniques have been used to achieve wideband and to reduce the size of microstrip antennas. This paper shows the review and survey of various such techniques. Out of all techniques shown above in this paper DGS technique and metamaterial technique have shown a better credibility than array of the antennas. As these two techniques yields good results.

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