ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 9, March 2013

Review on Techniques for Microstrip Patch Antenna Gain & Bandwidth Enhancement

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Abstract*— Microstrip antennas (MSA) received considerable attention in the 1970's, although the first designs and theoretical models appeared in the 1950's. They are suitable for many mobile applications: handheld devices, aircraft, satellite, missile, etc. The MSA are low profile, mechanically robust, inexpensive to manufacture, relatively light and compact. Micro strip antennas are used in a wide range of applications because of their advantageous features in terms of low profile, low cost, light weight and easy fabrication. However two major disadvantages are low gain and narrow bandwidth when high dielectric constant material is used for fabrication of the microstrip antenna. An individual microstrip patch antenna has a typical gain of about 6dB. Several approaches have been used to enhance the by perturbing the higher order mode by interpolating surface modification into patch geometry.

***Index Terms*—H shape patch, U-slotted Microstrip Patch Antenna, E-shaped patch with coaxial probe feeding.**

I. INTRODUCTION

The telecommunication always tries to reach the best performances, the reliability and the efficiency with the lowest possible costs. In this domain, antennas establish a basic element allowing the transmission of the electromagnetic waves in free space. We find several types of antennas which different by cuts, geometrical shape, capacity of transmission The most serious limitations of the microstrip antenna is its narrow band, which is typically of the order of some percents However, the new generation of the communication, the mobile or satellite communication, provokes considerable changes in patches antennas, from which the various modern applications require a functioning in wideband and dual band. For a rectangular patch, the length L of the patch is usually 0.3333λo< L < 0.5 λo, where λo is the free-space wavelength. The patch is selected to be very thin such that t << λo (where t is the patch thickness). The height h of the dielectric substrate is usually 0.003 λo≤h≤0.05 λo. The dielectric constant of the substrate (εr) is typically in the range 2.2 ≤ εr≤ 12. Microstrip patch antennas radiate primarily because of the fringing fields between the patch edge and the Ground plane. For good performance of antenna, a thick Dielectric substrate having a low dielectric constant is necessary since it provides larger bandwidth, better radiation and better efficiency. However, such a typical configuration leads to a larger antenna size.

II. THEORY OF PATCH ANTENNA

The patch is normally made of conducting material such as copper or gold and can take any possible shape. The radiating patch and the feed lines are usually photo etched on the Dielectric substrate.

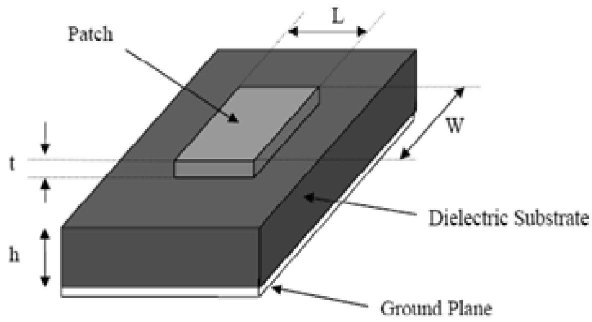

Fig 1: Microstrip patch antenna [6]

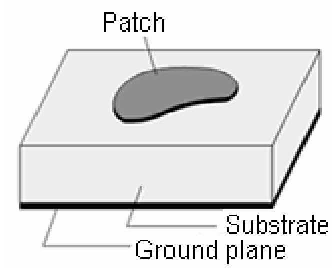

Fig 2: Patch antenna [4]

Patch: present the radiant conductive element and which can take several forms.

Substrate: allows isolating both conductive planes characterized by permittivity.

Ground plane: conductor situated below the circuit on which is placed the substrate.

III. MATH

Normalized field pattern= $E_\theta(\theta,\varphi)_n = \frac{E_\theta(\theta,\varphi)}{E_\theta(\theta,\varphi)_{max}}$ (dimensionless)
Directivity $D = \frac{P(\theta,\varphi)_{max}}{P(\theta,\varphi)_{av}}$

Gain = $G = kD$ (dimensionless)

IV. TECHNIQUES

1. H-Shaped Patch

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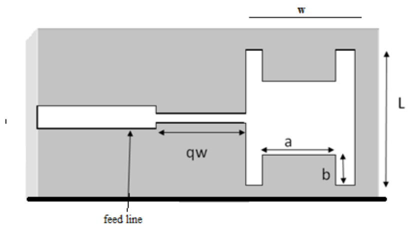

Fig 3: Patch antenna [3]

In the typical design procedure of the microstrip antenna, the desired resonant frequency, thickness and dielectric constant of the substrate are known or selected initially. In this design of rectangular microstrip antenna, glass epoxy dielectric material is selected as the substrate with 1.6 mm height. Then, a patch antenna that operates at the specified resonant frequency (3.3 GHz) can be designed by the using transmission line model equations. As shown in figure, microstrip line type feeding mechanism used. It is also possible to determine the length and width of quarter wave length long line (branch line) of the patch and the main feed line's length and width to ensure matching.

The main feed line is of 50Ω characteristic impedance. The quarter wave length long line is used between main feed line and patch for impedance matching. The characteristic impedance of branch line is calculated as Z0 – characteristic impedance of main feed line (50Ω) Ze – impedance at patch edge So for the rectangular microstrip patch antenna the parameters are Resonating frequency fr = 3.3 GHz Patch width W = 27.8 mm Patch length L = 21.42 mm Branch line length qw = 11 mm Substrate height h = 1.6 mm Relative permittivity εr = 4.5 Width of main feed line = 3 mm.

V. RESULT

Rectangular microstrip antenna and H-shaped microstrip antenna have been designed and simulated using high frequency structure simulator (HFSS). H-shaped microstrip antenna produced reduction in size and higher bandwidth (9.5%) in comparison to rectangular microstrip antenna (3.5%).

U-slotted Microstrip Patch Antenna

The essential parameters for the design of a rectangular microstrip Patch Antenna are:

Length (L): The two sides are selected to be of equal length and is 36 mm each.

Width (W): The two sides are selected to be of equal length and is 26 mm each.

Frequency of operation (fo): The resonant frequency of the antenna must be selected Appropriately. The resonant frequency selected for our design is 4.5 GHz.

Dielectric constant of the substrate (εr): The dielectric material selected for our design has a dielectric constant of 1.03. A substrate with a high dielectric constant has been selected since It reduces the dimensions of the antenna.

Height of dielectric substrate (h): For the microstrip patch antenna to be used in cellular phones, it is essential that the antenna is not bulky. Hence, the height of the dielectric substrate is 5mm.

Slot Length along the X axis (lx): The length of slot along the X axis was adjusted to be 12 mm in order to obtain better results.

Slot Length along the Y axis (ly): The length of both slots along the Y axis was adjusted to be 20 mm in order to obtain better results.

Slot Width (w): The width of all the four slits was selected to be 2 mm.

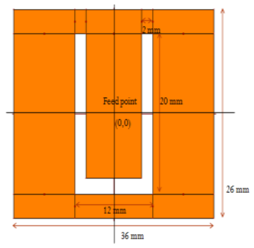

Fig 4: Designed Patch [7]

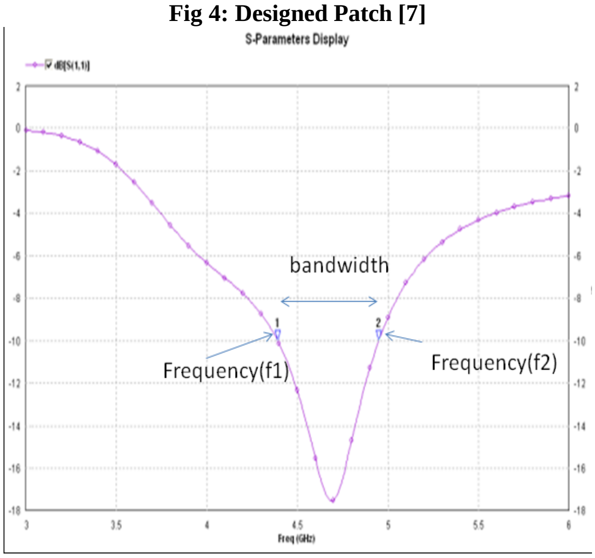

Fig 5: S Parameter display[7]

TABLE 1: S-parameter Study of U-Slotted rectangular patch by varying probe feed point position [7]

Feed point position(mm,mm)	Frequency(f1) GHz	Frequency(f2) GHz	Bandwidth (%)
(2,0)	4.41	4.92	10.93%
(-2,0)	4.41	4.92	10.93%
(0,-2)	4.49	5.35	17.47%
(0,-3)	4.39	4.94	11.78%
(0,-1)	4.33	5.16	17.49%
(0,-0.5)	4.34	5.06	15.31%

BANDWIDTH CALCULATION:

The bandwidth calculation at feed position (0,-1), we got maximum bandwidth. Frequency f1 is taken as 4.33GHz and f2 is taken as 5.16GHz. Therefore the bandwidth is obtained after doing calculation as 17.49%.

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E-shaped patch with coaxial probe feeding

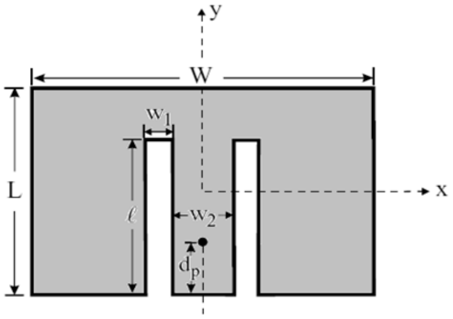

Fig 3: E-shaped patch [7]

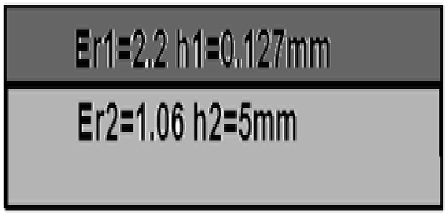

Fig 4: Substrate Dimensions [7]

L=35.5 mm, w=26 mm, I=18 mm, W1=2 mm, W2=10 mm DP=6 mm.

The geometry of the proposed antenna is shown in fig 16 A rectangular patch of dimensions L x W separated from the ground plane using two substrates.

1) A foam substrate (εr1) of thickness h1 and, the other

2) Substrate (εr2) of thickness h2. The E-shape is located in the center of the patch.

The location of the slots on the patch can be specified by parameter W2. The width and length of the slots are denoted by W1 and l. The rectangular patch is fed using 50Ωcoaxial probe with inner diameter of 0.65mm Parametric Study of E-Patch By Varying W1, W2 And L

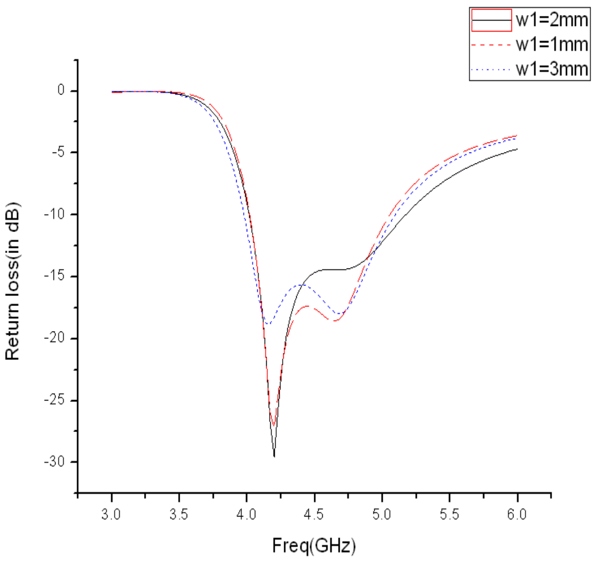

Fig 5: S-Parameter compared by varying slot width w1 [7]

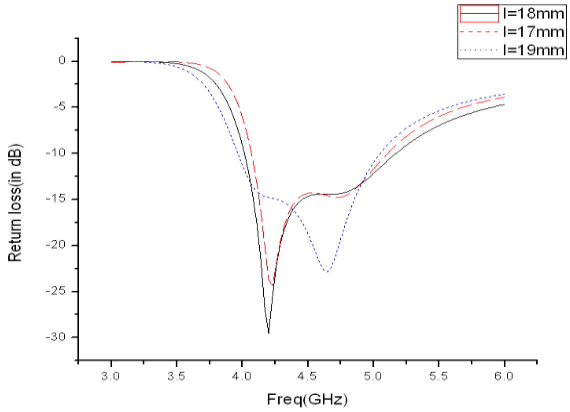

Fig 6: S-Parameter compared by varying slot length l [7]

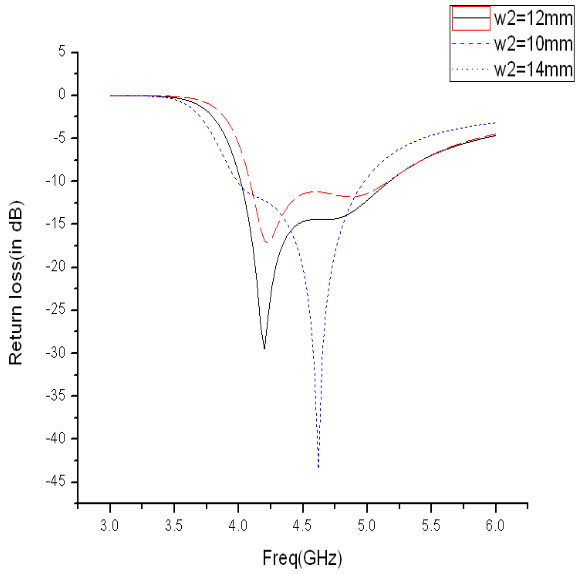

Fig 7: S-Parameter compared by varying slot width w2 [7]

SIMULATED RESULTS

The analysis of the antenna for different physical parameter values has been done by varying one of them and keeping others as constant. It is carried out here to study the flexibility in designing this of single layer patch antenna.

VI. CONCLUSION

Microstrip antennas are used in a wide range of applications because of their advantageous features. But there are two major disadvantages are low gain and narrow bandwidth of antenna. So for better performance of microstrip patch we analyze and simulate different techniques for gain and bandwidth enhancement.

REFERENCES

[1] D. M. Pozar and D. H. Schaubert, eds., Microstrip Antennas.

[2] Pdf gain and bandwidth enhancement in compact Microstrip Antenna rch_vibharch@sancharnet.in.

[3] Sudhir Bhaskar & Sachin Kumar Gupta. "Bandwidth Improvement of Microstrip Patch Antenna Using H-Shaped Patch'' IJERA, Vol. 2, Issue 1, Jan-Feb.2012, pp. 334-338.

ISSN: 2277-3754
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[4] D. M. Pozar and D. H. Schaubert, Microstrip Antennas: The Analysis and Design of Microstrip Antennas and Arrays, IEEE Press, 1995.

[5] Manjunath, Dr T S Rukmini, Rajine Swetha “gain Enhancement of microstrip patch antenna using Hemispherical And dielectric lens structure for WiMAX Application” IJETAE, Volume 2, issue 3, March 2012.

[6] V. Mohan Kumar. Sujith “Enhancement Of Bandwidth and Gain Of A Rectangular Microstrip Patch Antenna” Rourkela, 2010.

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