National Conference on Emerging Trends in Computer, Electrical & Electronics (ETCEE-2015)
International Journal of Advance Engineering and Research Development (IJAERD)
e-ISSN: 2348 - 4470 , print-ISSN:2348-6406,Impact Factor:3.134

STUDY ON THE EFFECT OF INSET FEED LENGTH ON RADIATION CHARACTERISTICS OF RECTANGULAR MICROSTRIP PATCH ANTENNA

ShreyaLathigara[1], H.M. Bhatt[2], Vivek Unadkat[3]
Atmiya institute of technology,Rajkot

***Abstract*:**The antenna technology with microstrip patch antenna is widely increasing for its compact structure, low cost, lesser size and easy configuration. Microstrip patch antennas with various configuration provides wide range of applications in GPS, GSM, Personal area network, Direct broadcast satellite, radar Wi max Wi-Fi. The frequency range between 3.3 GHz and 3.7 GHz is widely used for wimax application, here in this paper the effect due to changing the length of microstrip inset feed line on return loss, gain and directivity is observed by changing various lengths. The software used is CST studio suite 2012.

Keywords : CST studio suite, FR-4, return loss, gain, directivity

I.INTRODUCTION

There are many developments in the field of Microstrip patch antenna have begunin comparison with earlier developed antennas Microstrip antennas are light weight, lesscostlier, flexible and easier to fabricate.[1]Because of these qualities, the printed patch antennas have been utilized in many applications like in mobile & satellite communication systems, wireless communication systems etc. These advantages motivate universities, research organization all over the world to make serious efforts to overcome demerits like lower bandwidth, lesser gain and lower efficiency of printed patch technology.[10]

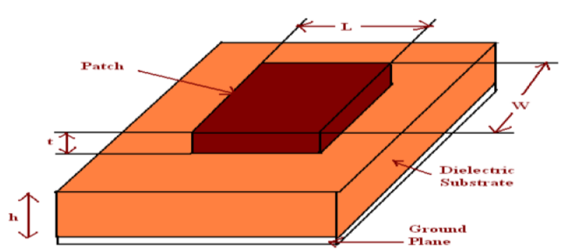

Fig 1 Basic layout of microstrip patch antenna [2]

many of the disadvantages are overcome by applying various ways of designing [3]. The antenna array elements make available with much larger effective aperture and consequently much higher gain as compared to a single microstrip element. [4]. Dual frequency band polarization is also achieved from array configuration. [5]

In this letter I present the analysis of a finite array of microstrip patchantennas with multiple, stacked layers without causing an increase in the difficulty orcomplexity of the analysis.it is observed that this model provides very good accuracy in simulated results in CST Studio 2012.

4.1.1 Design specifications

The three essential parameters for the design of a rectangular Microstrip Patch Antenna are [9]:

1. Operating frequency (f_0): The resonant frequency of the antenna must be appropriately selected according to application. The designed antenna must be able to operate in this frequency range.

2. Dielectric constant of the substrate (Ɛr): The dielectric material selected for the design is such that it has dielectric constant almost near to unity. A dielectric constant of the substrate should remain as low as possible.

3. Height of dielectric substrate (h): For the Rectangular Microstrip patch antenna to have wider bandwidth, the height of the substrate should be selected as high as possible.

II.SIMULATION RESULTS AND DISCUSSION FOR SINGLE PATCH ANTENNA

Entire simulation work is done using **CST Microwave Studio suite -2012.** First, a single rectangular patch antenna was modeled on a **FR-4 substrate [11]**. feed line extends inside the patch also, since the current is low at ends of a half wave patch and increases in magnitude toward the center, the input impedance (Z=V/I) could be reduced if the patch was fed closer to the center.one method for doing this is by inset feed.it is called 'inset feed' this type of feed line is widely used in array antennas. [7]

The substrate has a permittivity 4.3 and loss tangent 0.02-0.025. The model was being optimized for resonant frequency of **3.5 GHz** for wimax application [2] Here copper is used as ground plane and radiating patch. And microstrip line with inset feed is usedSubstrate length and width are taken 20mm and 26mm respectively with substrate height of 1.6mm and patch thickness is 0.035mm. Width and height of the substrate is taken almost double the measurements of patch.

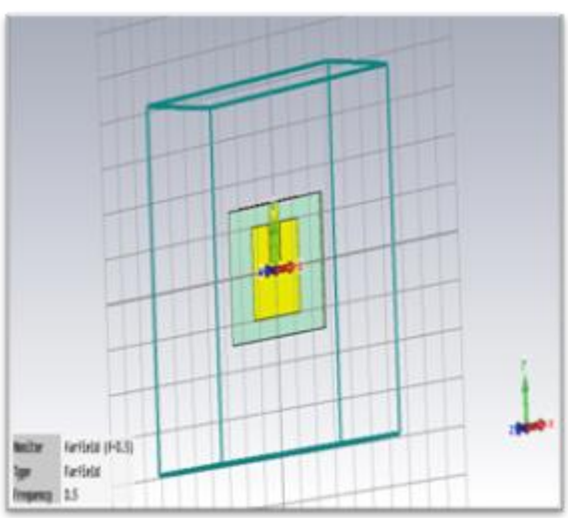

Fig.2 CST studio single patch microstrip antenna geometry

A. RETURN LOSS

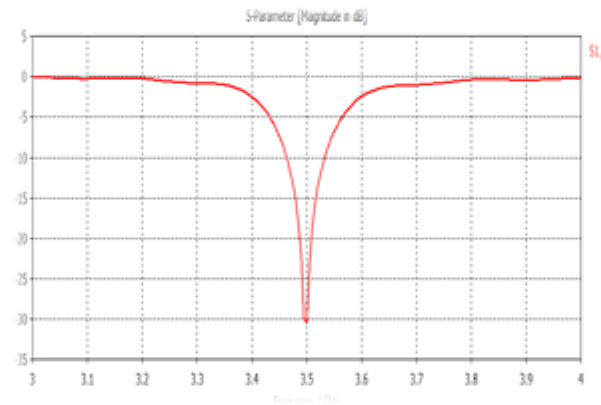

Fig 2-return loss graph for single patch antenna

The return loss of single patch antenna 30 .44db at resonance frequency 3.5 ghz.from the above graph bandwidth can be calculated as follows.

Bandwidth = (Upper freq .- lower freq.) at 10 dB Return loss

= 3.5322 GHz – 3.4622 GHz = 70.02 MHz

B. GAIN PLOT

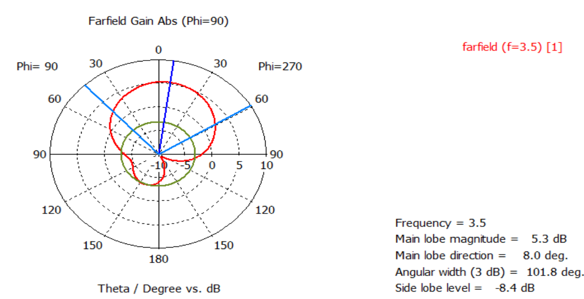

Fig.3 gain plot for single patch microstrip antenna

C.

D. DIRECTIVITY PLOT

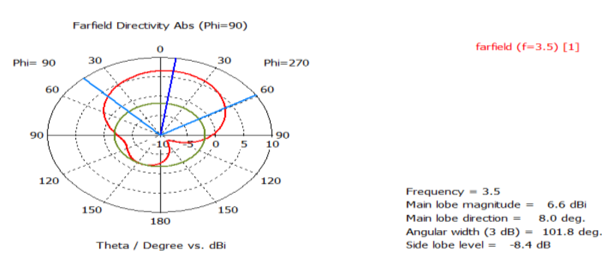

Fig.4 directivity plot for single patch microstrip antenna

The far field gain obtained at 3.5 Ghz from single patch is shown in polar plot shown in above figure. The gain obtained at major lobe is 5.3 dB in 8° and the side lobe magnitude is around 8.4 db. And from the directivity plot main lobe magnitude is 6.6 dbi with respect to isotropic gain.from the gain and directivity percentage efficiency can be calculated which is 80.30%

III.SIMULATION AND RESULT ANALYSIS FOR1*2 RECTANGULAR PATCH ARRAY ANTENNAS (PROPOSED DESIGN)

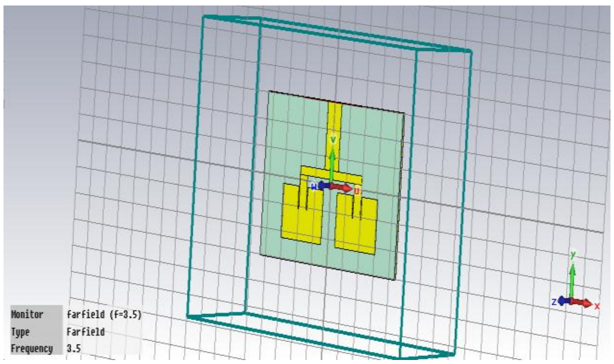

Fig.5 CST studio 1x2 patch microstrip antenna geometry

This new antenna, formed by multi-elements, is referred to as an array. Each active antenna induces currents in its neighbors affecting the element's radiation pattern and input impedance. Array structure is basically a collection of radiating elements arranged in specific manner to have wanted radiation patterns, gain and beam angle. The total field of the array is determined by the vector addition of the fields radiated from each radiating element. [8] ,[3].

The proposed design with array structure is shown. In this design instead of using single radiating patch array of two patches are used with single feed. The substrate chosen here is also FR-4 [6]. With both radiating patch having same height and width and common microstrip feed line. Various dimensions of proposed antenna are stated below.

E. RETURN LOSS PLOT:

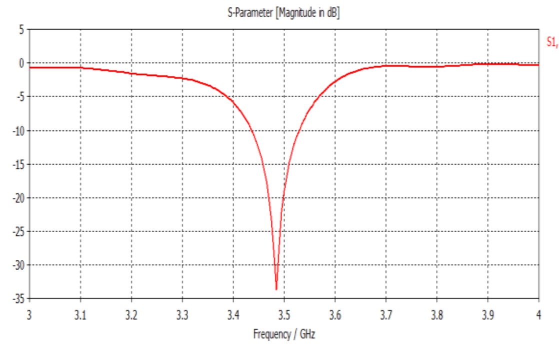

Fig6.return loss graph for 1*2 array patch antenna

The return loss of 1*2 array patch antenna is 30.7 dB at resonance frequency 3.5 Ghzwhich is a bit higher than return loss of single patch antenna.[3] From the above graph bandwidth can be calculated as follows.

Bandwidth = (Upper freq. - lower freq.) at 10 dB Return loss = 3.530 GHz – 3.436GHz = 94 MHz the bandwidth of array is higher than single rectangular patch.[4], [12].

F. GAIN PLOT

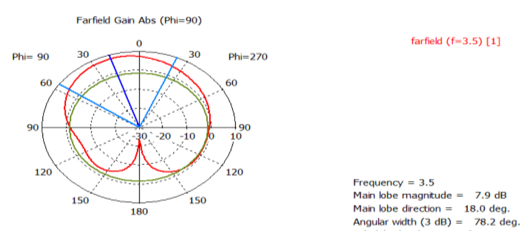

Fig 7 gain plot for 1x2 patch antenna

DIRECTIVITY PLOT

Parameter	Design 2	Design 1
Resonant frequency (fr)	3.5 GHz	3.5 GHz
Return loss (RL)	-33.70	-30.44
Bandwidth(B.W.)	94 MHz	70 MHz
Gain (G)	7.9 dB	5.3 dB
Directivity (D)	8.4 dBi	6.6 dBi
Efficiency (E)	94.04%	80.30%

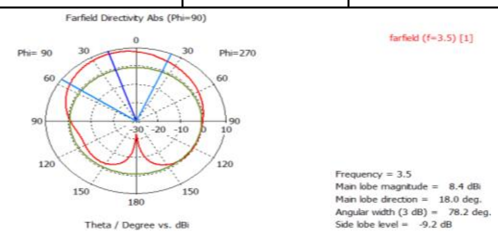

Fig 7 gain plot for 1x2 patch antenna

TABLE 1-COMPARISON TABLE

From the table it can be seen that array configuration gives much higher gain ,directivity charateristics than single patch.[8]array antennas for WiMAX application and these antenna structure gave gain of 8.4 dBi and cover up to 3.3 GHz to 3.8 GHz WiMAX band operating frequency. [13]

The similar type of research is performrd by F.H.Wee and F.Malek using BST (Barium Strontium Titanate)Wherethe measured gain and directivity of antennas with four, six and eight elements of BST array antenna and observed that the gain of an eight elements of BST array antenna was enhanced by about 0.06 dBi of directivity and 0.2 dB of gain over the four elements of BST array antenna at 2.3 GHz.[14]

The future goal is to obtain similar experimental results after fabrication of proposed antenna in that the measurements can be done inside an anechoic chamber to avoid external noises or disturbance. [15]

V.CONCLUSION

From the above comparative study of various antenna parameters it can be concluded that using the concept of 1*2 array of patch in MSA antenna gain, directivity and efficiency is improved significantly.

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About author

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Ms. Shreya Lathigara has completed B.E. in electronics and communication from Saurashtra University and pursuing M.E. in electronics and communication fromGujarat University and working on microstrip antenna simulation work.