Advanced Research in Electrical and Electronic Engineering
p-ISSN: 2349-5804; e-ISSN: 2349-5812 Volume 3, Issue 1 January-March, 2016, pp. 27-31

http://www.krishisanskriti.org/Publication.html

Performance Enhancement of Bow-tie Patch Antenna Array Using Defected Ground Structure

Gargi Poonia[1] and Sandeep Singh Sengar[2]

[1,2]JK Lakshmipat University Jaipur, India
E-mail: [1]gargipoonia2704@gmail.com, [2]sssengar@jklu.edu.in

Abstract—*This paper presents DGS (defected ground structure) design and simulation of linear antenna array of size 1*4. The elemental base shape antenna utilizes Bow-tie patch feeded through microstrip feed to achieve higher gain , highly directional beam and also to counteract the effect of fading while signal propagates through various corrupted environment. It is demonstrated that the proposed antenna works at 2.2GHz frequency. The antenna is microstrip line feeded and is simulated on HFSS (high-performance full-wave electromagnetic (EM) field simulator) software. The computer simulation results shows that the antenna having return losses -12.2dB and defected ground structure of antenna having return losses -22.1dB.*

Keywords*: Microstrip patch antenna ,return loss, Antenna gain.*

NOMENCLATURE

dB	Decibel
EM	Electromagnetic
GHz	Giga hertz
HFSS	High-performance full-wave electromagnetic (EM) field simulator
LAN	Local area network
PCS	Personal communication system
RF	Radio frequency
MMS	Mobile satellite service
ATC	Ancillary terrestrial components

1. INTRODUCTION

The Microstrip antennas are best suited where size, weight, cost, and ease of installation demand a low profile antenna [1]. It is widely used in high performance space crafts, aircrafts, satellite applications, wireless communication, radar and mobile communications. It is suitable for planner as well as non planer surfaces. It can be fabricated using printed circuit technology so it is simple and inexpensive. But there are several operational disadvantages of this antenna the bandwidth, efficiency, gain and power handling capacity of microstrip antenna is very low. Many scientists have done the research for increasing the bandwidth and gain. The gain of antenna can be increased by using the array configuration [2]. Microstrip patch antenna is made of metal patches placed on dielectric substrate and fed by microstrip or coplanar transmission line. The resonating frequency, radiation pattern, antenna impedance and polarization can be controlled by properly selecting the shape and dimension of patch [3]. Bandwidth of microstrip patch antenna can be increased by increasing the width and height of patch and decreasing the dielectric constant of substrate [4]. Losses are increased and efficiency is decreased because of increment in the volume [5]. Bandwidth is also dependent on impedance matching. There are several impedance matching techniques like quarter wave line [4-6], aperture coupled feeding technique [7] and slotted patches. Different shapes of slots like H shape [6], U shape [7], annular ring shape [8], L shape [9] and inverted F shape [10] are popular. Bandwidth can also be increased by stacking of patches [18].

In this paper, four Bow-tie slots are make a Bow-tie shaped structure . Array of four patches are fed by corporate fed network. The proposed antenna is simulated on HFSS virtual tool. The corporate fed networks and Bow-tie slots are used for decreasing the return loss and array is used for increasing the gain.

2. ANTENNA GEOMETRY

On the substrate (Rogers RT/ Duroid 5880™) of 400*200*1.6 cube mm having relative permittivity 2.2 or relative permeability 1, four Bow-tie shaped patches separated by distance of 62.5 mm (far apart from each other) and fed by corporate type feed network (symmetrical fed network) as shown in Fig. 1.

Each Bow-tie patch has 62.375 mm base and 54.9 mm height. For providing uniform phase distribution, all elements are connected to central feed port via equal length which is presented in fig 1. Due to symmetrical properties of network, each individual element is separated by distance of $\lambda/2$ from each other in linear way along y-axis. In order to combat fading, spacing chosen is $\lambda/2$. The independent signals are received by different antenna elements in uniform scattering environment due to this spacing. For avoiding aliasing, spacing is kept less or equal to λ/2 (the nyquist rate). Proposed designed antenna is simulated using HFSS simulation software.

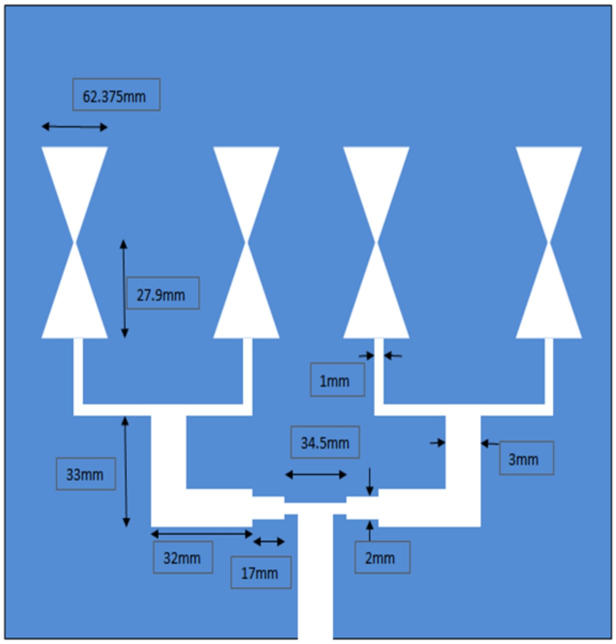


Fig. 1: Bow- tie Shaped Patch Array Antenna

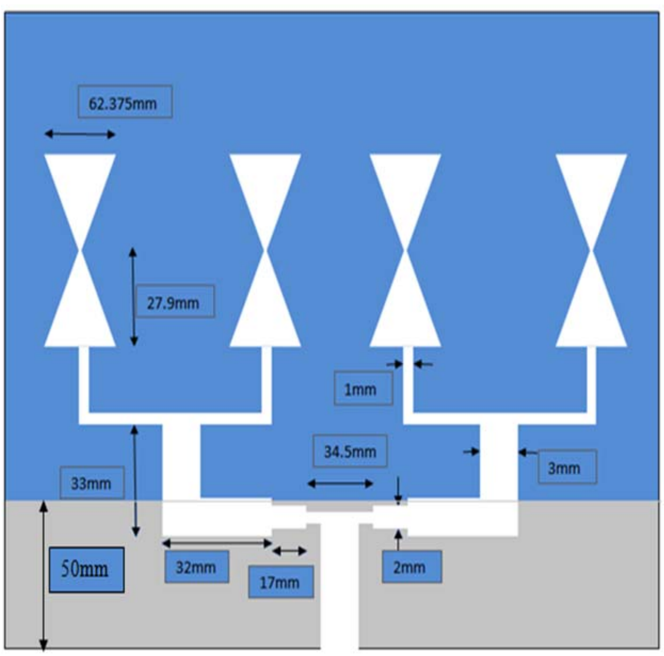


Fig. 2: DGS Bow-tie Shaped Patch Array Antenna

Defected ground structure is shown in Fig. 2 .and DGS antenna is simulated using HFSS simulation software.

A. Basic parameters

Table 4.1: Basic parameters of proposed Bow-tie Shaped Patch Array Antenna

Height	**1.6 mm**
Dielectric substrate	Rogers RT/ Duroid 5880™
Permittivity	2.2
Loss tangent (tanδ)	0.025
Simulator	HFSS
Lower bound frequency	1 GHz
Upper bound frequency	4 GHz

B. Software view

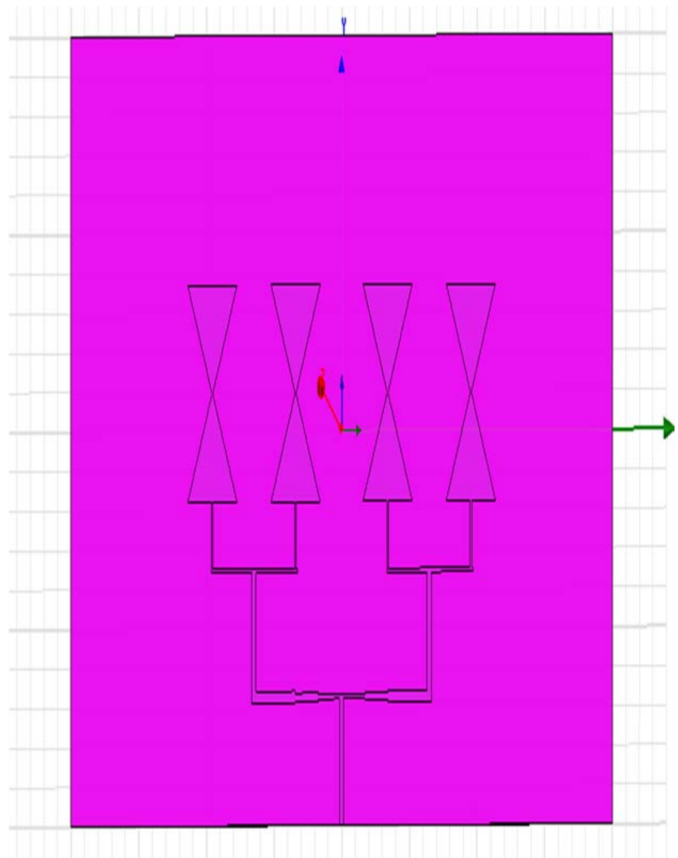


Fig. 3: Bow-tie Shaped Patch Array Antenna

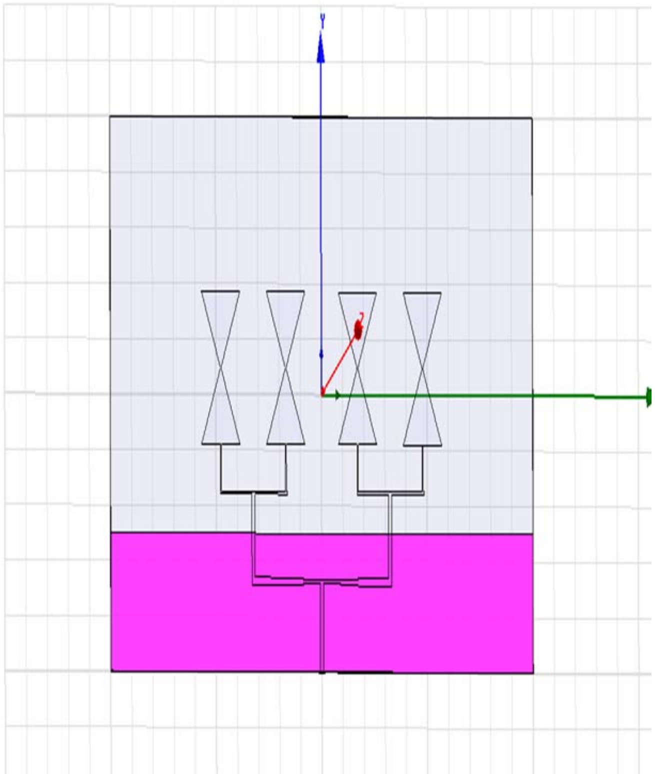


Fig. 4: DGS Bow-tie Shaped Antenna Array

For simulation on software use a radiation box size 430*230*50 for calculate radiation pattern and here use a lumped port for feed.

3. SIMULATION RESULT

Return loss of antenna can be determined using reflection coefficient versus frequency plot. Return loss compares the reflected power by the antenna to the fed power of antenna by the transmission line and it is a logarithmic ratio measured in dB. for calculate select the menu item HFSS> Results>Create Terminal Solution Data Report> Rectangular Plot.

In a microstrip patch antenna, radiations are normal to the surface of patch. θ is constant in the elevation plane and ϕ varies from 0 to 90 degree. The pattern has been presented at lowest and highest elevation angle. The parameter gain is presented at different angles. Red line shows radiation at phi is 0deg or blue line shows radiation pattern at phi is 90deg .

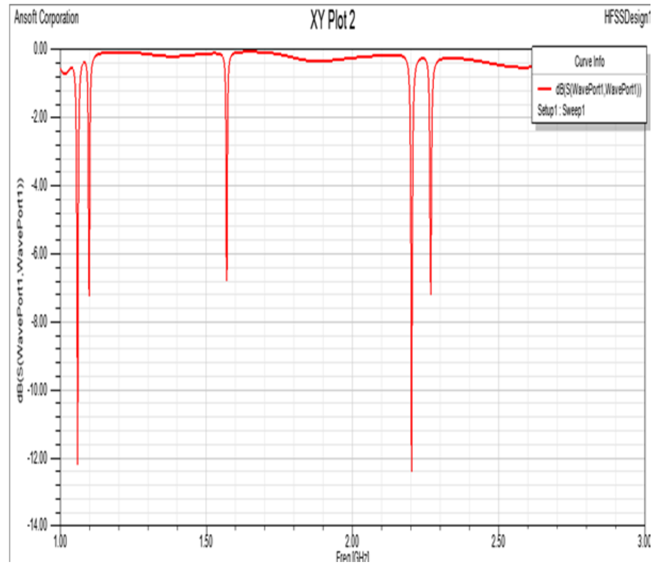


Fig. 5: Simulated reflection coefficient (S_{11}) of Bow-tie Shaped Patch Array v/s frequency

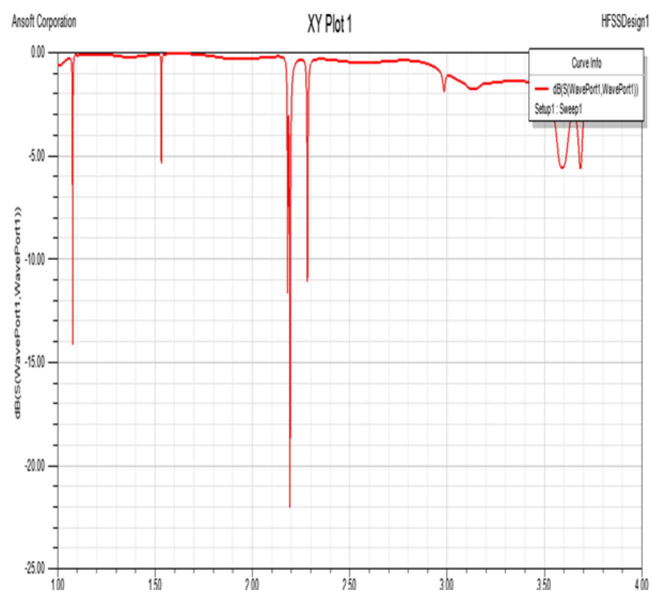
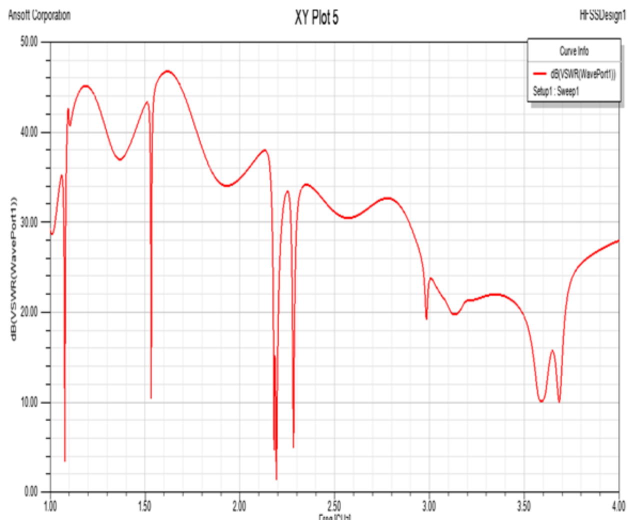
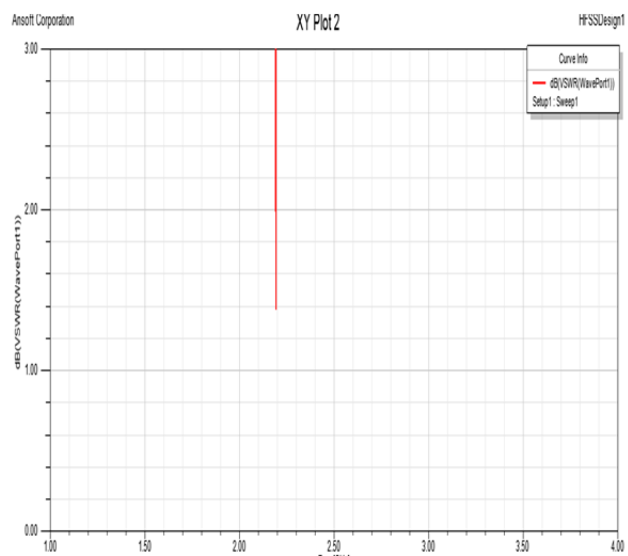


Fig. 6: Simulated reflection coefficient (S_{11}) of DGS Bow-tie Shaped Patch Array v/s frequency



(a)



(b)

Fig. 7(a) or (b) VSWR of DGS Bow-tie Antenna Array

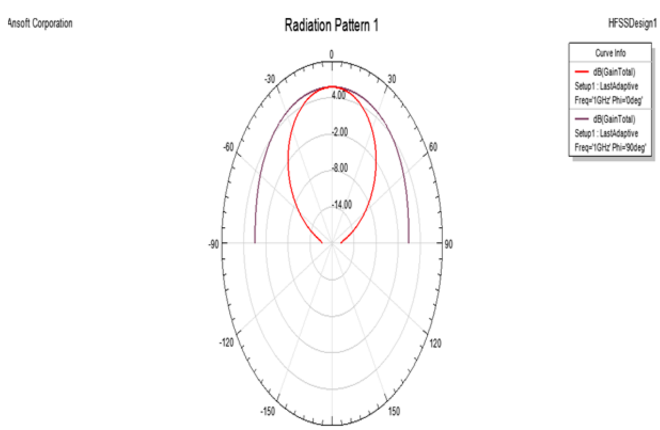


Fig. 8: Radiation pattern of Bow-tie antenna array

4. CONCLUSION AND FUTURE SCOPE

In this paper, the performance of DGS Bow-tie antenna array is analyzed. the refractive index is 2.2 For Rogers RT/Duroid material , return loss is calculated -22.1dB and return loss of Bow-tie antenna is calculated -12.2dB.this antenna array can be used for PCS ,wireless local area network ,RF applications. In U.S. more recently, it has approved for portions of the S band b/w 2.0 and 2.2 GHz the creation of mpbile satellite service [MSS] networks in connecting with ancillary terrestrial components [ATC].

REFERENCES

[1] John D Kraus, Ronald J Marhefka, Ahmad S Khan ,Antenna & Wave Propagation, Fourth edition, TMH India,2007.

[2] G.A. Dechamps,"Micro strips Microwave Antennas," presented at 3rd USAR Symposium on Antennas, 1953.

[3] D.M. Pozar,"Microstrip Antennas," Proc. IEEE, Vol.80, No.1, pp. 79-81, January 1992.

[4] I.J. Bahl and P. Bhartia, Microstrip Antennas, Artech House,Norwood, MA, 1980.

[5] J.R. James and P.S. Hall (eds.), Handbook of Microstrip Antennas, Peter Peregrinus Ltd., on behalf of the IEEE, Vol. 1 and 2, London, UK, 1989.

[6] Sudhir Bhaskar and Sachin Kumar Gupta,"Bandwidth Improvement of Microstrip Patch Antenna using H-Shaped Patch," IJERA,Vol.2,Issue 1, Jan-Feb.2012.

[7] Aruna Rani and R.K. Dawre ," Design and Analysis of Rectangular and U slotted microstrip patch using Optimization Program in Java for UHF Application,"IJCA,Vol. 5-No.5,June 2010.

[8] S. Azzaz-Rahmani and N. Boukli-Hacene,"Ultra-Wide-Band Microstrip concentric annular ring antenna for wireless communications," IJCSI, Vol.9, Issue1, No2, January 2012.

[9] Kin-Lu Wong, Compact and Broadband Microstrip Antennas, John Wiley & Sons, Inc, 2002.

[10] K. L.Wong and K. P. Yang, "Modified planar inverted F antenna," Electron. Lett. 34, 6–7, Jan. 8, 1998.

[11] A.G. Derneryd,"Extended analysis of rectangular microstrip resonator antennas," IEEE Trans. Antennas Propagat., Vol. AP-27, No.6, pp.846-849, November 1979.

[12] Tapan Nahar and Om Prakash Sharma," A Modified Approach for Bandwidth Enhancement of Microstrip Patch Antenna in L Band," First Edition, NSAWOA-2014 Proceedings, Jan 2014.

[13] D.M.Pozar,"Finite phased arrays of rectangular microstrip antennas," IEEE Trans. Antennas Propagat., Vol.AP-34, No.5, pp.658-665, May1986.

[14] K.R. Carver and J.W. Mink,"Microstrip Antenna Technology," IEEE Trans. Antennas Propagat., Vol. AP- 29,No.1,pp. 2-24,January 1981.

[15] W.F. Richards, Y.T. Lo, and D.D. Harrison, "An Improved Theory of Microstrip Antennas with Applications," IEEE Tras. Antennas Propagat., Vol. AP-29, No.1, pp.38-46, January 1981.

[16] J.R. Moisig and F.E. Gardiol,"General Integral Equation Formulation for Microstrip Antennas and Scatterers," Proc. Inst. Elect. Eng., Pt. H,Vol. 132,pp.424-432,1985.

[17] Balanis, Antenna Theory Analysis and Design, third Edition,Wiley India.

[18] H.F. Pues and A.R. Van de Capelle, "An Impedancematching Technique for Increasing the Bandwidth of Microstrip Antennas," IEEE Transactions on Antennas and Propagation, Vol. 37, No. 11, 1989, pp. 1345-1354.

[19] Jhaman das, Tzeem Ahmad Khan, Manoj kumar pal, “Rectangular patch antenna array for wireless applications,”