

Effect of EBG Presence on Elliptical Patch Antenna

O.Rangarao¹, M. Grace Priscilla², D.N. Bhushan Babu³, J. Naveen⁴, T. Vijay Sundee⁵, E. Raghu⁶

Assistant Professor (ECE Dept, VIT, Vijayawada, India)¹

Assistant Professor (ECE Dept, ALIET, Vijayawada, India)^{2,3}

Project Student(ECE Dept,ALIET,Vijayawada,India)⁴

Project Student(ECE Dept,ANUCET,Gunturu, India)^{5,6}

Abstract: The Paper demonstrates the design and performance of Elliptical Patch antenna in presence of EBG structure at one of its sides and its performance is compared with conventional type under similar design conditions. Here the designed Elliptical Patch antenna have a major radius 4 and ratio 30. And EBG designed as single layer of one array of patches for EBG and having 0.5cm pillar height patch size of 2cm side length square shape patches with 0.2cm gap. Conventional antenna operated at a frequency of 2.6608GHz and In presence of EBG it works at 2.6683GHz Frequency. and the comparative analysis is illustrated in this paper.

Keywords: Energy Band gap Structure (EBG), Surface Wave Suppression, Radiation Enhancement, improved gain.

I. INTRODUCTION

The micro strip patch antennas have their various advantages in wireless communication applications because of their low cost manufacturing, compatibility with low size, and these micro strip antennas are low profile antennas. But still these antennas have narrow band width and its radiation enhancement is much needed for improvisation of its usage in our communication applications. Here we use EBG structures to enhance the antenna parameters. Generally the EBG structures mainly suppresses the surface wave propagations many researches concentrated on using this EBG in various methods to enhance the antenna parameters and to check its effects on Conventional antennas here in this paper we analyse the Elliptical Patch antenna and compare its radiation pattern band width, gain directivity, intensity, front to back ratio and Radiation efficiency with conventional type.

II. ANTENNA AND EBG DESIGNS

A. Antenna

Here the same elliptical patch antenna is used for the analysis on same substrate under same execution conditions. The designs or shown in the below figure [1]. And the antenna is fed with micro-strip feed from wave port for excitation.

B. EBG structure

The EBG design is explained by the following figure [2]. And the EBG unit cell design and explains its working how it exhibiting high impedance

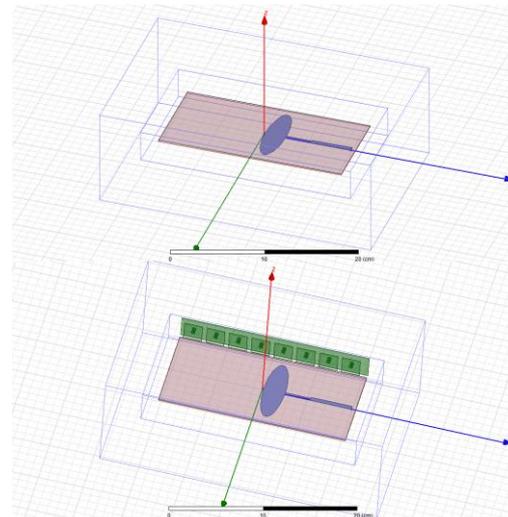


Figure [1]. Conventional and Designed antennas

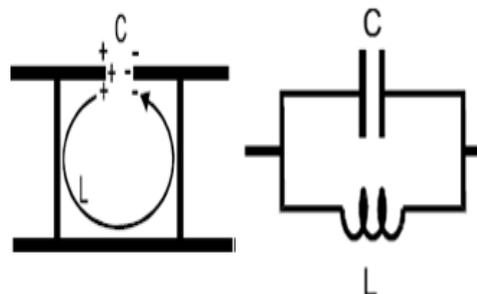


Figure [2]. EBG unit cell and its equivalent



III. SIMULATION RESULTS

A. Return loss

The return loss curves for the conventional and designed antenna are illustrated in the below figure [3] and by the figure [3] the operating frequencies are 2.6608GHz and 2.6683GHz for conventional and test antennas.

Return loss curves

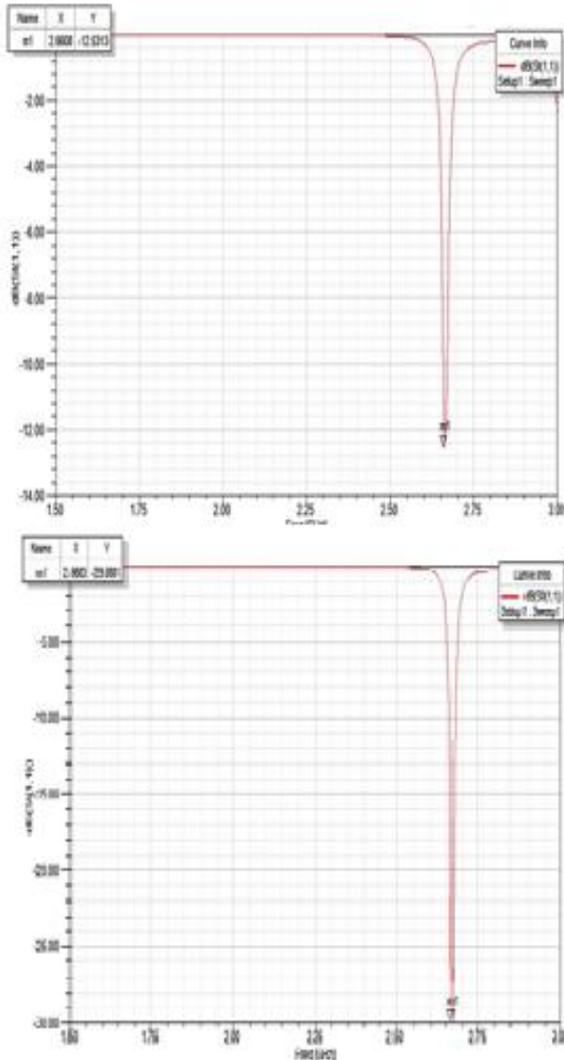


Figure [3]. Return loss VS Frequency curves

And it is also seen that the return loss for conventional antenna is -12.5313dB and for antenna with EBG is -29.8881dB by the comparison of return loss values we can say that the surface wave propagation or the loss due to surface waves is suppressed due to the presence of EBG and the return loss is very much improved.

B. Input Impedance

The both antennas are implemented under the same input impedance of 5Ω and the input impedance curves are shown in the following figure [4].

Input Impedance

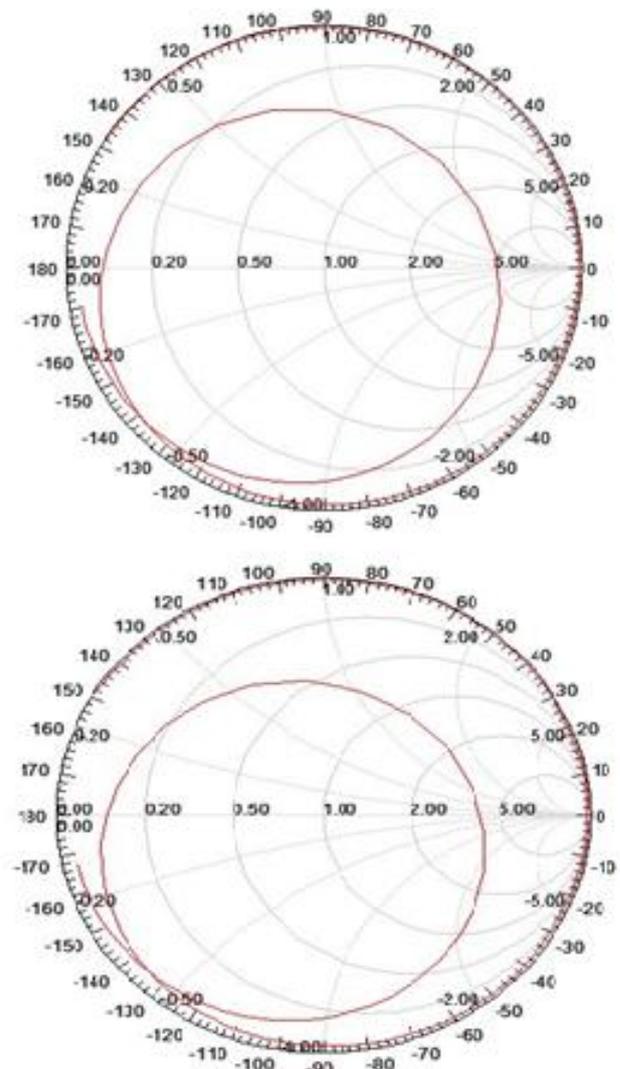


Figure [4] Input impedance curves

C. Radiation Patterns

The Radiation patterns in phi and theta directions for both conventional and designed antenna are illustrated in the figure [5] and [6]. And the change in radiation patterns are observed form theta direction because the EBG is placed at on side so its effects can be seen easily from top view.

Radiation pattern in Phi

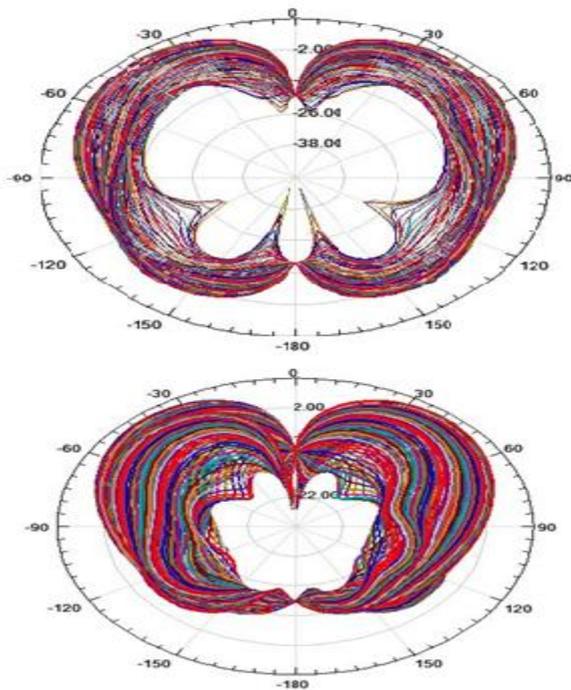


Figure [5] Radiation pattern in phi direction

Radiation pattern in Theta

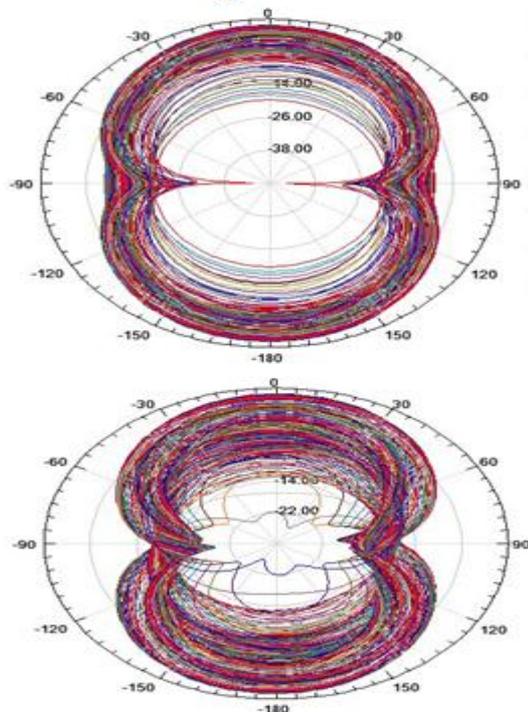


Figure [6] Radiation pattern in Theta direction

D. 3D-Gain

The 3D gain curves can explain the radiation enhancement and the improvement in gain. Comparative gain plots are illustrated in the figure [7].

3D-Gain

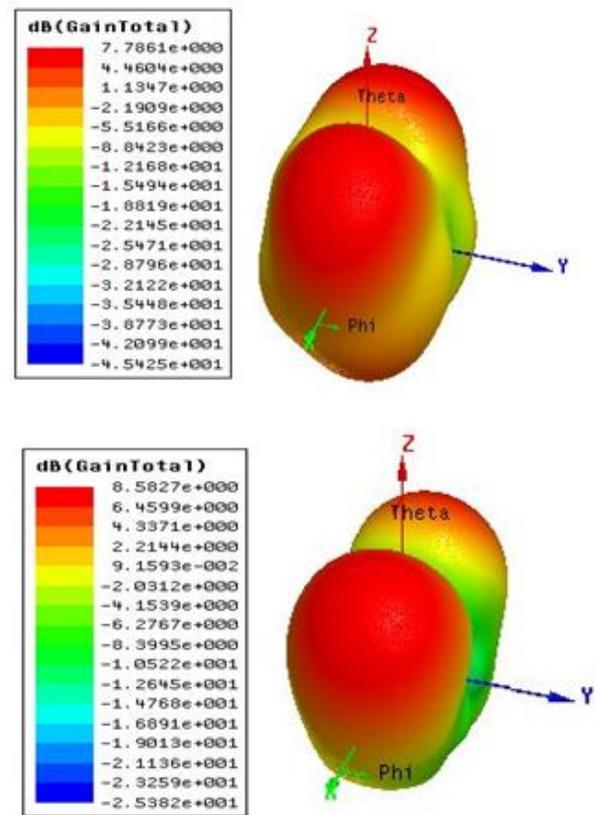


Figure [7] Gain in 3D plots (a) normal antenna (b) Antenna with EBG

Form the above figure [7] (a) we can explain that the conventional type have energy distribution in back ward direction which is reduced in (b) and form the above figure data we can also seen that the maximum gain value in 7(a) is 7.7861 which is enhanced to 9.1593 in 7(b) so that from this results we can conclude that the effect of EBG on antenna improves its performance.

IV. ANTENNA PARAMETERS

By the simulated data we are listing some antenna parameters comparison in the below table [1].

Quantity	Value	
Max U	0.00114143 (W/sr)	0.00199301 (W/sr)
Peak Directivity	6.98302	8.01318
Peak Gain	6.00636	7.21552
Peak Realized Gain	1.43439	2.50455
Radiated Power	0.00205411 (W)	0.00312553 (W)
Accepted Power	0.00238812 (W)	0.00347106 (W)
Incident Power	0.01 (W)	0.01 (W)
Radiation Efficiency	0.860137	0.900456
Front to Back Ratio	6.28365	11.8012

Table [1]. Antenna parameters



From above table [1] we can explain that all the parameters of conventional antenna are improved due to the presence of EBG. The presence of EBG improved peak gain and directivity from 6.98302, 6.00636 to 8.01318, 7.21552 respectively and the radiation efficiency also improved to 90% from 86%.

V. CONCLUSION

we can conclude that the presence of EBG have improved the performance of designed Elliptical micro strip patch antenna mainly its gain and radiation are improved and there is small improvement in its band width too. So this is very useful for wireless communication application to enhance the antenna parameters for effective utilization.

REFERENCES

- [1]. J. Doondi kumar , "Analysis of Monopole Antenna by Placing High Impedance Absorber Surface at one Side" /Volume-2Number-1PP-317-321.pdf
- [2]. J. Doondi kumar , "Design and Analysis of CO-axial Feed Rectangular Patch Antenna on High Impedance Surface" /Volume-2Number-1PP-405-410.pdf
- [3] D. Sievenpiper, "High - Impedance EM surfaces", Ph.D. Dissertation, University of California, Los Angeles, 1999.
- [4] D. Sievenpiper, E. Yablonovitch, U.S. provisional patent application, serial number 60/079953, filed on March 30, 1998.
- [5] Hashmi RM, Siddiqui AM, Jabeen M, Shehzad K, Abbas SM and Alimgeer KS, "Design and Experimental Analysis of High Performance Microstrip Antenna", International Journal of Computer and Network Security, vol. 1, no. 3, (2009) December.
- [6] Yang, F. and Y. Rahmat-Samii, "Microstrip antennas integrated with electromagnetic band-gap (EBG) structures: A low mutual coupling design for array applications," IEEE Transactions on Antennas and Propagation, Vol. 51, No. 10, 2936{2946, Oct. 2003.
- [7] Sievenpiper, D. F., "High-impedance electromagnetic surfaces," Doctorate thesis, University of California, 1999.
- [8] Sievenpiper, D. F., "Review of theory fabrication and applications of HIS ground planes," Metamaterials: Physics and Engineering, Explorations, Chap. 11, 287{311, Edited by N. En-gheta and R. Ziolkowski, Wiley Interscience, 2006
- [9] Yang, F. and Y. Rahmat-Samii, "Step-like structure and EBG structure to improve the performance of patch antennas on high dielectric substrate," Proc. IEEE AP-S Dig., Vol. 2, 482-485, July 2001.
- [10] C. Balanis, Antenna theory, Analysis, and Design 2nd ed., John Wiley and sons, New York (1997)

BIOGRAPHY



Ranga Rao Orugu, was born in A.P,India, Completed M.Tech in Communication Systems at C.R.Reddy engineering College, Eluru and B.Tech from Sri Sarathi Institute of engineering and technology in the year 2009 in Electronics &Communication engineering. worked as Assistant professor in SVSE and ALIET. And presently he is working as Asst.Professor in Vishnu Institute of Technology, Bheemavaram ,A.P,India.His research interests in communications.



Grace Priscilla Modi, was born in A.P,India, Completed M.Tech in Computer science and Engineering from Nova Institute of Engineering and Technology in the year 2010,

Jangareddygudem and B.Tech in Electronics &Communication Engineering from Malineni Lakshmaiah Engineering College in the year 2007. .Presently she is Working as Asst.Professor in ANDHRA LOYOLA college of Engg.& Technology, Vijayawada,A.P, India.Her research interests in communications.



D.N. BHUSHAN BABU was born in A.P,India, Completed M.Tech in Remote Sensing at ANDHRA UNIVERSITY College of engineering ,Vishakhapanam and B.Tech from Nimra college of engineering and technology in the year 2008 in Electronics &Communication engineering. Presently he is Working as Asst.Professor in ANDHRA LOYOLA college of Engg.& Technology, Vijayawada,A.P,India.His research interests in communications and Image Processing.