DESIGN OF MICROSTRIP ULTRA WIDE BAND ANTENNA FOR WIRELESS COMMUNICATION WITH ENHANCED GAIN

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Abstract : In the field of wireless communication such as WLAN (Wireless Local Area Network) band and WMAN (Wireless Metropolitan Area Network) and Hyper LAN band the devices need to concentrate the radiated energy in a particular direction, with high gain and directivity for applications, these devices must be less bulky. Using simple EBG substrate provides answers to the problem of congestion for this type of antenna, because this type of antenna has usually a relatively reduced thickness. The proposed antenna has an average gain 4.611dbi and the peek is 6.124dbi at 6.37GHzs. A microstrip ultra-wideband (UWB) antenna for wireless communication with enhanced gain using electromagnetic band-gap (EBG) structures concepts has been specifically designed in this project using CST (Computer Simulation Technology) for designing and simulation.

***IndexTerms* - Electromagnetic band gap, Antenna EBG, CST, Ultra-wide band.**

I. Introduction

On 14th February 2002, the Federal communications commission (FCC) a bandwidth from 3.1GHzs to 10.6GHzs allocated to UWB applications, it is the largest spectrum allocation granted by FCC for unlicensed usage. So, the UWB antennae design enables high data transmission rates, low power consumption and simple hardware configuration in communication systems for different applications.

Periodic structure type Bragg mirror can create a frequency band within which any electromagnetic propagation is impossible [3]– said by Rayleigh in 1887. EBG resonator antennas consist of an EBG material placed a half-wavelength above a ground plane containing a single source and it can form a single resonator that acts as a spatial filter to the source and creates highly gain and directional radiation characteristics[2]. Several different types of EBG materials have been used to create these antennas, and the materials may be classified according to the dimensionality of the periodicity[1]. In 1987, E. Yablonovitch and S. John extend the concept of Bragg mirrors in 2 and 3 dimensions. The propagation of electromagnetic waves within these materials generates strong interactions with the components of materials. As soon as the wavelength becomes less than spatial period of material, the laws of propagation become dispersive and anisotropic. This creates spatial and frequency filtering, creating the bandgap[3].

The concept of Bragg mirror consists of two layers permittivity and air is shown in below figure 1. With three parllel plates arranged periodically having the thickness Using a Bragg mirror constitutes of dielectric plates[4] FR4_epoxy witha permittivity εr=4.4 and thickness correspond the frequency f0=10GHz, the plates are separated with layers of air. This structure will interact with an external electromagnetic aggression, we have an interaction with a normal incident plane wave propagating at the resonant frequency f0. The diffracted waves are characterized by the transmission or reflection coefficients. The number of plates of a EBG structure effects the width and depth of the band gap. increase in the plates number the well transmission becomes narrow and deeper, causes multiple reflections on periodically arranged dielectric plates.

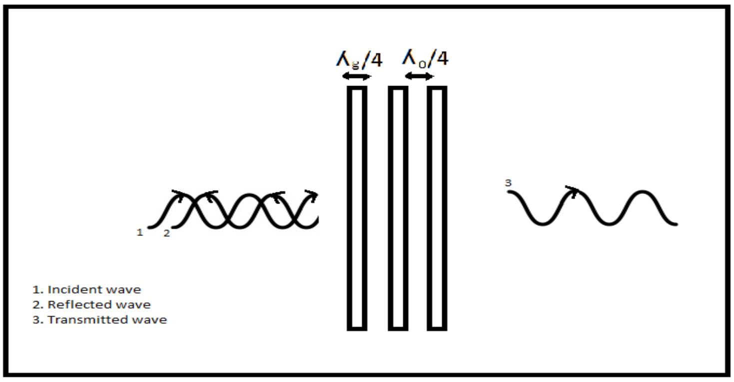

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Figure 1: Representation of Bragg mirror consists of two layers permittivity and air.

ii. Antenna Design and results

Figure 2 shows the top and bottom view of designed UWB antenna. The antenna was constructed on hight 0.8mm, width 22mm, length 32mm. Rogers RO 4003 substrate with a relative permittivity 3.5 and coppere is used for the ground and radiator patches on the both side of the substrate[8]. This UWB antenna is designed and simulated using computer simulation technology.

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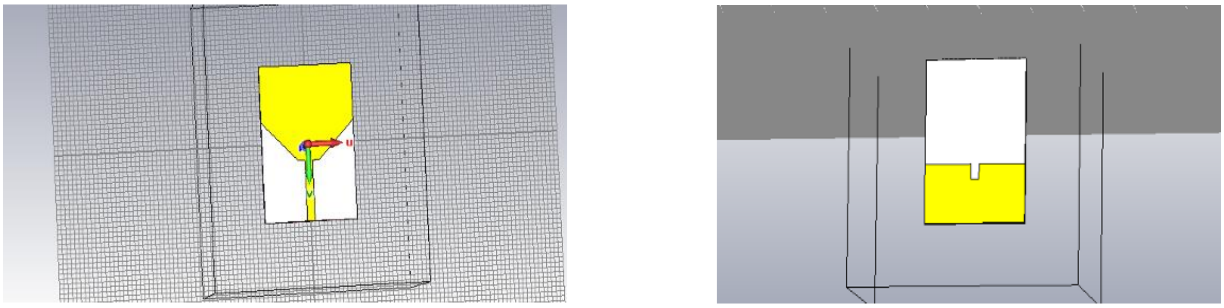

(a) **(b)**

Figure 2: The Characteristics of antenna (a) top view and (b) bottom view

The result is obtained by using CST. A patch antenna radiator is fed by a 50ohms microstrip line. The microstrip feed line source itself is fed by lumped port. Figure 3 shows that antenna obtains good impedance matching in an ultra-wide band. The variation in return loss of designed antenna is observed that is less than -10dB.

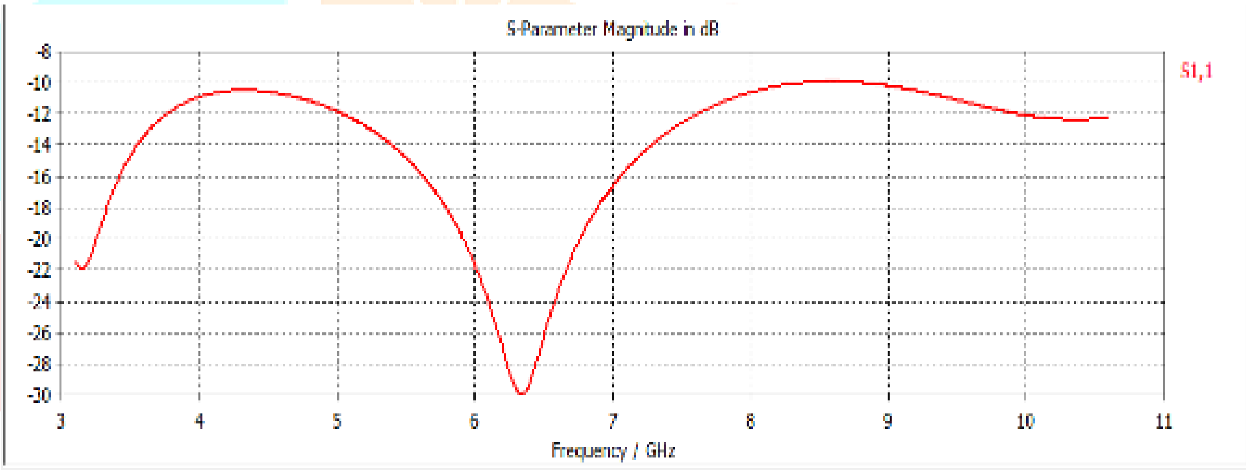

Figure 3: Variation of return loss

The simulated gain of the designed ultra wideband antenna with a considerable amount of 2.849 dBi at 4.19 GHz as shown below Figure 4 and the simulated gain of the antenna by a considerable amount of 4.611 dBi at 6.85 GHz as shown below figure 5.

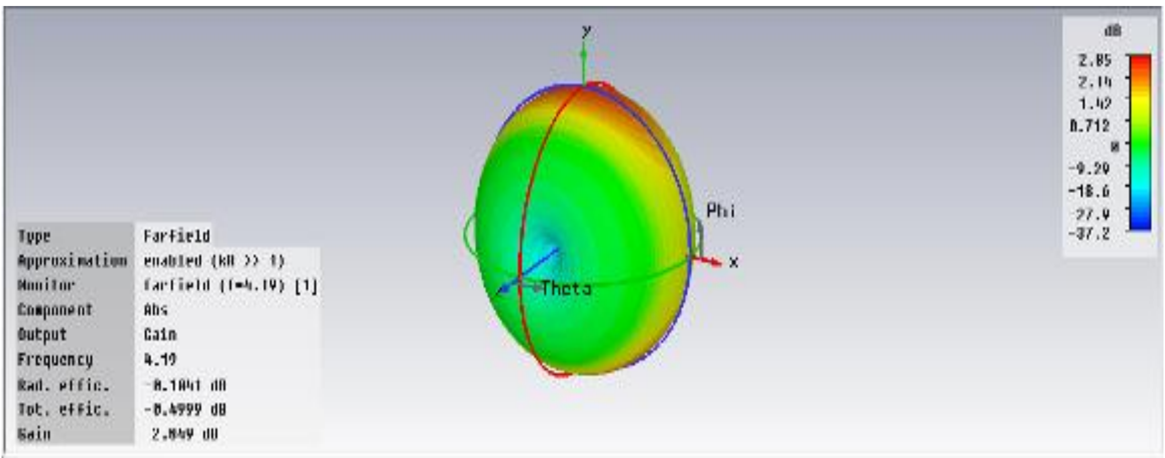

Figure 4: simulated gain for the designed antenna

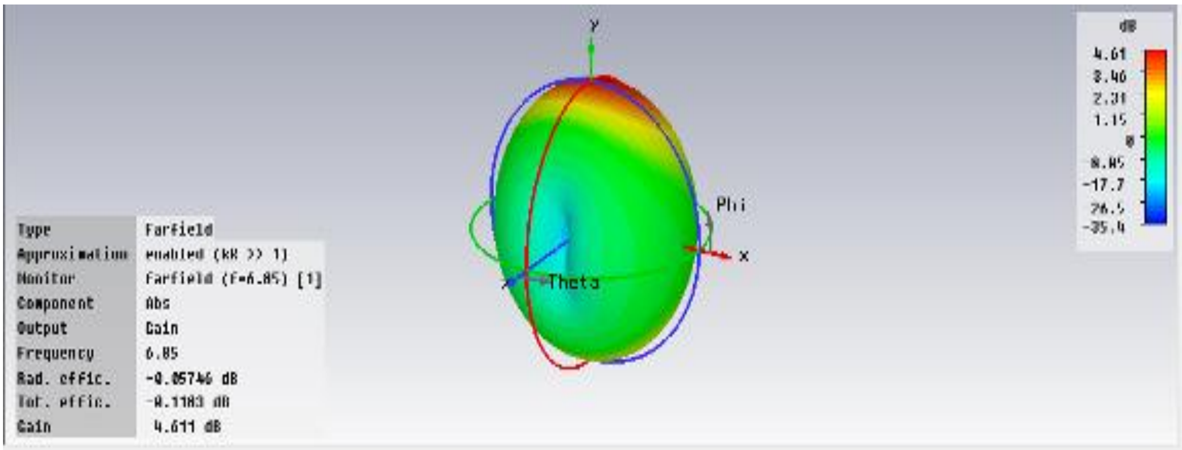

Figure 5: simulated gain for the designed antenna

A resonant cavity composed of EBG material is added to the above antenna to enhance its gain. Figure 6 shows the designed UWB antenna using EBG structures consists of 3 layers of FR4_Epoxy substrate with a relative permittivity 4.4. EBG resonator antennas consist of an EBG material placed a half-wavelength above a ground plane containing a single source and it can form a single resonator that acts as a spatial filter to the source and creates high gain and directional radiation characteristics [9].

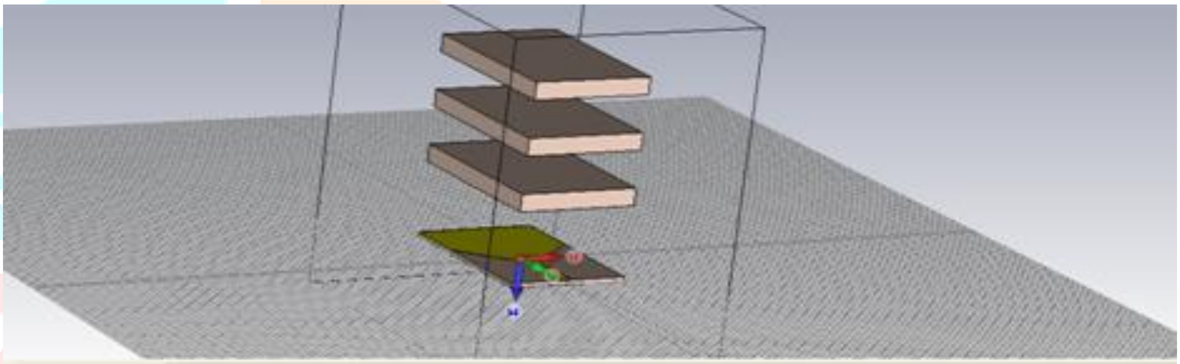

Figure 6: UWB antenna using EBG structures

The Figure 7 shows the impedance bandwidth of the ultra-wide band antenna using EBG structures and that can be operating at the band 3.1GHzs to 10.6GHzs i.e., entire UWB band for wireless communication.

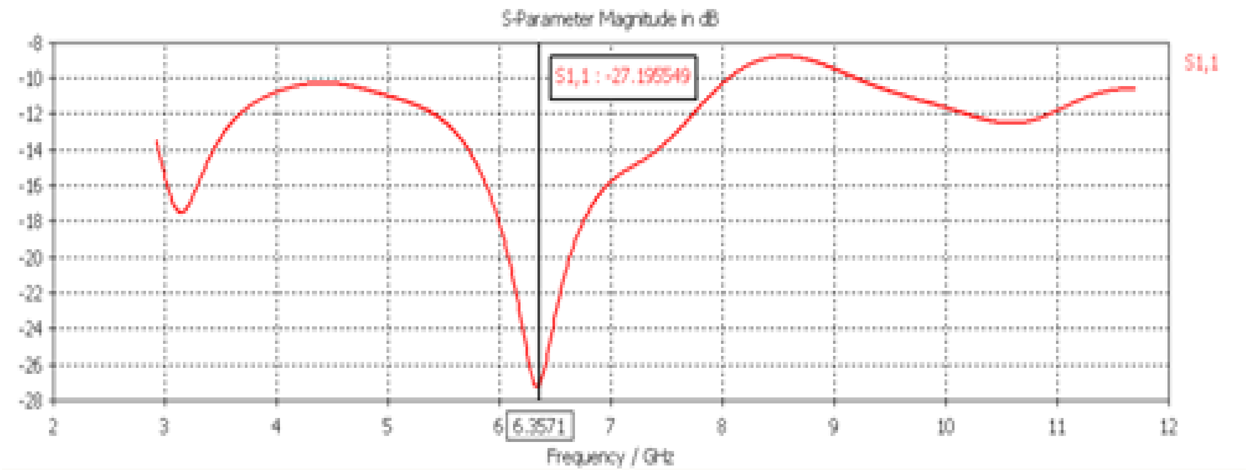

Figure 7: return loss of the UWB antenna using EBG.

The gain of the EBG antenna is increased by the considerable amount of 4.724 dBi at 4.19GHzs and 6.114 dBi at 6.37 GHzs compared with the simple ultra-wide band antenna at the same frequency is shown in the below figures 8 and figure 9.

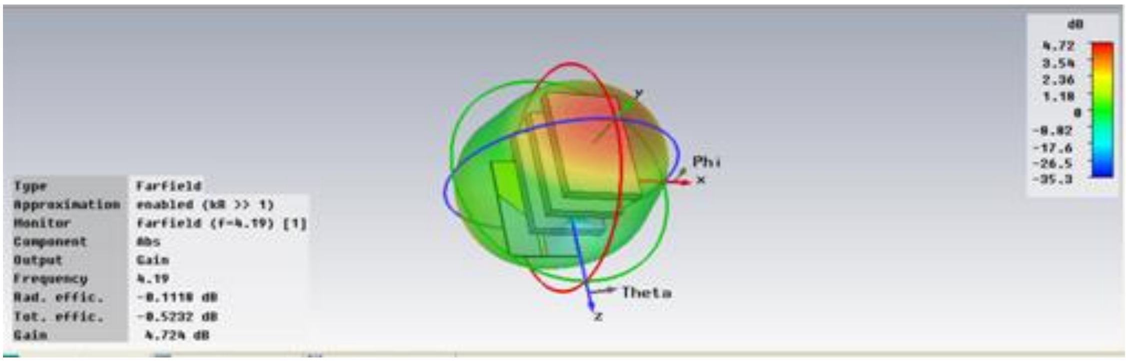

Figure 8: simulated gain for the designed UWB antenna using EBG structures at 4.19Ghzs.

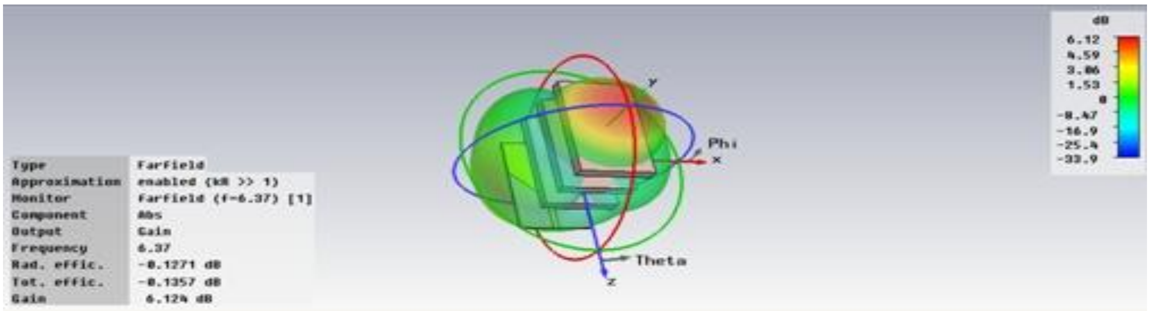

Figure 9: simulated gain for the designed UWB antenna using EBG structures at 6.37Ghz

iii. Conclusion

A compact UWB antenna based on EBG structure composed of triple layers EBG cavity has been studied. The gain of EBG antenna has increased by a considerable amount of 4.724 dBi at 4.19 GHz and 6.124dBi at 6.37 GHz compared with the simple ultra-wide band antenna at the same frequency.

References

1) JIN Chong-jin et al. (1999), ‘‘A novel Two-Dimensional Photonic Crystal’’, Chin. Phys. Lett. Vol 16 No. 1, pp. 20-22.

2) Alexander J. Glass (2005), ‘‘Non-Optical Applications of Photonic Crystal Structures’’, A Report to the US Air Force Office of Scientific Research, University of New Mixico.

3) Julien DROUET (2007), ‘‘Méthodes d’analyse électromagnétique spécifiques à la conception des antennes à résonateur BIE multi sources’’, Thèse, Université de Limoges, France.

4) E. Yablonovitch (1993) , ‘‘ Photonic band-gap structures ’’, J. Opt. Soc. Am. B, Vol. 10, No. 2, pp. 283-295.

5) E. Yablonovitch (2000), ‘‘How to Be Truly Photonic ’’, Applied Physics. Vol. 289. no. 5479, pp. 557 - 559.

6) S. John (1987), “Strong localization of photons in certain disordered dielectric superlattices”, Physical Review, vol. 58.

7) A. M. M.PLIHAL (1991), “Photonic band structure of two dimensional systems: the triangular lattice”, Physical Review, vol. 44.

8) Pradeep Kumar et al.(2013), “Realization of Band-Notch UWB Monopole Antenna Using AMC Structure”, International Journal of Engineering and Technology. Vol.5, No.3.

9) Lin Peng and Chengli Ruan (2013), “Design and time-domain analysis ofcompact multi-band-notched UWB antennas with EBG structures”, ProgressIn Electromagnetics Research B, Vol. 47, pp. 339-357.