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Review Article

ANALYSIS OF THE PRINTED MICROSTRIP ANTENNA FOR ULTRA WIDE BAND APPLICATIONS

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Recently Ultra Wide Band Technology has demand in industry as well as in academic due to its low cost, potential to handle to high data rates, relatively low power requirement. UWB antennas are much more challenging than conventional narrowband antennas. To produce omni-directional radiation pattern UWB antenna cover wide bandwidth of 3.1-10.6 GHz with compact size. This paper focuses some methods which provide the better results with some characteristics. Present antennas are studied in this paper, some future trends of UWB antenna and comparison of different parameter in the present antennas. This paper focuses on bandwidth enhancement, improvement in gain, stable radiation patterns and their applications.

Keywords: Compact ultra wide band antenna, Band notch antenna, Wide band antenna, Printed Tapered Ultra Wideband

INTRODUCTION

Ultra Wide Band System (UWB) system covers frequency range from 3.1-10.6 GHz which are narrow pulses which transmits the data with very low power. UWB emits timed pulses of electromagnetic energy so transmitter and receiver can made simple which is important for portable devices. To make use of UWB antenna in portable devices the size of UWB antenna is reduce which generates many compact UWB microstrip antenna and printed microstrip antenna. Compact antennas play critical role for broad impedance matching, acceptable gain and stable radiation pattern. Small design affects

antenna performance as size affects the gain and bandwidth. Thus reduce the size with broad impedance bandwidth and acceptable gain is challenging task. For that printed coplanar antenna are studied and found that give broad impedance bandwidth and stable radiation pattern. It is found that most of the research has compact dimension with high dielectric constant material and additional matching circuits or parasitic patch.

Antenna plays essential task in UWB system which is different from narrow band system. Because of narrow pulses the bandwidth increases in GHz. The UWB system provides

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high data rate which is useful in military application. It provides low transmission power as compare to narrowband communication system. So, their use can prolong battery life. Use of short pulses reduce multipath channel fading since reflected signals do not overlap with original one. So the operating frequency of several narrow band system overlap with those of UWB system. To mitigate the potential interference between the UWB system and narrowband system, the traditional method is to incorporate a band stop filter in to the antenna. This increases complexity and cost both. This is the designing goal to implement band rejection antenna which is quit challenging. This can be fulfilled by non planer UWB, U shaped antenna having good band notch characteristics and able to meet UWB communication requirement. They are limitedly used because of their larger size. For that printed microstrip antenna is studied. After that many antennas are proposed but they have some leakage of electromagnetic wave problems which affects the radiation pattern. To improve the performance stubs is inserted in to ground plane or radiating patch of antenna. This is band notch UWB antenna.

There are some problems in antenna like radiation of waves in dielectric and in ground to avoid this problem EBG structure is introduced in this paper. Discovery of EBG structures has revealed promising solutions to the some problem like how to suppress surface waves in the antenna ground plane, how to design an efficient low profile wire antenna near a ground plane, how to achieve a uniform field distribution in a rectangular waveguide, how to increase the gain of an antenna. Due to the complexity of the EBG

structures, it is usually difficult to characteristics them through analytical methods. Periodic structure with electromagnetic wave exciting results in amazing feature. Characteristics like frequency bands could be identified. The terminologies have been used depending on the domain of the applications which are seen in filter designs, gratings, Frequency Selective Surfaces (FSS), photonic crystals and Photonic Band Gaps (PBG), etc. We classify them under the broad terminology of "Electromagnetic Band Gap (EBG)" structures.

UWB ANTENNA

1) Compact UWB Microstrip Antenna with Modified Ground Plane For bandwidth Enhancement

The microstrip antenna has many advantages like compact, economic, light weighted, etc., but it has some disadvantages like lower bandwidth. The main aim of this paper is to increase bandwidth by modifying the ground plane or by inserting some notch in ground plane. The design in this paper is less ground plane dependent in terms of impedance matching. At lower frequency the effect of ground plane and RF cable can be reduced.

This paper emphasis on some parameter like vertical gap, width of ground plane, removal corners of ground plane to improve bandwidth. Increase in gap will result in reduction of the return loss and bandwidth. Next is width of ground plane, maximum bandwidth is achieved when top of ground plane bottom of patch are same. Further improvement is done by removal of ground plane corners. This method adds some slots in ground plane to moderate the reflection of surface current.

It has almost stable radiation pattern on operating frequency 3-12 GHz, above 8 GHz the direction E field becomes complex and has side lobes and H plane is still omni directional. The gain is high except at 5.5 GHz.

2) Printed Tapered Compact UWB Antenna With Single Notch Characteristics

In printed tapered compact UWB antenna with single band notch characteristics paper a compact ultra wideband antenna is proposed for wireless application. Reduction in bandwidth due to size reduction is compensated by bevelling the antenna with a pair of slots in the ground plane. This slot increases the bandwidth by introducing two resonant modes. The proposed antenna is further extended to band notch function by inscribing a C shaped slot on the radiator, which investigate numerically and validated experimentally. The results give impedance matching, notch characteristics and radiation pattern. The antenna designed for a compact size of $18 \times 19 \text{ mm}^2$ and operates for the frequency band 3.1-12 GHz has VSWR < 2 for band rejection performance in the frequency band of 5 to 6 GHz. The antenna shows omni directional radiation pattern having gain which is averaged and about 2.26 dB.

The gap between the radiating patch and ground plane has an important effect on impedance matching of the proposed antenna. As the angle between the patch and feed line decreases, the notch frequency band wideness and the centre of the notch band shifts. High frequency band reduces due to improper matching between the feed and the patch. Hence band notch and bandwidth can be controlled by varying angle between the feed and the patch.

3) Design And Analysis of Microstrip-Fed Band Notch UWB Antenna

A band-notched function is described with a novel planar Ultra Wideband (UWB) antenna. This consists of a radiation patch that has an arc-shaped edge and a modified ground plane which makes it different from the traditional monopole antenna. In traditional monopole antenna there is the modification in the shape of ground plane. It has two bevel slots on the upper edge and two semicircle slots on the bottom edge of the ground plane. These improve the input impedance bandwidth and the radiation performance at high frequency. With this design, the return loss is in 3.1–10.6 GHz frequency range and the radiation pattern is similar to the monopole antenna. By inserting a T-shaped stubs inside an elliptical slot cut in the radiation patch which produces a notch around 5.5 GHz which is known as WLAN band. The average gain is less than 18 dB in the stop band, while the patterns and the gains at frequencies other than in the stop band are similar to that of the antenna without the band-notched function.

In this paper introduced a new term, an effective length of a slot. An effective length of a slot concept is used along with the surface current distributions and transmission line models which gives the analysis of the physical effects of these slots which generates the band-notched characteristics. The antenna was fabricated and measured to show broad bandwidth, designed notched bands, and good omni directional radiation patterns.

4) Design of High Gain UWB Antenna for Wireless Communication Using Electro-Magnetic Band Gap Structure

The properties and advantage of materials Electromagnetic Band-Gap (EBG) are studied;

Antennas Parameter	Compact UWB	Printed Tapered UWB	Band Notch UWB	Antenna using EBG
Method	Modification in Ground Plane	Single Band Notch	Band Notch	EBG Structure
Characteristics	Bandwidth enhancement	High Impedance bandwidth, Gain	Input Impedance And stable Radiation Pattern in High Frequency	High Gain
Material	FR4	FR4	FR4	FR4
Dimension	(4.7*3.6) cm (10*3.5) mm (7.5*2.5) mm	18*19 mm ²	25*29 mm ²	32*22 mm h=11.5 mm e=1.8 mm
Operating Frequency	2.957-12.1 GHz	3.1-12GHz	3.1-11 GHz	2.9-11.7 GHz
Impedance bandwidth	3.1-10.6GHz	8.9 Stretch to 3-12 GHz	Changes as per application	5.2-10.5 GHz
Gain	1-6GHz except at 5.5	2.26 dB avg	No effects of band notch	6.6 dB
Radiation pattern	Stable	Omni directional and stable	Good Omni-directional in H-plane	-
Return loss or VSWR	-17 dB & 30 dB	<2	-	2.8-11 GHz

then in this paper a high gain UWB microstrip antenna using EBG structures concepts is designed. The impedance bandwidth of the proposed antenna is 2.9–11.7 GHz about 251% broader, which are the most usable bandwidth regions for WiMAX, WiFi outdoor, WLAN, Hiperlan like wireless applications. The average gain of proposed antenna is of 6.6 dB and the peaks are found at 18.99 dB at 4.19 GHz. The designing as well as simulation results done by using ANSOFT High Frequency Structure Simulator (HFSS), show that the antenna has higher gain than conventional UWB microstrip antennas. In this paper introduced a new term, an effective length of a slot. An effective length of a slot concept is used along with the surface current distributions and transmission line models which gives the analysis of the physical effects of these slots which generates the band-notched characteristics. The antenna was fabricated and measured to show broad bandwidth, designed notched bands, and good omni directional radiation patterns.

COMPARISONS OF PAPERS IN TABLE FORM

CONCLUSION

In this paper we have reviewed a wide variety of Printed UWB antennas. And have found that there are several interesting aspects that need to be taken in to account when designing UWB antenna as opposite to UWB antennas. We have mentioned a number of potential applications that could be further considered or UWB antennas. Looking in to the future, we believed that UWB antennas shows considerable promise and they will witness further developments alongside the rapid and explosive growth of wireless communication that we are witnessing today.

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