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Designing of Ultra-Wideband Microstrip Patch Antenna for WLAN Application – A Review

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Abstract: *As per the antenna theory, the main advantage of the microstrip patch antenna (MPA) is that it is small in size, suitable for flat and non-planar surfaces, and is simple to manufacture and low in cost using current printed circuit technology. Therefore, in this modern era, microstrip patch antennas are widely used in communication accessories. Ultra-Wide Band (UWB) technology is emerging as a promising solution to this problem. High data rates, large bandwidths and immunity to multipath interference are important features of UWB. UWB antennas must not create unwanted distortions and therefore good design is very important. This paper reviews the work done in this field to date and attempts to give an overall scenario of the research direction in UWB antenna design. This article has shown in the previous years of research that various antenna design methods in the ultra-wideband range, such as U-shaped cutting edge tapered grooves, DGS-based microstrip patch antennas, planar partially grounded patch antennas, and parasitic patch antennas, Fractal antennas and reconfigurable antennas.*

Keywords: Microstrip Patch Antenna (MPA), Ultra-Wide Band (UWB), WLAN, Antenna Design.

I. Introduction

The theory and practical of "classical" antennas are well understood and well developed for sinusoidal transmission and reception. Expecting and defining antenna radiation patterns for UWB signals is not familiar to engineers for the reason that the effect of the antenna on the radiated signal is more important - all antennas differentiate the input signal from one or more times, depending on the antenna, and while the derivatives of the sinewave are simply the phase shift of the sine, the entire shape of the UWB waveform can change due to antenna. Although existing antennas can emit the shape of a baseband UWB wave, they will not necessarily do so efficiently or with the desired shape due to the large bandwidth required. For this reason, it is recommended that antennas for UWB applications be specifically designed for waveforms. Basically, the theory of such a design is well known, but sometimes debatable.

The Federal Communications Commission (FCC) designated the unregistered ultra-wideband (UWB) frequency band (3.1-10.6 GHz) in 2002 to address numerous wireless system design issues such as greater data rates, improved reliability, greater protection, and higher capacity. The increased bandwidth allowed users to share enormous amounts of data with less worries about interference. The microstrip antenna is among the best possibilities for creating low-profile, low-cost planar designs that are simple to integrate with other RF components. The ultra-wide bandwidth is usually obtained in such architectures by using many resonance frequencies that are closer together. Other licensed frequency bands, such as WiMAX, WLAN, and HIPERLAN, create disturbance in the unregulated UWB. Ultra-Wide Band designs with band-notched characteristics are highly desirable to minimise the impact of such interferences. Fractal geometries are also widely employed to obtain lower cutoff frequency UWB properties. Several UWB antenna designs having notch band characteristics in assigned frequency bands have been documented in the literature.

II. Literature Survey

Renato Cicchetti, Emanuela Miozzi, Orlandino esta Presents a summary of the various development methods, related literature, and different techniques employed for the analysis and development of wideband and ultra-wideband (UWB) antennas. Factors including flatness, printability, dielectric, and wear resistance in the antenna can be achieved both on multi-layer textiles as well as on dielectric textile supports. This work serves as a suggested guide on the required bandwidth, field polarization, gain, size, response time, materials involved in integration into current communication systems. [1]

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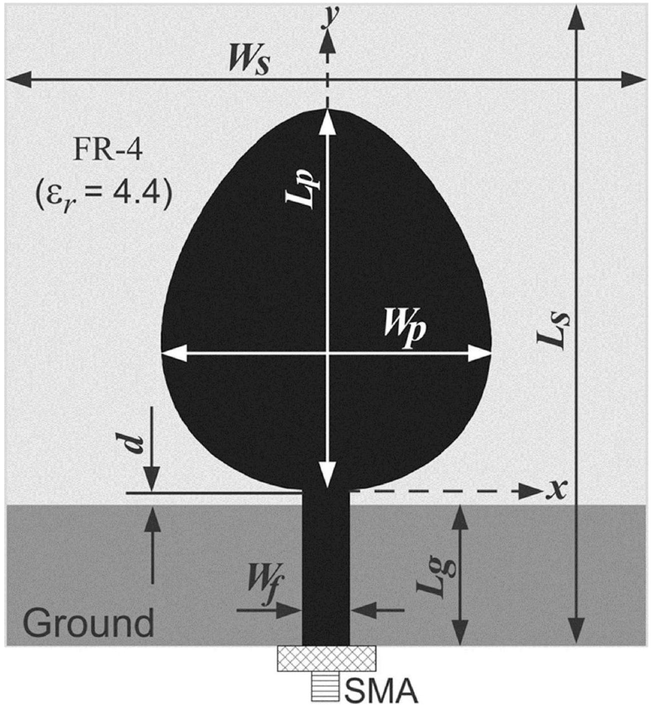

Figure 1: Layout of Newton's egg curved monopole antenna for ultrawideband applications

Verma, S. and Kumar, P. designed the antenna prototype with a size of 40 mm × 40 mm as shown in Fig 1 is printed on a double-sided FR4 substrate, with a relative permittivity = 4.4, a loss tangent of 0.018, and a thickness of h = 1.6 mm. A parameter formula based on Newton's egg curve is proposed to design the monopole profile, and an empirical formula is introduced to determine the lower cut-off frequency of the impedance bandwidth. Antenna analysis and design are performed using HFSS based on full-wave FEM. Experimental measurement shows that the FBW of the antenna is 116.55% (2.9-11.0 GHz), and the stable gain is about 2.2-2.9 dBi. The proposed antenna has almost an omnidirectional radiation pattern, low cross-polarization in all directions, and has sufficient group delay over the entire UWB bandwidth (3.1-10.6 GHz). [2]

Ibrahim, Ahmed A., and Mahmoud A. Abdalla designed a compact UWB antenna for dual track frequency range. They used a faulty microstrip patch antenna and a slot etched into the radiation patch to achieve dual-band banding. The authors obtained good impedance matching from 2.5 GHz to 12 GHz with two knurled bands from 3.3 GHz to 3.8 GHz and from 5.1 GHz to 5.9 GHz. However, there is a frequency variation between the simulation results and the measured results. Post-production deviations cannot be completely avoided. [3]

Wong, Chen & Li, Proposed two UWB MIMO antennas. These antennas have a compact size and small correlation for upcoming new age smart phones and provide coverage between 3300-6000 MHz. The planar coupled-fed inverted-F antenna structure was used on which two UWB antennas were based. Two -antenna block got a length of 35mm only. They provide hopeful services to cover the 5G mobile communication and 5GHz-WLAN operation in coming time. [4]

Maiti, Satyabrata, Sudip Kumar Rajak, and Amrit Mukherjee proposed design of the compact microstrip patch antenna as shown in fig. 2 and in this paper the authors have shown that their patch antenna design for the 2.20 GHz resonant frequency has a bandwidth of 1900 MHz for a maximum gain of 3.65 dB. They also reduced the size of their designs by 83%. They also produce an almost omnidirectional radiation pattern. However, the effect of the 83% size reduction is not explicitly mentioned. [5]

M. Ojaroudi demonstrated a new type of printed monopole antenna (PMA) for ultra-wideband (UWB) applications with variable frequency band notch characteristics. The proposed antenna consists of a stepped square radiating patch with two U-shaped slots and a notched ground plane with a T-shaped sleeve, providing a wide usable sub-bandwidth of more than 130%. By cutting two modified U-shaped grooves of variable size on the radiating patch, a band stop-band power is created, which can control its performance, such as band notch frequency and bandwidth. The designed antenna is small in size, 12.0 × 19.0 mm2, and exhibits band rejection performance in the 5.02-5.97 GHz frequency band. [6]

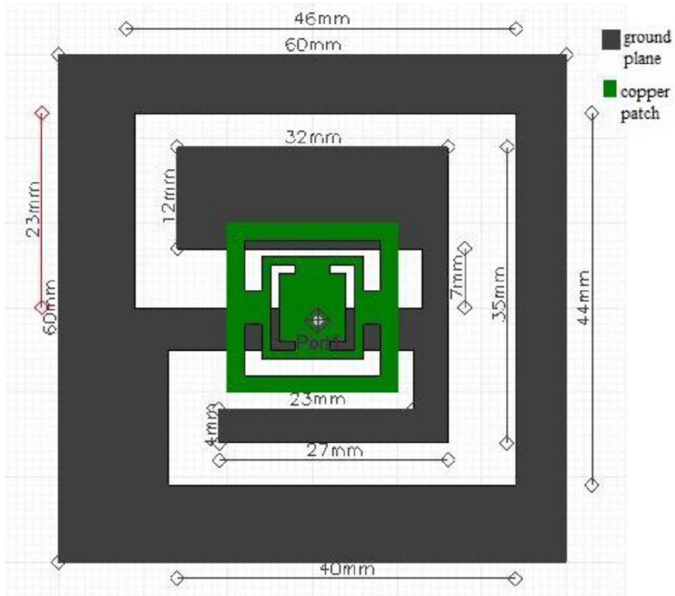

Figure 2: Compact Microstrip Patch Antenna for UWB application.

Singh, C., Kumawat, G. provides a compact rectangular microstrip ultra-wideband patch antenna with dual-band notch function for WiMax and WLAN. The designed antenna consists of an ordinary rectangular patch antenna and a partly defective ground structure. In order to achieve the dual-notch feature, a "U" and an "inverted U" groove are embedded in the radiation patch. A local ground plane structure with a U-shaped groove in the middle is integrated to achieve additional resonance and bandwidth improvement. The recommended antenna size is 20 × 33 × 1.6 mm3. The first notch formed by a U-shaped slot with a frequency of 3.5 GHz is used for WiMax (from 2.9 to 4.5 GHz), and the second notch is formed by an inverted U-shaped slot with a frequency of 5.4 GHz, which is used for WLAN (from 5.49 To 6.45 GHz). The antenna covers almost the entire ultra-wideband range (3.1 to 10.6 GHz). The simulation analysis of the proposed antenna is carried out with the simulation software CST2011. The radiation pattern of the simulated antenna is almost omnidirectional, and the gain of the proposed antenna is almost stable in the UWB range without the notch band. [7]

Satyabrat Hota, Sudeep Baudha, B. B. Mangaraj & Manish Varun Yadav Researched and introduced a new compact antenna for ultra-wideband applications. The proposed structure consists of a modified patch with rectangular parasitic elements on the top, while the defective ground plane is etched on the flame-retardant FR4 substrate below, with feed lines 50. The size of S11 <−10 dB of the structure is 2.7–11 GHz, which constitutes an interrupt bandwidth of 121.1%. The total volume of the structure is compact, with a size of 20 × 20 × 1.6 mm3. The gain and antenna efficiency of this structure are 3.34 dB and 79.8%, respectively. The structure has stable radiation over the entire operating frequency band. The measurement and simulation results of the same direction and cross (X) polarization are relatively consistent. All these characteristics indicate that the proposed structure will find its application in WiMAX bands 3.5 and 5.5 GHz, WLAN bands 5.2 and 5.8 GHz, satellite data links, and various other applications in the field of wireless communications. [8]

Qasim Awais, Hassan Tariq Chattha, Mohsin Jamil, Yang Jin, Farooq Ahmad Tahir, Masood Ur Rehman designed a new type of CPW antenna with a rectangular shape with overlapping circular slots and circular edges is proposed and implemented. The top and bottom strips effectively control the 2.4 GHz and 3.4 GHz resonant bands. The fillet technology is used to achieve ultra-wide bandwidths of 1.1 GHz-2.71 GHz in the first resonant frequency band and 3.15 to 3.65 GHz in the second resonant frequency band, and to improve antenna gain. Each of these tapes can be customized by changing the size of the top and bottom strips. The proposed antenna shows a directional radiation pattern, good return loss and better gain, and acceptable radiation efficiency. The proposed design is very small (875mm2), which makes it a suitable competitor for various portable and portable IoT applications. [9]

M. Debab and Z. Mahdjoub This article proposes a new ultra-wideband antenna for WLAN and WIMAX applications. This antenna has a compact size of 20 x 17.6 mm2, and the also has a satisfactory (VSWR < 2) requires 3.1 GHz to 10 or higher. Through this design, only need to radiate Three uniform grooves are etched on the body to realize the dual-band notch characteristics of the antenna in the WiMAX frequency band (3.1-3.9 GHz) and the WLAN frequency band (5.1-5.9 GHz). Parametric studies have shown that the location slot can control the frequency of rejections. The antenna prototype has been proposed, implemented and tested. The measurement results show a slight deviation of from the simulation results (CST MWS and HFSS) program, which is caused by the influence of manufacturing tolerances and SMA connectors. The pattern of the proposed antenna is almost omnidirectional over the entire UWB frequency and has a stable radiation pattern, indicating that it may be suitable for UWB systems for various commercial and military broadband applications. [10]

Mansour Nejatijahromi, MuhibUr Rahman, and Mahdi Naghshvarianjahromi, introduces a CPW-powered UWB band gap antenna with continuously adjustable WiMAX suppression band and fixed WLAN suppression band. Since the WLAN frequency band is fixed on a global scale, it is fixed in a radiation patch with a newly constructed resonator. Since the main problem is the difference between the 3 GHz and 4 GHz WiMAX frequency bands in different countries around the world, a new miniaturized resonator is used in a part of the ground plane with a variable capacitor to make it continuously tunable. By changing the values of these capacitors, the stop band of 3-4 GHz is continuously tuned. [11]

This article proposes a new compact balloon antenna that provides impedance bands from 1.75 to 10.3 GHz and dual-frequency notch bands from 2.2-3.9 and 5.1-6 GHz. The notch band is realized by the inverted patch-shaped resonator on the back of the lead and the curved U-shaped groove on the radiating patch to avoid possible interference from coexisting wireless communication standards. The inverted U-shaped groove on the patch can form a wide impedance band. The antenna also provides omnidirectional h-plane and monopole, such as e-plane mode with average efficiency> 80%, flat gain and constant group delay behaviour [12]

III. Conclusion

This manuscript examines and presents an extensive literature review on UWB antennas that have the band suppression characteristics proposed by various researchers over the past decade. In the literature reviewed, the existing UWB antennas are characterized according to the frequency band and are divided into different categories such as single, dual and triple band notch characteristics. In addition, the different techniques used by the researchers are explained in detail in the subsections. In addition, this article also discusses the design of different types of UWB antennas, which may be helpful for future research.

References

[1]. R. Cicchetti, E. Miozzi and O. Testa, "Wideband and UWB Antennas for Wireless Applications: A Comprehensive Review," International Journal of Antennas and Propagation, 2017.

[2]. S. Verma and P. Kumar, "Printed Egg Curved Monopole Antenna for ultrawideband applications," in National Conference on Communications, 2013.

[3]. A. A. Ibrahim and M. A. Abdalla, "Compact size UWB antenna with multi-band notched charactristics for wireless applications," IEEE International Symposium on Antennas and Propagation (APSURSI), pp. 1819-1820, 2016.

[4]. K.-L. Wong, Y.-H. Chen and W.-Y. Li, "Decoupled compact ultra-wideband MIMO antennas covering 3300 - 6000 MHz for the fifth-generation mobile and 5GHz-WLAN operations in the future smartphone," Microwave and Optical Technology Letters, vol. 60, no. 10, pp. 2345-2351, 2018.

[5]. S. Maiti, S. K. Rajak and A. Mukherjee, "Design of a compact ultra-wide band microstrip patch antenna," in Fifth International Conference on Computing, Communications and Networking Technologies (ICCCNT), 2014.

[6]. S. Yazdanifard, R. Sadeghzadeh and M. Ojaroudi, "Ultra-Wideband Small Square Monopole Antenna with Variable Frequency Band-Notch Function," Progress In Electromagnetics Research C, vol. 15, pp. 133-144, 2010.

[7]. C. Singh and G. Kumawat , "A Compact Rectangular Ultra-Wideband Microstrip Patch Antenna with Double Band Notch Feature at Wi-Max and WLAN," Wireless Personal Communications, vol. 144, pp. 2063-2077, 2020.

[8]. S. Hota, S. Baudha, B. B. Mangaraj and M. Varun Yadav, "A novel compact planar antenna for ultra-wideband application," Journal of Electromagnetic Waves and Applications, vol. 34, no. 1, pp. 116-128, 2020.

[9]. Q. Awais, H. T. Chattha, M. Jamil, Y. Jin, F. A. Tahir and M. U. Rehman, "A Novel Dual Ultrawideband CPW-Fed Printed Antenna for Internet of Things (IoT) Applications," Wireless Communications and Mobile Computing, 2018.

[10]. M. Debab and Z. Mahdjoub, "Characteristics UWB Planar Antenna with dual notched bands for WIMAX and WLAN," Advanced Electromagnetics (AEM), vol. 7, no. 5, pp. 20-25, 2018.

[11]. M. Nejatijahromi, M. Rahman and M. Naghshvarianjahromi, "Continuously Tunable WiMAX Band-Notched UWB Antenna with Fixed WLAN Notched Band," Progress In Electromagnetics Research Letters, vol. 75, pp. 97-103, 2018.

[12]. S. Kundu, "Balloon-shaped CPW fed printed UWB antenna with dual frequency notch to eliminate WiMAX and WLAN interferences," Microwave and Optical Technology Letters, vol. 60, no. 7, pp. 1744-1750, 2018.