International Journal of Engineering Technology and Applied Science
(ISSN: 2395 3853), Vol. 2 Issue 9 September 2016

A Survey Report on UWB Antenna and its Application

Prashant Parashar[1](M.Tech) Digital Communication, Prof. Anil Khandelwal[2] (Assistant Professor)
[1,2]Electronics and Communication
[1,2]VNS Group of Institutions, Bhopal [M.P.]
prashantparashar_83@yahoo.com[1], akhandelwal7@gmail.com[2]

***Abstract*—Coplanarultra-wide band antenna is the main requirement of different communication devices. There are different types of UWB antenna proposed in the last decade. UWB antennas one of the hot research topic in between researchers. In the last decade the growth satellite communication is indomitable that's by the main focus on UWB antennas applicable in the different communication areas like satellite, wireless, Wi-Fi, Wi-Max, L, C, Ku, K bands. In this review paper analyses the different UWB antenna on the basis of bandwidth, no of bands, gain, bandwidth optimization etc.**

***IndexTerms*—Wi-Fi, Wi-Max, UWB and substrate.**

INTRODUCTION

The rapid development of components and systems for future ultra-wideband (UWB) technology has significantly increased measurement efforts within the electromagnetic compatibility community. Therefore, frequency- and time-domain testing capability for UWB compliance is at the forefront of research and development in this area. Within such testing systems, the UWB antenna is a specific component who's transmitting and receiving properties differ from those for conventional narrowband operation. Several antennas have been developed. For localized equipment as, e.g., in chamber measurement setups, TEM horns can be used for mobile testing, though, printed-circuit antennas are more appropriate. Also, with the release of the 3.1 - 10.6 GHz band for ultra-wideband (UWB) operation, a variety of typical UWB applications evolved; examples are indoor/outdoor communication systems, ground-penetrating and vehicular radars, wall and through-wall imaging, medical imaging and surveillance. Many future systems will utilize handheld devices for such short-range and high bandwidth applications. Therefore, the realization of UWB antennas in printed-circuit technologies within relatively small substrate areas is of primary importance. And a number of such antennas with either 2 micro strip or coplanar waveguide feeds, and in combined technologies have been presented recently, mostly for the 3.1 - 10.6 GHz band, but also for higher frequency ranges, and lower frequency ranges.

FUNDAMENTALS OF ULTRA-WIDEBAND TECHNOLOGY

Consider the term "ultra-wideband" (UWB) as a relatively new term to describe a technology, which had been known since the early 1960's. The old definition was referring to "carrier-free", "baseband", or "impulse" technology. The fundamental concept is to develop, transmit and receive an extremely short duration burst of radio frequency (RF) energy, like a short pulse. The pulse typically has duration of a few tens of picoseconds to a few nanoseconds. These pulses represent one to only a few cycles of an RF carrier wave; therefore, as for resultant waveforms, extremely broadband signals can be achieved. Often it is difficult to determine the actual RF center frequency for an extremely short pulse; thus, the term "carrier-free" comes in. The amount of power transmitted is a few milli-watts, which, when coupled with the spectral spread, produces very low spectral power densities. The Federal Communication Commission (FCC) specifies that between 3.1 and 10.6 GHz, the emission limits should be less than -41.3 dBm/MHz, or 75 nW/MHz. The total power between these limits is a mere 0.5 mW. These spectral power densities reside well below a receiver noise level. Typical UWB signals, which cover significant frequency spectra, are presented in.

Advantages of UWB technology are listed as:

1) UWB waveforms have large bandwidths due to their short time pulse duration. For example, as in communication technology, like in multi-user network applications, extremely high data rate performance can be provided by UWB pulses. As for radar applications, very fine range resolution and precision distance and/or positioning measurement capabilities can be achieved by those same pulses.
2) Short duration waveforms have relatively good immunity to multi-path cancellation effects as observed in mobile and in-building environments. Multi-path cancellation is the effect happening when a strong reflected wave (e.g., off of a wall, ceiling, vehicle, or building, etc.) cancels the direct path signal. The reflected wave arrives partially or totally out of phase with respect to the direct path signal, thus causing a reduced amplitude response in the receiver. Due to the very short pulse property of the UWB signal, no cancellation will occur because the direct path signal has passed before the reflected path signal arrives. Therefore, high-speed, mobile wireless applications are particularly well suited for UWB system implementation.
3) Extremely short pulse duration in the time domain is equivalent to extremely large bandwidth in the frequency domain. Due to the large bandwidth, energy densities (i.e., transmitted Watts of power per Hertz of bandwidth) can be quite low. This low energy density can be translated into a low probability of detection (LPD) RF signature. An LPD signature is particularly useful for military applications (e.g., for covert communications and radar). Also, a LPD signature generates minimal interference to proximity systems and minimal RF health hazards. The UWB

signal is noise-like due to its low energy density and the pseudo-random (PR) characteristics of the transmitted signal. This feature might enable the UWB system to avoid interference to existing radio systems, one of the most important topics in UWB research. Those characteristics are very significant for both military and commercial applications.

4) Low system complexity and low cost are the most important advantages of UWB technology. Those advantages arise from the essentially baseband nature of the signal transmission. Compared with conventional radio systems, short time domain pulses are able to propagate without the need for an additional RF mixing stage, which means less complexity in the system design. Also, UWB systems can be made nearly "all-digital", with minimal RF or microwave electronics, thus, low cost.

Engineering is all about tradeoffs; no single technology is good for everything. There are always solutions that may be better suited to some applications than others. For example, in point-to-point or point-to-multipoint applications with extremely high data rate (10 Gigabits/second and higher) applications, UWB systems cannot compete with high capacity optical fiber or optical wireless communications systems. However, the high cost associated with optical fiber installation and the property of an optical wireless signal not able to penetrate a wall limit the applicability of optically based systems for in-home or in-building applications. Also, optical wireless systems will need an extremely precise pointing alignment, which make optical wireless systems not suitable for mobile environments. The dispersive Light-Emitting-Diode (LED) optical wireless communication systems will not need the extremely precise pointing alignment; thus, in-room high-data-rate based systems are achievable, but not in mobile environments.

ANTENNA PARAMETERS

There are different parameters of antenna which are utilized to examine the efficient functioning of the antenna. The following are the few antenna parameters:

Return Loss

It is the power loss in the signal that is reflected due to discontinuity in the transmission line. As we already know, when impedance matching between the transmitter and antenna is not perfect, the radiations within the substrate results into the standing waves. As a result the return loss is the criteria similar to VSWR that indicates the perfect impedance matching between the transmitter and the antenna. The return loss is formulated as

$$RL = -20 \log_{10} (Pi/Pr) \qquad (3.1)$$

Where Pi =Incident power
Pr= Reflected power

Smith Chart

It was created by Phillip H. Smith and is a wonderful tool for viewing the impedance of the transmission line and antenna working as a function of frequency. They are exceptionally advantageous for impedance matching. The complex reflection coefficient denoted by Ѓ for the load impedance ZL attached to the transmission line with characteristic impedance Z0 is represented by:

$$Ѓ= (ZL- Z0) / (ZL+Z0) \qquad (3.2)$$

We represent all the values of Ѓ on the real and imaginary axis. The center point denotes the point where the reflection coefficient is zero.

Voltage Standing Wave Ratio (VSWR)

It states that how well the matching takes place between antenna and transmission line and the receiver which illustrates the maximum energy transfer. Imperfect impedance matching results into reflected back waves approaching the transmitter. The interplay between the reflected waves and the forward waves results into standing waves.

$$VSWR= (1+ Ѓ) / (1- Ѓ) \qquad (3.3)$$

Where Ѓ =Reflection coefficient
Ideally, VSWR =1 is perfectly matched, that is no power is reflected back.

Directivity

The measure of directionality of an antennas radiation pattern is known as directivity. An antenna which radiates evenly in every direction has directivity equal to 1 or 0 dB. It is also defined as the radiation intensity in a given direction from the antenna divided by the radiation intensity averaged over every direction. Analytically, it is represented as –

$$D = U / U_0 = 4\Pi U / P_{rad} \qquad (3.4)$$

U = radiation intensity (power density per unit solid angle)
U0 = radiation intensity of isotropic source (power density per unit solid angle)
P_{rad} = total radiated power (W)

Gain

It is relative measure of an antennas ability to direct RF energy in particular direction. It is defined as how much power is transmitted in the direction of peak radiation to that of an isotropic source. Mathematically it is be represented as

$$Gain = 4\Pi U/Pin \qquad (3.5)$$

U = radiation intensity
Pin = total input power

LITERATURE SURVEY

Philip Cherian, Mythili P., "Bandwidth Optimization of a Coplanar UWB Patch Antenna", 2013

Summary- A coplanar waveguide fed ultra-wideband patch antenna with symmetrically positioned slots in the modified ground plane which can adjust the useful bandwidth is proposed in this paper. The antenna occupies an area 37.5mm x 27 mm on FR4 substrate. The analysis and simulation of the geometry has been done in FEM based High Frequency Structure Simulator (HFSS). The 10-dB return loss bandwidth of the antenna without slots spans from 2.96 GHz. to 7.96 GHz and 8.6 GHz to 11.15 GHz, whereas with a single pair of slots in the ground plane from about 2.8 GHz to 19 GHz. The bandwidth of the antenna can be adjusted by positioning a second pair of slots as per user requirements keeping the first pair of slots at the same position. It can be seen that when a second pair of slot is introduced in the ground plane at a particular position, the return loss bandwidth extends from 3GHz to 10.8GHz yielding ultra-wide band. The position of the slots has been optimized through parametric analysis. The experimental results are in good agreement with the calculated values from simulation. [1]

A coplanar UWB patch antenna whose bandwidth can be increased by placing a pair of slots on the feed gap between the ground plane and the patch which can be further controlled by a second pair of slots on the feed gap between the ground plane and the first pair of slots have been proposed. The bandwidth of the proposed antenna can be precisely tailor made to suit the requirements of the designer. Here the antenna bandwidth is exactly made to UWB i.e., from3 GHz to 10.8 GHz. The antenna performs well in this band.

J. Liang, L. Guo, C.C. Chiau, X. Chen, and C.G. Parini, "Study of CPW-fed circular disc monopole antenna for ultra-wideband applications", 2005

Summary- The paper presents a study of coplanar waveguide (CPW) fed circular disc monopole antenna for ultra-wideband (UWB) applications. A circular disc monopole printed on a dielectric substrate and fed by a 50Ω CPW on the same layer can yield an ultra-wide -10dB return loss bandwidth with satisfactory radiation patterns. The performance and characteristics of the antenna are investigated in order to understand its operation. Good agreement has been obtained between the simulation and experiment. [2]

This paper has provided further insights into the operation of the CPW-fed circular disc monopole antenna. It has been shown that the feed gap h, the width of the ground plane W, and the dimension of the CPW-fed circular disc monopole antenna are the most important parameters that determine the performance of the antenna. The ground plane, serving as an impedance matching circuit, tunes the input impedance and hence the operating bandwidth by changing h and W. The first resonant frequency is determined directly by the dimension of the circular disc because the current is distributed mainly along the edge of the disc. The overlapping of multiple resonant harmonics leads to the UWB characteristic. Both simulation and measurement have demonstrated that the CPW-fed circular disc monopole can achieve an ultra-wide bandwidth, covering the FCC defined UWB frequency band. It is also observed that the radiation patterns are nearly omni-directional over the entire operating bandwidth. The results have proved that this antenna is very suitable for future UWB applications. [2]

R. Chair, A. A. Kishk, K.F. Lee, "Ultrawide-band Coplanar Waveguide-Fed Rectangular Slot Antenna", 2004

Summary- An ultrawide-band coplanar waveguide (CPW) fed slot antenna is presented. A rectangular slot antenna is excited by a 50- CPW with a U-shaped tuning stub. The impedance bandwidth, from both measurement and simulation, is about 110% (S11 10 dB). The antenna radiates bi-directionally. The radiation patterns obtained from simulations are found to be stable across the matching band and experimental verification is provided at the high end of the band.

A new ultrawide-band coplanar waveguide fed rectangular slot antenna on a thin substrate was presented. The wide-bandwidth of 110% was achieved by using a U-shaped tuning stub. Results obtained from the numerical simulation showed that the antenna had stable bidirectional radiation patterns across the operating band. The radiation patterns were experimentally verified at the upper end of the band.[3]

C. Zhang and A.E. Fathy, "Development of an ultra-wideband elliptical disc planar monopole antenna with improved omni-directional performance using a modified ground", 2006

Summary- A planar monopole antenna has many attractive features such as a simple structure, exhibition of ultra-wideband characteristics, and a near omni-directional radiation pattern. However, the ability to sustain an omni-directional pattern over ultra-wide band has not been adequately addressed in the literature up until now. The use of a modified ground plane can aid in providing such a feature. [4]

A novel elliptical disc monopole antenna with a modified ground has been developed. Good agreement between simulated and measured results has been achieved. The antenna shows an excellent omni-directional radiation pattern, as well as satisfactory input impedance match over an ultra-wide bandwidth (almost 3:1 bandwidth). In addition, time domain impulse response experiments have demonstrated that the proposed UWB monopole introduces minimal pulse distortion.[4]

E. Antonino-Daviu, M. Cabedo-Fabre´s, M. Ferrando-Bataller, and A., Valero-Nogueira, "Wideband double-fed planar monopole antennas", 2003

Summary- Planar monopole antennas with multiple feed points are proposed to improve pattern and impedance bandwidth. A square planar monopole antenna including two feed points and a bevelled variant are designed. These antennas exhibit an excellent performance compared to existing planar monopoles. [5]

A new feed configuration for the square planar monopole antenna has been presented. Electromagnetic simulations have been carried out for a square planar monopole antenna with a double feed and for its bevelled variant. Enhanced impedance bandwidth with respect to a square monopole antenna with a single feed has been obtained and better cross-polarisation levels within the impedance bandwidth have been achieved with respect to the CM. [5]

M.A. Habib, M.Nedil, A. Djaiz, T. A. Denidni," UWB binomial curved monopole with binomial curved ground plane", 2009

Summary- The design of a new ultra-wideband (UWB) coplanar waveguide antenna is presented. The proposed antenna is a printed circuit monopole using coplanar technology. The radiating element is a modified monopole with an optimal shape based on a binomial function. The ground plane is also designed with the same law. Different orders of this binomial function are considered. The antenna shape and dimensions are optimized to achieve an UWB bandwidth operation covering the frequency range from 3.1 to 10.6 GHz. A prototype of the designed antenna was fabricated and measured. Obtained results show that the proposed antenna provides omnidirectional elevation pattern across the operating band. Results provided by simulations and measurements are presented and discussed; they show a good agreement.[6]

In this article, an UWB antenna has been designed. This monopole-shape antenna uses a third-order binomial law curve for both the monopole branch and the modified ground plane. The antenna has a small size (40 × 30 mm2) with a dipole-like radiation pattern for azimuth plane. For elevation plane, the

antenna behaves like a dipole at 4 GHz. The monopole and the ground planes act similarly to the branches of this new dipole-like structure. Besides that, at 7 GHz, the current distribution resonates with the monopole edge and hence the structure behaves like a classical monopole. The antenna bandwidth meets UWB requirements. [6]

CONCLUSION

A theoretical survey on UWB antennas is presented in this paper. After study of various research papers it concluded that Lower gain and low power handling capacity can be overcome through an array configuration and slotted patch. Some characteristics of feeding technique and various antenna parameters are discussed. Particular rectangular shaped antenna can be designed for each application and different merits are compared with conventional microwave antenna.

Also shows the different antenna of UWB range with different shapes. I conclude them in this survey paper. In future continue this work with design a new rectangular ring shaped with cuts and slots. Also improve the gain, bandwidth and other properties.

REFERENCES

1) Philip Cherian,Mythili P., “Bandwidth Optimization of a Coplanar UWB Patch Antenna”, IEEE, 2013.
2) J. Liang, L. Guo, C.C. Chiau, X. Chen, and C.G. Parini, "Study ofCPW-fed circular disc monopole antenna for ultra-widebandapplications, IEEE Proc Microwave Antennas and Propagation 152(2005), 520–526.
3) R. Chair, A. A. Kishk, K.F. Lee, “Ultra-wide-band Coplanar Waveguide-Fed Rectangular Slot Antenna”, IEEE Antennas and Wirelesspropagation Letters, Vol. 3, 2004, pp. 227- 229.
4) C. Zhang and A.E. Fathy, "Development of an ultra-widebandelliptical disc planar monopole antenna with improved omni-directionalperformance using a modified ground", IEEE Int Antennas PropagSympDig,Alburqueque, NM, (2006), 1689–1692.
5) E. Antonino-Daviu, M. Cabedo-Fabre´s, M. Ferrando-Bataller, andA., Valero-Nogueira, "Wideband double-fed planar monopoleantennas, Electron Lett 39 (2003), 1635–1636.
6) M.A. Habib, M.Nedil, A. Djaiz, T. A. Denidni,” UWB binomial curvedmonopole with binomial curved ground plane”, Microwave and OpticalTechnology Letters,Vol. 51, Issue 10, Pages 2308-2313, October 2009.