A Review Study on Dual Band Notched Antenna for UWB Applications

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Abstract: **Ultra-wideband applications have grabbed much attention in the field of antenna because of it's extremely wideband for high data rate applications. Since UWB antennas may transmit baseband signal without a carrier, the RF front end can be simplified and become inexpensive**

Keywords: **UWB, Dual Band Notched Antenna, Multi Band Antenna, Bandwidth Enhancement.**

I. INTRODUCTION

Ultra-wideband (UWB) signals are commonly defined as signals that have a large bandwidth (bandwidth divided by the carrier frequency) or a large absolute bandwidth. The use of large transmission bandwidth offers a number of benefits, including accurate ranging, robustness to propagation fading, superior obstacle penetration, resistance to jamming, interference rejection and coexistence with narrow bandwidth systems. On the other hand generating, receiving and processing UWB signals poses significant challenges that require new research in signal generation, transmission, propagation, processing and system engineering [1].

The first UWB signals were generated in experiments by Hertz in 1887, in which he generated sparks and radiated them via wide-band loaded dipoles. As time went on, emphasis of communication systems shifted to narrow band carrier-based (tuned) systems, which were easier to multiplex with the technology available at that time. It was only in 1990's that the improvements in digital signal, processing, invention and investigation of time hopping (TH) impulse radio revived interest [2],[3]. This interest was greatly magnified by the decision of the U.S.frequency regulator, the Federal communications commission's, to make the frequency band between 3.1 to 10.6 GHz available for unlicensed operation of UWB devices, subject to certain restrictions on the spectral emission mask. The initial applications of UWB technology were primarily radar related, driven by the promise of fine range resolution that comes with large bandwidth [4].

II. ANTENNA DESIGN FOR UWB SYSTEM

Some of the desirable antenna characteristics for UWB radio systems are as follows:

(i) Wide impedance bandwidth

(ii) Fixed –phase centre over frequency

(iii)High radiation efficiency

Good impedance matching over the operating frequency band is desired to minimize reflection loss and to avoid pulse distortion. If the phase centre (the point where spherical wave radiation effectively originates) of an antenna moves with frequency (as in the case with spiral, log periodic and travelling wave antennas) pulse dispersion will occur [5]. At the time of designing a care should be taken to choose impedance parameters. These impedance parameters are mainly the width of feeding line, substrate, distance between this feeding line and ground plane. Dimensions of radiating patch are responsible for working frequency of antenna. A notch in operating frequency can be introduce by cutting the slot in radiating patch or in ground or in feeding line or any combination of these. VSWR, Bandwidth, Gain, Efficiency, Omni-directional pattern and good impedance matching are some of the parameters that should be considerable on the time of designing the antenna.

III. DESIGN SPECIFICATION

The transmission line model was used to design the antenna. The procedure is as follows [6]:

Step 1: Estimation of the Width (W**):** Its width is obtained by equation (1.1) as:

$$W = \frac{c}{2f_r}\left(\frac{\varepsilon_r+1}{2}\right)^{-0.5} \tag{1.1}$$

Where c is speed of light.

ε_r is dielectric constant of substrate.

f_r is resonance frequency.

Step 2: Effective dielectric constant ($\mathcal{E}_{eff}$**): Computation** Equation (1.2) gives the effective dielectric constant as:

$$\mathscr{E}_{\mathrm{eff}} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left(1+\frac{12h}{W}\right)^{-0.5} \qquad (1.2)$$

Where h is thickness of substrate.

Step 3: Length extension (Δl) Estimation: Equation (1.3) gives the length extension as:

$$\Delta l = 0.412h\left(\frac{0.262+(W/h)}{0.813+(W/h)}\right)\left(\frac{\mathscr{E}_{\mathrm{eff}}+0.3}{\mathscr{E}_{\mathrm{eff}}-0.258}\right) \qquad (1.3)$$

Step 4: Actual length Estimation of patch (L): The actual length is given by rewriting equation (1.4) as:

$$L = \frac{c}{2f_r\sqrt{\mathscr{E}_{\mathrm{eff}}}} - 2\Delta l \qquad (1.4)$$

Step 5: Calculation of 50 Ω feed lines: For given characteristic impedance Z_0 and dielectric constant (ε_r) the W/d ratio can be found as:

$$\frac{W}{d} = \left[\frac{8e^A}{e^{2A}-2}\right] for\ W/d < 2 \qquad (1.5)$$

$$\frac{W}{d} = \left(\frac{2}{\Pi}\right)\Bigg[B - 1 - \ln(2B-1) + \Bigg\{\left(\frac{\varepsilon_r-1}{2\varepsilon_r}\right)\Bigg(\ln(B-1) + 0.39 - 0.61\varepsilon r \qquad (1.6)$$

$$for\ W/d > 2$$

Where

$$A = \left(\frac{Z_0}{60}\right)\left[\left(\frac{\sqrt{\varepsilon_r+1}}{2}\right) + \left(\frac{\varepsilon_r+1}{\varepsilon_r-1}\right)\left\{0.23 + \left(\frac{0.11}{\varepsilon_r}\right)\right\}\right] \qquad (1.7)$$

$$B = \left[\frac{377\Pi}{2Z_0\sqrt{\varepsilon_r}}\right] \qquad (1.8)$$

$$\varepsilon_{re} = \left[\frac{\varepsilon_r+1}{2}\right] + \left[\left(\frac{\varepsilon_r-1}{2}\right)\left(\frac{1}{\sqrt{1+\frac{12h}{W}}}\right)\right] \qquad (1.9)$$

$$\lambda_g = \frac{\lambda_0}{\sqrt{\varepsilon_{re}}} \quad \text{and} \quad L = \frac{\lambda_g}{4} \qquad (1.10)$$

IV. LITERATURE REVIEW

As we know that the several design methods and structures have been reported, some of them are as follows:

1. M. Ojaroudi, G. Ghanbari, N. Ojaroudi, and C. Ghobadi. Proposed an antenna consists of a stepped square radiating patch with two U-shaped slots and a notched ground plane with a T-shaped sleeve that provides a wide usable fractional bandwidth of more than 140% (2.85–16.73 GHz)[7].
2. M. Abdollahvand, G. Dadashzadeh, and D. Mostafa. Proposed the antenna by inserting two I-shaped notches in both sides of the micro strip feed line on the ground plane, additional resonances is excited, and hence the bandwidth is increased up to 123% [8].
3. M. Mehranpour, J. Nourinia, Ch. Ghobadi, and M. Ojaroudi. Proposed the antenna consists of a square radiating patch with a pair of L-shaped slits, and an E-shaped slot and a ground plane with a V-shaped protruded strip, which provides a wide usable fractional bandwidth of more than 140% (2.89–17.83 GHz) [9].
4. M. Rostamzadeh, S. Mohamadi, J. Nourinia, Ch. Ghobadi, and M. Ojaroudi. Proposed the antenna is designed to cover the bandwidth for UWB applications (3.1–10.6 GHz) with a VSWR lower than 2 and provide sufficient rejection band notches for WiMAX (3.3–3.88 GHz), WLAN (4.96–6.23 GHz), and ITU (7.9–8.7 GHz) [10].
5. Syed Muzahir Abbas, YogeshRanga, Anand K. Verma, and Karu P. Esselle.Proposed a compact ultra wideband antenna with strong notch-band rejections up to VSWR=26 that is tunable over a wide frequency range from 3.55 GHz to 6.8 GHz, is presented. It has wide radiation patterns and yields a measured 10 dB return-loss bandwidth from 3 GHz to 10.5 GHz [11].
6. Trang Dang Nguyen, Dong Hyun Lee, and Hyun Chang Park. Proposed a micro strip fed monopole ultra wideband antenna with triple notched band is presented. In this three notched band has been generated. The first notched band is in the range of 3.3-3.7Ghz which is for the radiating patch etched to the open ended quarter wavelength slot. The second and third wavelength is in the range of 5.15-5.825 for WLAN and 7.25-7.75GHZ for downlink of X-band satellite communication [12].
7. James R. Kelly, Peter S. Hall, and Peter Gardner. Proposed to prevent the Ultra wideband from sensitive components it is necessary to attach the notch band filter in the front end rear of the receiver. In these a new method has been adopted to present the notch band in the UWB within the frequency range i.e. resonator is placed in back of the substrate [13].
8. Symeon Nikolaou,Marijia Nikoliu,Photos Vryonides. Proposed triple notches characteristics have been designed for the micro strip fed UWB monopole antenna. These three notches will occur at WIMAX frequency range, the WLAN frequency range and higher end of the UWB range. Each notch can be adjusted without disturbing the position of the other

two. In this three resonator is used namely 3/4 open stubs, CLL and 3/4 parasitic linear segment [14].

9. Chia-Ching Lin, Peng Jin,Richard W. Ziolkowski. Proposed monopole antenna is designed which have a tri-band notched characteristics. Two compact, printed monopole antennas is used. To achieve the notched filters CLL resonators is used .Three CLL elements must be added which is close to the feed line. By these band notch characteristics is achieved in WIMAX (3.3-3.6GHz), Lower WLAN (5.15-5.35 GHz), Higher WLAN (5.725-5.825 GHz).Simulation and measurements results shows that UWB have broadband impedance and stable radiating patterns [15].
10. A. Nouri and G. R. Dadashzadeh. Proposed a novel band-notched ultra wideband (UWB) monopole antenna is proposed which has high notch band edge selectivity. These antennas consist of radiation patch and embedded second –order band stop filter. These band stop filter consists of a non uniform short circuited stub as well as coupled open/short circuited stub resonators. The proposed antenna with second orders maximally band stop filter is designed at 5.5GHz [16].
11. Chao-Tang Chuang, Ting-Ju Lin, and Shyh-Jong Chung Proposed a new compact antenna is design which has a broad bandwidth and quad sense circular polarization. The first properties are based on the compact monopole structure. Quad sense CP wave is obtained by cutting the ground plane with a T-shaped slit and annular patch etched by an X shaped slit. Results show it has a impedance of 3.1- 22.2 GHz and 150% broad bandwidth [17].
12. Guihong Li, Huiqing Zhai, Tong Li, Long Li, and Changhong Liang Proposed the antenna diamond shaped patch is presented. In these it has been shown that by removing the centre part of the DSP antenna without disturbing the behavior of UWB we will add ¼ wavelength strip to the notch region. Result specifies that antenna is omnidirectional and radiation pattern is stable. Especially prototype quad band antenna is fabricated. Result of both i.e. fabricated as well as simulated is compared [18]

V. CONCLUSION

In this paper, we have received multiple types of UWB antennas and also observed various techniques for designing band notch. We have also observed the applications of the UWB and the various parameters that are used in the designing of antennas

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