EFFICIENT NOISE REDUCTION BASED U_SLOT MICROSTRIP ANTENNA DESIGN

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Abstract

Wireless networks has witnessed rapid growth in line with wide band communication systems, in which the polarized patch antenna plays a vital role. The multi band operations are performed generally using CPW – fed dual folded symmetry planar antenna. Such antennas cover the bands of GSM and ISM networks. The CPW – fed dual folded symmetry planar antenna require high bandwidth and results in low gain. It has a complex design and fabrication process. In order to reduce the bandwidth consumption and produce high gain U-slot and square patch antenna designs are proposed in this paper. It results in simple design with cost effective process. The resonant frequency level of the antenna is improved based on Gaussian Process Regression. The proposed method analyses the reflection radiation pattern and removes the noise radiation in the antenna patch design. The designed antenna is applied in the WiMax communication system.

Index Terms: *Antenna, U-slot patch design, square patch design, WiMax.*

Introduction

LAN technology, developed primarily is to increase wired networks to permit, roaming network nodes for mobile computers inside a building. Typically a wireless local area network association can use spread-spectrum modulation over a a pair of.4 GHz RF carrier, with a raw over-air data rate of 1–2 Mbits/s. Spread-spectrum modulation is a technique that, as the name implies, disperses the modulated signal over a much wider RF band-width than the conventional modulation techniques. Spread-spectrum modulation is especially acceptable for a traditional WLAN setting as a result of it helps over-come issues that may usually be related to multiple transceivers sharing identical RF spectrum, and with high levels of multi-path interference. Spread-spectrum modulation also confers a high degree of noise immunity, including immunity to accidental or deliberate interference. There are two variants of spread-spectrum modulation in common use. Frequency hopping (FH) spreads the spectrum by apace change the carrier frequency [1]. The additional subtle direct sequence (DS) technique achieves identical impact by multiplying the message information with a pseudo-random bit sequence (PRBS). Both variants have the same overall characteristics outlined here, but DS typically will allow a higher over-air data rate than FH. Because of their supposed application with moveable or notebook computers, manufacturers have produced remark-ably compact wireless network interface hardware [2]. Typically these employ the Personal Computer Memory Card International Association (PCMCIA) interface [3], which is a actual standard in portable computers, and usually have a two-part construction consisting of a PCMCIA card with a separate similarly sized wireless transceiver. Two additional implementations are available: an ISA-bus plug-in card for desktop computers, and a stand-alone wireless to wired network bridge, sometimes known as an Access Point.

It is the PCMCIA wireless network interface that's of explicit interest here, since its compact size makes it ideal for integration into an embedded micro-controller suitable for mobile robotics applications[. Although wireless devices for interconnecting computers and their peripherals square measure accessible for some years, it is only recently that the adoption of agreed standards by manufacturers has meant that the wireless LAN can be regarded as a generic system level component interchange-able with the wired LAN network interface card (NIC). Fig 1 shows the antenna architecture of a WiMax communication.

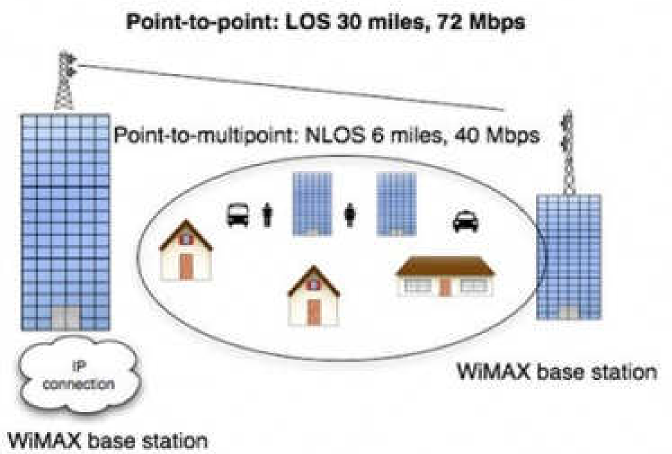

Fig.1: Antenna architecture of a WiMax communication

Two standards in particular have brought this about: the IEEE standard 802.11-1997 and the European Telecommunications Standards Institute (ETSI) spectrum allocationRES.2.The IEEE 802.11 standard specifies the media access control (MAC) protocol, which forms the lower half of layer 2 of the open systems interconnect (OSI) 7-layernetwork reference model, and also the physical layer (PHY) specification for layer 1. Within the physical layer specification of IEEE 802.11 there are standards covering the use of either infrared optical communications or spread-spectrum radio. The spread-spectrum radio normal successively covers each FH and DS variants. Wireless LANs have a great deal of applications. Modern implementations of WLANs vary from little in-home networks to giant, campus-sized ones to utterly mobile networks on airplanes and trains. Users will access the web from WLAN hotspots in restaurants, hotels, and currently with moveable devices that hook up with 3G or 4G networks. Oftentimes these forms of public access points need no registration or secret to hitch the network. Others may be accessed once registration has occurred [4].

The existing method is to design the CPW-fed dual folded symmetry planar antenna. This antenna used to the multi band operation and this design consists symmetry radiation patch, dual rectangular ground plane. The existing design patch can increase the current path length and get lower resonance frequency also. The existing design covers GSM and ISM bands. A existing CPW-fed patch antenna designed by simply embedding two types of shaped slots into a rectangular patch for achieving WLAN and C-band (4–8 GHz) satellite operations. In order to achieve the broadband performance of the micro strip antenna, some scholars have proposed a variety of antenna structures, such as U-slot patch antenna bow-shaped antenna, monopole antenna [5]. Traditional Ultra-wideband (UWB) antennas are unable to mix with the fashionable integrated system for his or her complicated structures and enormous volumes, miniaturized ultra-wideband printed antennas being good candidates for their low profile. Recently CPW-fed written antennas have received considerable attention because of their at- rubbing deserves, such as ultra-wide frequency band, good radiation properties and easy integration with system circuits. The design of antenna used the symmetrical structure of two-dimensional wave guide information measure up from three.5 to 11.0 GHz (VSWR < 2), but these antennas are large in size. The divergent patch typically used unit of space of normal form, like rectangular, circular or circular ring sheet micro-strip patch [6]. With the same working frequency, the rectangular patch is available to slight higher efficiency, gain and wider bandwidth than the circular patch.

In this paper, the drawbacks of the existing antenna designs are resolved by the U-slot and square patch antenna design. It reduces the bandwidth requirement thereby increasing the gain on the network. The fabrication and design process is more effective and provides a cost effective procedure.

The paper is organized as follows: Section II reviews the different types of antenna designs. Section III explains the proposed U-Slot and square patch design. Section IV evaluates the performance of the proposed system. Section V concludes the work with a highlight of the extension work.

Related Art

This section reviews various antenna designs used in communication system. The ultra-wide band (UWB) radio systems will become one of the most important communication systems in the future since the demanding of the high data rate between the base station/mobile station and the mobile stations. In this letter, an UWB annual ring antenna fed by a microstrip line is proposed. Traditional ring antennas have a quite narrow bandwidth. This performance satisfies the requirement of the UWB antenna. It is noted that without the metal plane B, the bandwidth will reduce to 6.9 GHz. Parameters determining the antenna characteristics are studied. The metal plane behaves as a parasitic resonator to increase the bandwidth. Another parameter affecting the bandwidth is the inner radius of the ring when the outer radius is fixed for simplifying the design. As the inner radius increased, the return loss becomes smaller and hence the bandwidth decreases gradually. Here, the best inner radius of 3.5 mm has been used. The feed-line affects the return loss much and a finite metal plane is added to improve the bandwidth [7].

An electromagnetic coupled balun from microstrip to CPS is used for higher-frequency application. The back-to-back balun has a measured return loss of better than 10 dB and an insertion loss of less than 3 dB from 4.4 to 12 GHz. The polarization of the antenna is controlled by the arm length. For very low frequency, as the arm length is small compared to the wavelength, the antenna is linearly polarized but the size of antenna is large [8].

Circular polarization (CP) operations are often earned employing a lightening-shaped feedline protruded from the signal line of the feeding planar wave guide (CPW).For the purpose of more flexibly deploying a transmitter and a receiver without causing a severe polarization mismatch between them, circular polarization (CP) is getting more and more popular in wireless communications. The high data-rate capability needs to be supported by antennas having an oversized in operation information measure. In view of those views, the need for broadband CP antennas is inevitable. A CPW-fed square slot antenna has been proposed for CP operations. The lightening-shaped feedline protruded from the CPW and the pair of inverted-L grounded strips both contribute to generation of CP radiation. The vertical and horizontal calibration stubs have effectively widened the resistance band with the exception of slightly broadening the 3-dB AR band [9].

Koch fractal antenna has been projected for ultra-wideband applications. The iteration of Koch form antenna helps to attain wide ohmic resistance information measure. It is determined from antenna performance that the projected antenna achieved a ultra-wideband starting from three. 52-10.24 rate with the information measure is half-dozen.72 GHz. As the result, there is 54.15% increment of bandwidth after doing first iteration of proposed antenna. For second iteration, the bandwidth performs 69.5% increased. It is shown that the antenna with higher iterations exhibits higher information measure. This antenna can be applied for many applications such as wireless communication. [10][11]

A new tapered CPW-fed isosceles trapezoid disk printed mono- pole UWB antenna is proposed. A prototype antenna was fabricated and measured. It demonstrates that the com- pact design can achieve an ultra-wide bandwidth, the operation bandwidth being 2.7 - 9.3 GHz, covering WLAN operating band, with satisfactory radiation pat- terns and 9.6 dB peak gain [12][13]. Coplanar waveguide feed structure consists of the feed-forward signal band and the feed forward signal with both sides of the slit. The magnitude of antenna was 40.0 mm × 50.0 mm × 1.6 mm, of which the material was FR4 with relative permittivity of 4.4. The final design achieves CP with 50% AR bandwidth. The proposed circularly polarized DRA (CPDRA) with good radiation characteristics offers an impedance bandwidth of 58% between 3.45 and 6.26 GHz for VSWR ≤ 2. The proposed DRA is fabricated and tested. Very good agreement between simulated and measured results is obtained new configuration of wideband circularly polarized DRA with a single feed is presented. By choosing the C-shaped resonator fed by a simple stripe line connected to the CPW feed-line, 19% AR bandwidth is achieved. For further improvement of CP bandwidth, a narrow short grounded strip is introduced and connected to the ground plane in the right hand side of the dielectric resonator.

Proposed System

This section briefly explains about the proposed U-slot and square plot antenna design. Using a split-ring slot implanted in the square patch and a U-shaped slot etched partial ground plane, three resonant modes with excellent impedance performance are achieved. The simple structure makes this antenna suitable for practical wireless communication systems, working on WLAN and WiMAX networks. The proposed patch designs are shown in Fig 2. The proposed system consists of three modules such as

- Patch design
- Analysis setup
- Performance Evaluation

WiMAX is brief for Worldwide ability for Microwave Access. It is a metropolitan wireless normal created by the businesses Intel and Alvarion in 2002 and sanctioned by the IEEE (Institute of Electrical and natural philosophy Engineers) underneath the name IEEE-802.16.

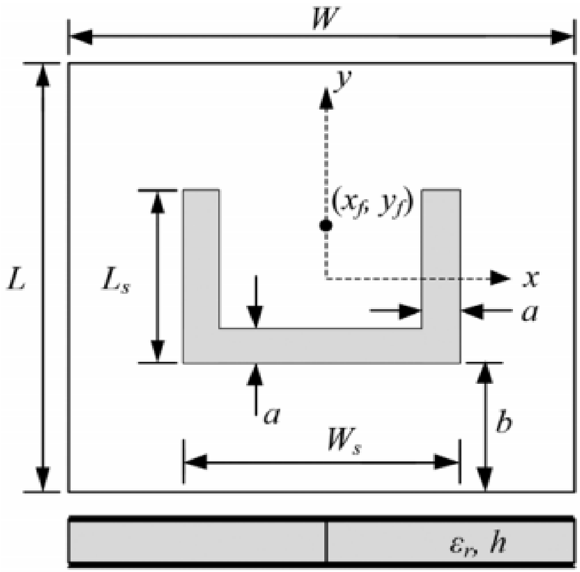

Fig.2: U-slot patch design

More specifically, WiMAX is the commercial designation that the WiMAX Forum gives to devices which conform to the IEEE 802.16 standard, in order to ensure a high level of interoperability among them. The goal of WiMAX is to supply high-speed net access in an exceedingly coverage vary many kilometres in radius. In theory, WiMAX provides for speeds around 70 Mbps with a range of 50 kilometres. The WiMAX normal has the advantage of permitting wireless connections between a base transceiver station (BTS) and thousands of subscribers while not requiring that they be in an exceedingly direct line of sight (LOS) with that station. This technology is called NLOS for non-line-of-sight.

In reality, WiMAX will solely bypass little obstructions like trees or a house and can't cross hills or giant buildings. When obstructions area unit, actual throughput might be under 20 Mbps. At the center of WiMAX technology is that the base transceiver station, a central antenna which communicates with subscribers' antennas. The term point-multipoint link is employed for WiMAX's methodology of communication. The revisions of the IEEE 802.16 standard fall into two categories: Fixed WiMAX, also called IEEE 802.16-2004, provides for a fixed-line connection with an antenna mounted on a rooftop, like a TV antenna. Fixed WiMAX operates in the 2.5 GHz and 3.5 GHz frequency bands, which require a licence, as well as the licence-free 5.8 GHz band. Mobile WiMAX, also called IEEE 802.16e, allows mobile client machines to be connected to the Internet. Mobile WiMAX opens the doors to movable use over information science, and even high-speed mobile services.

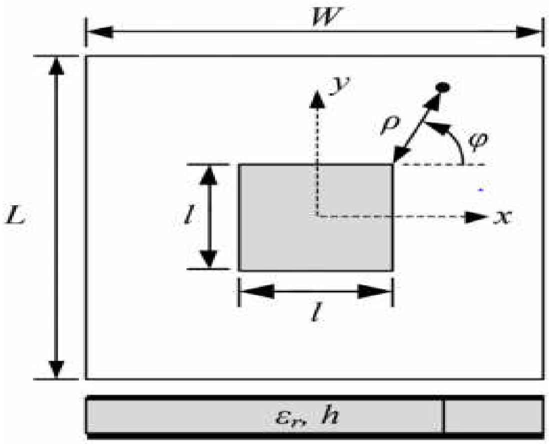

Fig.3: Square patch design

One of WiMAX's potential uses is to cover the alleged "last mile" area, meaning providing high-speed Internet access to areas which normal wired technologies do not cover such as line, cable, or dedicated T1 lines. Another risk involves exploitation WiMAX as a backhaul between 2 native wireless networks, such as those using the Wi-Fi standard. WiMAX can ultimately alter 2 completely different hotspots to be joined to form a mesh network. The design of a simple small-size multi-band antenna for wireless local area net-work (WLAN) and worldwide interoperability for microwave access (WiMAX) application is presented in this paper. The antenna covers the two.4/5.2/5.8-GHz wireless local area network operative bands and also the a pair of.5/3.5/5.5-GHz WiMAX bands.

Performance Evaluation

The performance of the proposed design is evaluated by plotting the radiation pattern generated by the design in the form of a polar graph. The loss and gain of the antenna design is computed using the following antenna calculations. The ANSYS HFSS software is the industry-standard simulation tool for 3-D full-wave electromagnetic field simulation and is essential for the design of high-frequency and high-speed component design. HFSS offers multiple state-of the-art solver technologies based on either the proven finite element method or the well established integral equation method.

The steps for antenna calculation along with the equations are given in this section.

Step 1: Calculation of the Width (W)

$$W = \frac{c}{2f_o\sqrt{\frac{(\varepsilon_r + 1)}{2}}}$$

Step 2: Calculation of the Effective Dielectric Constant. This is based on the height, dielectric constant of the dielectric and the calculated width of the patch antenna.

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}}$$

Step 3: Calculation of the Effective length

$$L_{eff} = \frac{c}{2f_o\sqrt{\varepsilon_{eff}}}$$

Step 4: Calculation of the length extension ΔL

$$\Delta L = 0.412h\frac{(\varepsilon_{eff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{eff} - 0.258)\left(\frac{W}{h} + 0.8\right)}$$

Step 5: Calculation of actual length of the patch

$$L = L_{eff} - 2\Delta L$$

The substrate parameters used for both U-slot and square patch design is shown in Table 1 and Table 2 respectively.

Table 1 S-Parameter for U-Slot Patch Design

S- Parameter	UNIT(mm)
SUBSTRATE	FR4
H	3.4
W	35.5
L	35.5
WS	15
LS	24
a	2
b	5

Table 2 S-Parameter for Square Patch Design

Parameter	UNIT(mm)
SUBSTRATE	FR4
H	3.4
W	35.5
L	35.5
l	26
Radius	1.2
Feed-position	17,24.5,0

The polar graph generated by the HFSS software for U-Slot design in shown in Fig 4. The Fig 5 depicts the polar graph of square patch design. The HFSS spiral inductor plotted the plot that provides curve information of sweep of the S-parameter in terms of frequency of Giga Hertz (GHz).

The gain is high in the proposed antenna design and the fabrication of the U-slot and square patch design in cost effective. Fig 6 depicts the plot of Evaluation of S-parameter along with Frequency.

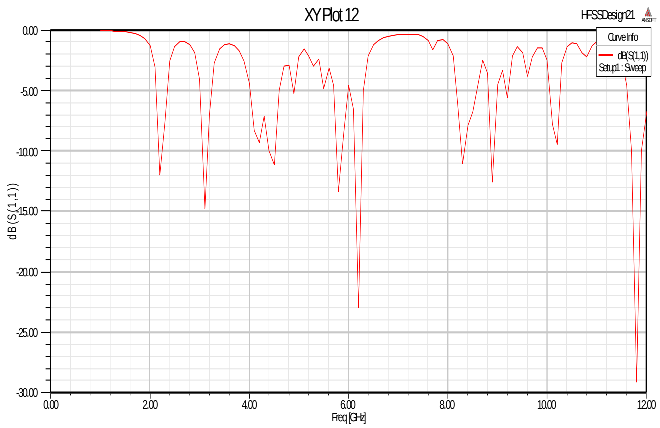

Fig.4: U-Slot Patch Design S-Parameter Graph

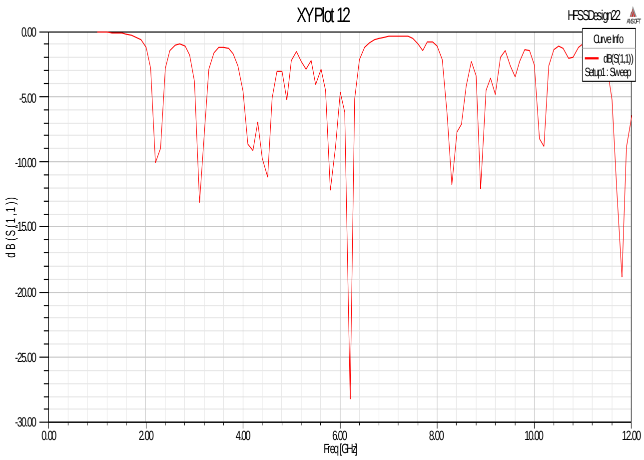

Fig.5: Square Patch Design S-Parameter Graph

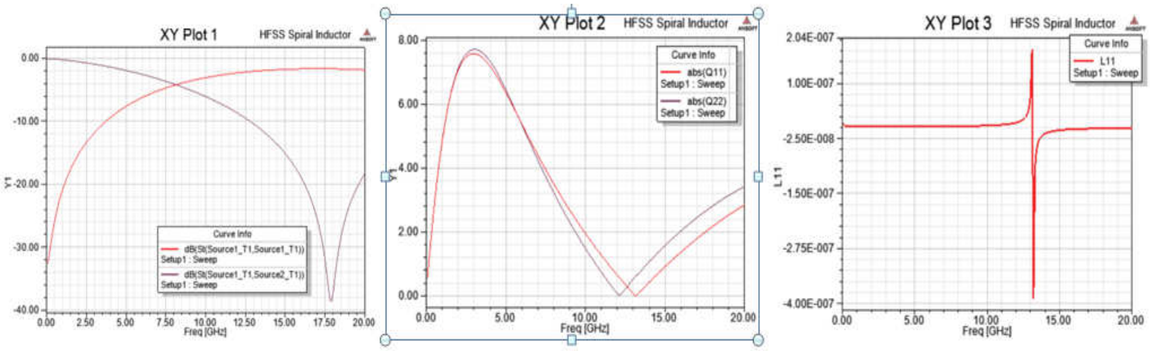

Fig.6: Evaluation of S-parameter along with Frequency

Conclusion

This paper proposes a U-slot and square patch antenna design for WLAN/WiMAX applications. Using a split-ring slot implanted in the square patch and a U-shaped slot etched partial ground plane, three resonant modes with excellent impedance performance are achieved. The designed antenna has high ratio of gain and the size in compact. The radiation patterns shown in the polar graph is efficient for the design. The structure of the antenna is apt for practical wireless communication systems, working on WLAN and WiMAX networks. The proposed method analyses the reflection radiation pattern and removes the noise radiation in the antenna patch design.

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