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ANTENNA DESIGNING IN WIRELESS COMMUNICATION

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ABSTRACT

This research paper focus on the latest research happening a crucial research topic of antenna designing for body centrical wireless communication. This concentrates on the design specifications of antennas, antenna frequency bands, a material used in antenna designing, future design and performance analysis challenges involved in designing of antennas for body centrical wireless communication.

Keywords: Body space networks, On-Body communication, Off-Body communication, Personal space networks, UWB Antennas.

INTRODUCTION

With the evolution of wireless communication, particularly in last decade focus is on enhancing and contributory to the life type of individuals, one projection of wireless communication that is contributory in the field of health care, hearth fighters, support for military personal specially in war zones and alternative diversion primarily based personal wireless communication systems is body central communication that lies underneath the umbrella of Body area Network (BAN) and private area Network (PAN). Body centric communication includes both the on-body and off-body communication. In an on-body communication signal is transmitted between two systems implanted over the body while in off body communication a body mounted system is communicating with some other system which are located in the surroundings like WiFi, GSM or some other system. Body centric communication is a hot topic of research and significant work is done and published related to this topic. Antenna is a prime component of wireless communication this paper focus on the current trends and approaches proposed by various researchers in designing of antennas for body centric wireless communication and associated parameters like frequency bands, Bandwidth, materials used in antenna fabrication, design approaches and performance.

PARAMETERS OF ANTENNA DESIGNING

Design and Frequency Band

The basic and common approach in designing antennas for body centric communication is that antennas need to be compact in size. Design basics are further divided into two prongs one being the antenna directly mounted onto the body and second one the antenna is constructed on some costume like a helmet or jacket.

Size of antenna is directly dependent upon the frequency of the antenna, so size and frequency are interlinked with each other. The current focus is on three different frequency bands.

- 2.45GHz and 5.8GHz band

- 3.6GHz to 10.6GHz band

- 60GHz band

Many researchers have worked on designing of 2.45GHz and 5.8GHz dual band antennas for body-centric communication, Anupan and Willam designed C-shaped slotted patch antenna for dual band, two frequency bands are achieved resonance of inner and outer patches at two different frequencies. TM10 mode achieved radiation efficiency more than 90% for both the bands. Another dual band and dual mode antenna operate at 1.9GHz and 2.45GHz by M. Khan, Qammar it's an Omnidirectional and power efficient disk loaded monopole antenna. Radiation efficiency of more than 50% is achieved for both the bands.

3.6GHz to 10.6GHz broadband is an attractive blend of research for body-centric communication because the Federal Communication Commission (FCC) released this spectrum for Ultra-broad band communication in 2002. Shanshan, Shaoqiu designed a rectangular patch antenna with quasitrapeziform ground. Antenna simulations were carried out in Ansoft HFSS and CST Microwave Studio environment. Less than -10dB return loss is achieved for the entire set. Hall, Hao and Cotton discussed 60GHz band as a new band for BAN's and established the fact that 57GHz to 64GHz wide spectrum will be the future of body centric communication. Researchers presented 60GHz horn antenna that excites surface waves on the ground whose parameters are the same as that of the human body.

The above mentioned three bands do have their pros and corns as you keep on increasing the frequency the penetration depth of electromagnetic signal into the body decreases. Dual band 2.4GHz and 5.8GHz do face some interference with other technologies operating in these bands like Bluetooth, WLAN and Wimax. At lower frequencies multipath effects are more dominant as comparable to those on higher frequencies. In today's world security is seen as a prime concern in designing of wireless communication systems so is the case for BAN's and PAN's 60GHz band gives us the leverage of greater security along with high data rates.

Fabrication Material

The material used in the manufacture of antennas holds a key role. Fabrication material is also directly dependent of the design approaches, either the antenna will be designed to directly implant on a human body or it is to be placed onto some costume. Various materials are suggested by the researches T.F. Kennedy and others from NASA used woven conductive material, Nora for designing of e-textile antennas for distance applications. Nora is a right choice for designing efficient antennas in wireless communication frequencies another fabric Nomex used to have electrical properties same as air and this fact make them good enough to use at high frequencies. Hall and Hao designed a wearable antenna using fleece fabric and copper foil. Carla and others designed wearable patch textile antenna using a combination of textile materials namely Shield it, Fleece, Flectron and Felt. Shanshan suggested Felt substrate in designing of the antenna. Dielectric constant ε of above mentioned fabric lies in the range of 1.18 to 1.40 and dielectric loss tangent tan δ 0.010 to 0.082 ranges and resistivity 0.03Ω/square to 0.1Ω/square range.

Design Constraints

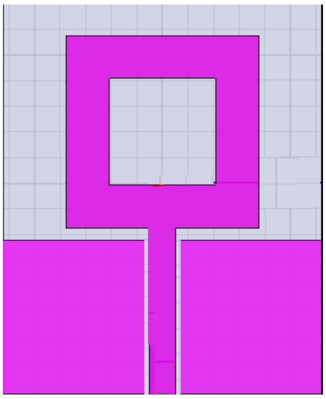
Antennas for body centric communication need to be small in size and power efficiency. Normal antennas and antennas operating near the human skin are different because body movements, body temperature changes or if skin becomes wet it affects the antenna performance. Human tissues dielectric properties do also change with the change in frequencies. Wearable antennas get affected by twisting and flexing. Researchers also focus on maximizing the radiation intensity while trying to reduce losses like dielectric loss, multipath loss. Integration of designing antennas with other components is also a challenge. Researchers mentioned specific absorption rate (SAR) is an important entity and should be considered when the antenna is placed on the torso. SAR is dependent on three factors firstly; conductivity of the body second is electric field strength of the body and lastly density of the body.

UWB

Ultra-wideband (UWB) technology could be a revolutionary wireless technology used to transport massive amounts of digital information short distances (up to 230 feet) over terribly wide information measure (from one gigahertz [GHz] up to 10 gigahertz) and at very low power levels (less than 0.5 milliwatt). Unlike typical frequency broadcasts that use continuous sine waves to carry information, UWB uses exactly positioned pulses at specific time intervals to transmit the signals across a good spectrum. Ultra-Wideband (UWB) wireless is a quickly growing technology that guarantees to revolutionize the low power and the short-range wireless applications. The UWB has quickly emerged as the leading technology for applications like wireless Universal Serial Bus (USB) and short-range ground penetrating radars. UWB radios dissent from standard narrow-band radios, with a range of specialized check demands. Huge signal bandwidths, short length pulse and transmits Power Spectral Densities (PSDs) close to the thermal noise floor, build UWB tests troublesome. Fortunately, leading instruments like the Tektronix Arbitrary Waveform Generators (AWG), RFXpress waveform creation software and Digital Phosphor Oscilloscopes (DPO) with UWB measurement software offer solid solutions to UWB test challenges. In this Technical note we explain the concepts behind the UWB technology with its unique hardware and software architectures with future applications.

A Compact Monopole of CPW-Fed Band Notch Square with ring Antenna for UWB Applications

The initial objective of this projected analysis study is to reduce the size of the antenna and avoid interference between applications of UWB and WLAN at 5.5GHz.ANTENNA DESIGN. The geometry of the proposed antenna is shown in Fig with various dimensions. The antenna is mounted on FR-4 printed circuit board substrate (WsubxLsub=35×31) with a dielectric constant of the εr=4. 4 and thicknesses of the h=1. 6mm. The CPW feed line has a single strip with a dimension of Wf x Lf and gap of distance which is made for a 50 Ω characteristic impedance. The radiating part of the antenna is a square ring patch in the middle of substrate with outer length and inner length of L and Ln respectively.



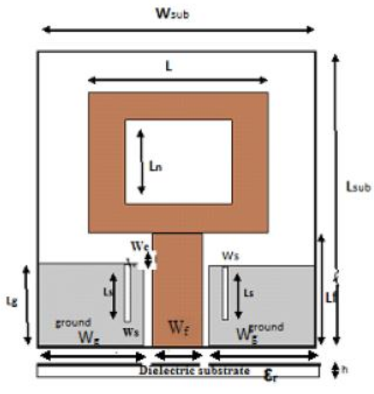


Fig. Shows the characteristics of the measured and simulated VSWR and group delay of antenna (a). A good agreement in simulation is observed. The input impedance of the antenna is well matched as the bandwidth covers the entire UWB band (3.1–10.6 GHz) and goes beyond the required 10.6 GHz with .The ground plane of dimension Lg X Wg is used in this antenna configuration near the both sides of the CPW feed line of space WC.

TABLE I

DIMENSIONS OF ANTENNA

Parameter	W_{sub}	L_{sub}	W_f	L_f	L	L_n	L_g
Size(mm)	31	35	3.3	14	15	8.3	13
Parameter	W_g	W_c	L_s	W_s	h	ε_r	--
Size(mm)	13.35	0.5	7.5	0.3	1.6	4.4	--

The slot of dimension Ls X Ws is etched from both sides of the ground plane. The width and location of those slots can also adjust the notched band. The length of the slot etched from the ground plane near of the feed line can be given as the notch

$$f_{notch} = \frac{c}{4L.\sqrt{\varepsilon_{eff}}}$$

Where L is the total length of the slot, c is the speed of light and εeff is the effective dielectric constant. This is approximately found as below.

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2}$$

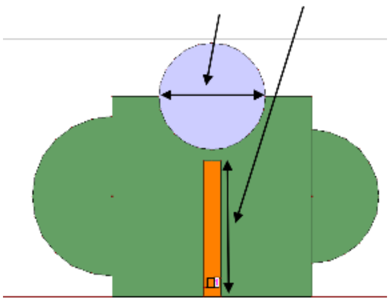
The antenna is called a square ring due to square ring lock and a WLAN band is notched from UWB using the slot cut-out of the land. The antenna design software package, called Ansoft HFSS 13.0 has been used to develop and simulate this antenna.

Circular shape, Dual band proximity feed UWB Antenna

This Circular shaped microstrip antenna provides a dual band. This paper suggests an alternative approach in raising the bandwidth of microstrip antenna for the wireless application operating at a frequency of 3 GHz.

ANTENNA DESIGN

The geometry of the proposed antenna is shown in Fig. The antenna parameters are also given in Fig. The antenna is mounted on an FR4 substrate having dielectric constant 4.4 and loss tangent of 0.02, fed by a proximity method. Simulations were performed using IE3D. In the proposed design ground plan is of square shape with side length of **L = 30 mm** and having two semicircular geometries attached with this square of radius **RG1 = 12mm** and **RG2 = 10mm.** The sandwiched layer between radiating plane and the ground plane is 50 Ω lines with length **LF = 20 mm** and width**WF= 3 mm.** The radiating plan consists of a circle of radius **R = 8 mm.**



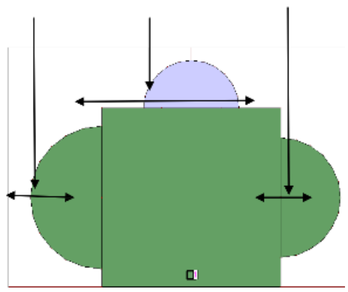


Fig. Front View of Antenna 12 mm 30 mm 10 - Fig. Back View of Antenna 5 mm 20 mm

Design of a CPW-fed Compact Dual Band (UWB/Bluetooth) Integrated Antenna with Single Band Notched Features

A compact, low-profile, and planar Ultrawideband and (UWB) Bluetooth integrated antenna with dual Band WiMAX/WLAN (3.4/5.5) notch features are presented. Antenna works dual-band operation covering 2.4–2.484 GHz (Bluetooth) and 3.1–10.6 GHz (UWB) frequency band with single Band WLAN (5 to 6 GHz) notch features. It is fed with CPW and built on a FR-4 substrate with height 1 mm and 41*40 mm2 plane areas. By cutting C-shaped slot in the patch band-rejected filtering property of WLAN band is reached. The VSWR, phase linearity and radiation pattern, group delay properties of the antenna are studied on the basics of simulation. Calculation and simulation results are tallied. The antenna shows satisfactory gain uniformity with stable omnidirectional radiation patterns across the UWB and Bluetooth integrated bands. The average group delay is about 0.2 ms across UWB frequencies.

The antenna structure is straightforward and the aperture size is compact. Broad electrical resistance bandwidth and stable radiation patterns are obtained, whereas the earth plane dimension may be a slight bit of lag. This technique is appropriate for making UWB antenna with slim frequency notches or for making multiband antennas. However, the antenna isn\'t suitable for integration with compact systems, because its ground plane is incredibly serious and it\'s perpendicular to the radiator, that restricts its applications in compact UWB systems. Moreover, the bandwidth performance of the antenna is from 2 gigacycle to 6 gigacycle, that cannot meet the demands of a UWB system. Based on the higher than researches in 2008, Qing-Xin Chu planned an easy and compact CPW-fed two-dimensional UWB antenna with matching band-notched characteristics at three. 4 GHz (3.3–3.8 GHz) and 5.5 gigacycle (5–6 GHz). The dual band-notched operations are carried out by etching two nested C-shaped slots in the rectangular metal radiating patch but it was not integrated Ultrawideband and (UWB) Bluetooth also Bahadir S. Yildirim design an Integrated Bluetooth and UWB Antenna but it is not compatible to suppress the interference with other services like WiMAX and WLAN.

Based on the setting of the researches higher than the planned antenna designed with compact rectangular slots in diverging patch, this slot is liable for impedance matching of both integrated bands UWB and Bluetooth. The planned antenna has one slot of c-shape find time for diverging patch with half wavelength that is accountable the needed notch band 5 to 6 GHz. The forward section of the feed has the advantage of compact size compared with an existing antenna and without a lot of adjustment the present structure is often used for notched style. The antenna is simulated and analyzed by simulation package.

(a) (b)

! Antenna (a) and (b) with optimized dimensions (a) without notch (b) with single notch and.

Conclusion Applications

UWB technology will modify a wide kind of WPAN applications. Examples include: exchange cables between transportable multimedia system atomic number 58 devices, like camcorders, digital cameras, and transportable MP3 players, with wireless property. Enabling high-speed wireless universal serial bus (WUSB) connectivity for computers and PC peripherals, together with printers, scanners, and external storage devices. Replacement cables in next-generation Bluetooth Technology devices, like 3G cell phones, moreover as IP/UPnP-based connectivity for succeeding generation of IP-based PC/CE/ mobile devices. Creating ad-hoc high-bit-rate wireless connectivity for metallic element, PC, and mobile devices.

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