Minimization of UWB Microstrip Patch-Slot antenna (MPSA) at 4 GHz and 50Ω Input Impedance

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ABSTRACT

Ultra-wideband (UWB) is a unique technology for short-range and low data rate wireless communications, especially for wireless personal area network (WPAN) and wireless body area network (WBAN) systems.Common to all these implants is the need for power supply and a wireless interface. Wireless power transfer via electromagnetic fields is identified as a promising option for powering such devices. This paper deals with system level design considerations for mm-size implantable Microstrip Patch-Slot antenna(MPSA) design for human head with wireless connectivity and minimizing size of antenna with 20x7.75x1.27 such as length(L), width(w) and substrate thickness (t) respectively at resonant frequency 4GHz and 50Ω constant input impedance for feed which is covered by 20.98 length of cylinder that showing reflectiveradiation power level with minimum size of antenna.

Keyword:* *Antenna design, Microstrip patches Antenna, Antenna Bandwidth etc.

I INTRODUCTION

A microstrip patch antenna is widely used in communication devices due to its small size, thin profile configurations, low cost and conformity.The development of medical technology, more and more sophisticated biomedical devices are used for diverse applications, such as telemedicine systems, remote health monitoring, body implantable devices, and so on[3]. In-body medical implantable devices are classically battery-operated, and once implanted, they should operate for numerous [4, 12] years and consume as little power as possible. Also, more and more advanced implantable devices need high data rate, low complexity, and small size. Due to the inherent characteristics of simple electronics and high transmission speed, ultra wideband (UWB)

technology has great potential to satisfy the needs of the next generation implantable devices[5, 6]. In particular, impulse radio UWB (IR-UWB), the simplest form of UWB, is a promising low complexity solution. An IR-UWB transmitter which is always implanted in the body is simple to design and has lower power consumption.

Micro-strip Patch antennas

A micro strip patch antenna iseasily configuration in Ultra-wideband (UWB) shown in Fig1. It involves of a radiating patch on one side of dielectric substrate (Єr≤10), which has a ground plane on other side.

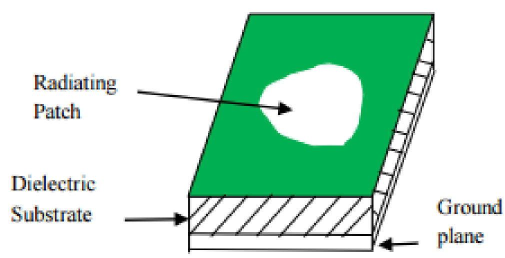

Figure 1: Microstrip antenna configuration

Microstrip antennas are considered by a larger number of physical parameters than are conventional microwave antennas. They can be designed to have many geometrical shapes and dimensions [2]. All micro strip antennas can be divided into four basic categories:

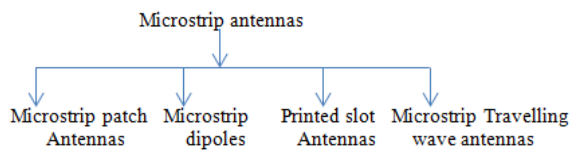

Figure 2: Microstrip Antennas divided into four basic categories

II SYSTEM MODEL

Equation design forMicro strip patch Antenna

The **Microstrip** patch antenna is designed to function at a center frequency of 4GHz. The relationship between the [8] operation frequency (f_c) and length (L) of the patch is given by:

$$Fc = \frac{1}{2L\sqrt{eoer\ \mu o}} \ldots\ldots\ldots 1$$

Substituting the values of ε_r=9.8; L = 20.98 mm is obtained. The width of the patch is calculated to be W = 7.7 mm using the following equation:

$$W = \frac{\sqrt{2}}{2fc\sqrt{\mu oeo\ (er+1)}} \ldots\ldots\ldots 2$$

Usually, height of the substrate should be greater than 0.05 times the wavelength. Since some of the waves travel in the substrate and some in air, [10] an effective dielectric constant ε_{eff} is introduced to explanation for fringing and wave propagation in the line. For W/H>1,

$\varepsilon_{eff} = \varepsilon_r+1/2 + [\varepsilon_r-1/2(1+12H/W)^{-1/2}]$…………3

This formula results in ε_{eff}= 12.5464. Due to fringing fields, the effective length of the patch is [9] modified as:

L_{eff}=L-2ΔL…………………………………4

Where ΔL is given by

ΔL/H= 0.412 (ε_{eff}+ 0.3/ ε_{eff}-0.258) (W/H/ W/H+0.8).6

III PROPOSED METHOD

The proposed**DCSD(Dual Cylinder Slot Design) for Antenna Design** technique has been accomplished for slot antennas on finite and curved ground planes. By using integral equation solutions to determine theE-field distribution has been extended to apply to patches of surface instead of strips.

A dual-slot antenna has been developed for wide-angle coverage in the ultrahigh-frequency range. The WBAN is dependent on the slot width, slot length, and body depth at the low end of the band.

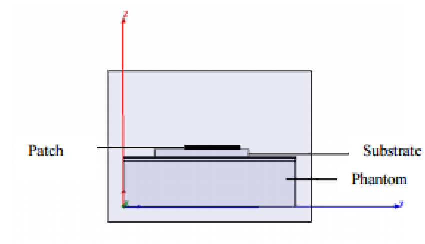

Figure 3: Antenna with Micro-strip feed

Coaxial probe: Micro strip patch antenna consists of a conducting rectangular patch of width W and length L on one side of dielectric substrate of thickness h and dielectric constant εr .Most popular methods to feed the microstrip patch antenna are microstrip line feed, coaxial probe feed, aperture coupled feed and proximity coupled feed. Top view of rectangular microstrip patch antenna using coaxial probe feed.

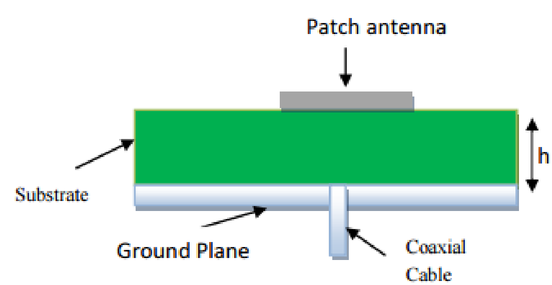

Figure 4: Coaxial probe feed patch

Simulation parameter

Table 1 below lists the antenna parameters obtained from the above equations in system model.

Parameter	Value
f_c	4GHz
Input Impedance	50Ω
Characteristic Impudence	50Ω
Pulse duration	2 ns
$E_{ff\ Length}$	0.12 mm
Simulation Environment	MATLAB 2012

Table 1: Summary of theoretical antenna parameter values

IV RESULT ANALYSIS

A planar impulse radio (IR) ultra wideband (UWB) antenna isexamined for use in wireless body area networks (WBANs). The objective of the proposed antenna is toconsider electromagnetic phenomena due to coupling between an antenna and human body tissues. A rectangular patch with dimensionis of dimension 20mm*7.5mm*1.27mm and microstrip fork-shaped feed is of length 4.5mm and width 6mm. Substrate is RT/TMMi with dielectric loss of 9.8 and dielectric loss tangent 0.0009.The thickness of the substrate is 1.27 mm. In order to design an antenna with a sufficiently large bandwidth and sufficiently high radiation efficiency,the antenna is excited by microstrip line feeding a patch at the center of the patch element.

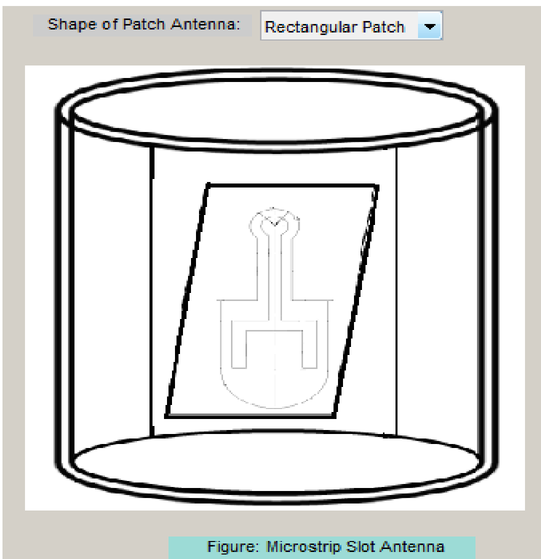

Figure 1: Design of Microstrip Patch Antenna

Rectangular Shape		
Length of Cylinder	20.98	mm
Length of Microstrip	20	mm
Width of Microstrip	7.75	mm
Effective Length	1.14632	mm
Width of Feedline	0.00360978	mm
Inset Feed point Yo	0.0979088	mm
Radiated Power	0.667114	mW
Directivity	5.16688	dB

Figure 2: output parameters with different feeding micro strip patch antenna

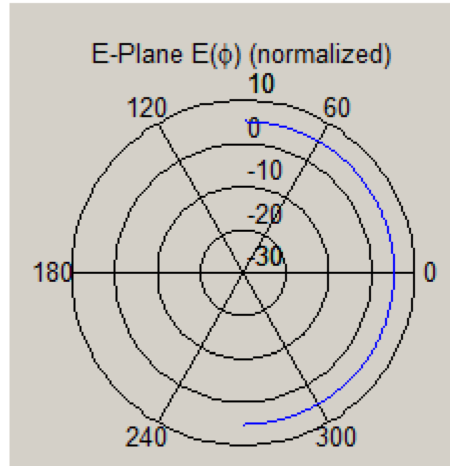

Figure 3: Showing Azimuth angle of Slot Antenna E-plane

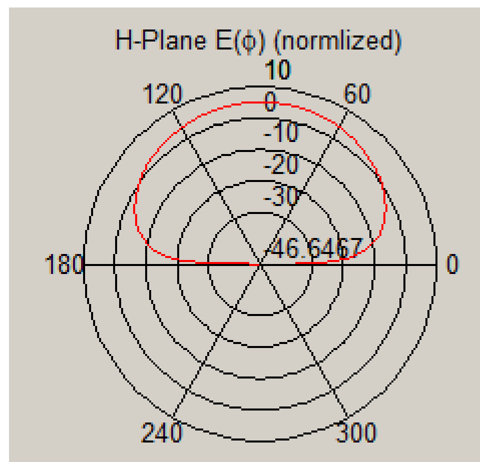

Figure 4: Showing Azimuth angle of Slot Antenna H-plane

V. CONCLUSION

This paper presented a new structure of a Microstrip Patch-Slot antenna (MPSA)for applications within the BAN, at the 4 GHz band.The measurements and simulations in free space parameters:S_{11}, radiation efficiency and total efficiency have shown agood correlation, in part due to a good computational model in MATLAB Simulation tool. By performing electromagnetic (EM) simulation based onan electromagnetic human model indicates the feasibility of using 3.0-10.5 GHz UWB band for the wireless communication of implantabledevices.

If further work proposed MPSA antenna have to implant in human head skin tissue voxel data and identify its return loss, gain and SAR (**specific absorptionrate**) variation with input signal bandwidth and SAR variation with different input signal power level.

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