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Miniaturized Micro strip patch Antenna for Ultra Wideband Applications

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Abstract

Objectives: In this digital era, Ultra Wideband (UWB) is an emerging technology and it has numerous applications in different fields. The frequency of UWB ranges as 3.1GHz – 10.6GHz and some narrow band applications also exist which causes interference to Ultra band applications. The miniaturized antenna with CO shaped radiating antenna element pattern for Ultra Wideband applications is proposed in this paper. **Methods/Statistical Analysis**: The micro strip coplanar fed line technique through the ground plane is used to nosh the antenna with 50Ω impedance. The proposed micro strip patch antenna is designed using Teflon dielectric substrate material which has a conducting surface on another side. The polytetrafluoroethylene or PTFE which is also known as Teflon is a high flexible, electrically resistant material and shows better resistance to water. **Findings**: The proposed antenna made up of Teflon substrate material with the dimension of 20mm X 20mm and CO shaped radiating patch with micro strip feed line having the dimension of 7mm X 0.5mm. The power loss in the signal returned in the transmission line is -20.36dB the miniaturized micro strip patch antenna operates at the frequency of 10.3GHz. The gain attainment is 3.7dBi. The proposed antenna applications are in Military areas, Medical imaging and Medical Monitoring.

Keywords: Micro Strip Patch Antenna, Miniaturized Antenna, Teflon Substrate Material,

1. Introduction

In the recent technologies of wireless communications many industries require miniature, attuned and affordable devices for communication purpose[1]. In this significance the micro strip patch antennas are playing vital role. A patch antenna is designed by using different shape of patches and different substrate materials based on their resonating frequency[2]. The ground plane is formed to the opposite plane of substrate material. The flexible antenna made from textile materials such as silk, wash cotton and jeans can be integrated on body or into clothing[3]. Such types of antennas are known as wearable antenna. The antenna is designed using Teflon as a dielectric material with CO shaped radiating element pattern to operate at the frequency of UWB. The Teflon substrate material provides high resistance to the water and makes the antenna to be flexible one[4].

The concert of the antenna is affected by the significant key aspect related to multipath fading[5]. It occurs due to the movement of human body results in shadowing and polarization mismatching. The antenna performance and the signal quality can be improved significantly in biomedical applications by using different diversity techniques[6]. of *10.6GHz* for Ultra Wide Band applications. The frequency and the divergence of the incident wave describes about direction of the Electric field and how effectively the Electromagnetic waves are radiated as power into free space[7]. The proposed antenna operated at super high frequency which causes the signal to spread over a high frequency range and introduces low power consumption due to spreading the energy of UWB signals over a wide band of frequency. The designed CO shaped micro strip patch antenna has a simple structure, easy fabrication and wideband characteristics to operate at Ultra Wideband applications. Interference can be avoided

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in such wireless systems by introducing a filter with band stop characteristics[8].

2. Design Analysis

General Design calculations of proposed patch antenna

Step 1. Incremental length ΔL

$$\Delta L = 0.412H \frac{(\varepsilon_{reff} + .3)\left(\frac{w}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{w}{h} + 0.8\right)}$$

Step 2. Effective length of the patch (Left)

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

Step 3. Patch length

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

Step 4. Output Admittance

$$Y_0 = \frac{L}{\pi} COS^{-1}\sqrt{\frac{Z_{in}}{R_{in}}}$$

where, Zin - Resonant input impedance, Rin - Resonant input resistance.

The greatest amount of electric field that an insulating substrate material can resist under ideal conditions without breaking down is known as dielectric strength of the pure substrate material. The dielectric value of air and substrate is different.

3. Design Considerations

The antenna has been designed with CO shaped copper radiating patch on Teflon substrate material. To design the simple and stretchy antenna, the properties of substrate material must be known at the operating frequency bands. Teflon, Acrylic and polycarbonate suitable to be employed as substrate in micro strip antenna design. The dielectric constant value of Teflon material is 2 which will improve the gain and directivity of the antenna. The patch is fed with power by means of different feed line techniques which has been connected directly to the radiating patch. The proposed CO shaped patch antenna has been employed with micro strip feed line technique in order to feed power to radiating patch.

In this paper, we designed super high frequency band miniaturized CO shaped antenna radiating element pattern with the dimension of *20mm X 20mm* and simulated using High Frequency Electromagnetic Fields Structure Simulator (HFSS). The antenna performance on a Teflon substrate were analysed by antenna parameters such as return loss, VSWR and gain. The result shows that the proposed antenna is highly suitable for UWB applications. It concludes that flexible material of Teflon substrate is very feasible compared to textile materials because of its high dielectric strength and resistance to water[13]. The radiating antenna element pattern having the shape of interconnected C and O. The radius of the O shape pattern is *5mm*, the dimension of the interconnecting rectangle is *7mm X 0.5mm*.

Figure 1 shows the feasible micro strip patch antenna for Ultra Wideband with the dimension of *20mm X 20mm* with CO shaped radiating patch. The interconnecting rectangle of C & O shaped radiating element pattern having the length and breadth of *2mm X 4mm*. The proposed patch antenna is fed by using *7mm X 0.5mm* micro strip line. The radius of O shaped ring is 5mm and the gap between C & O is *1mm*.

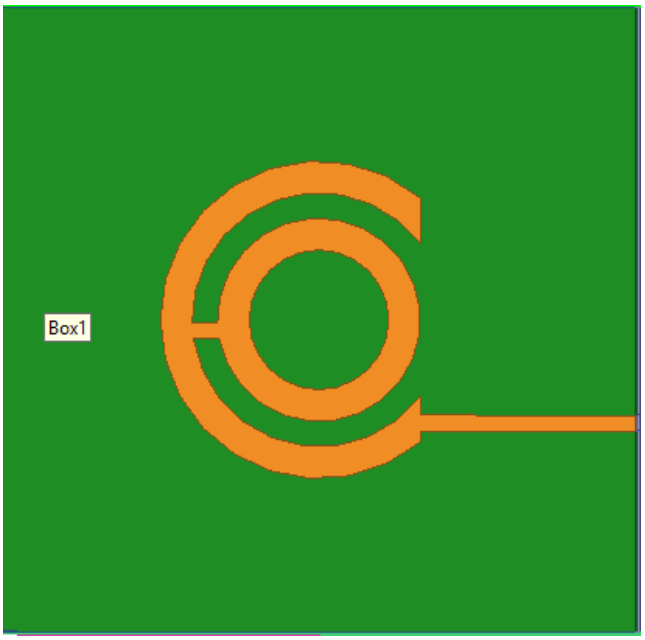

Figure 1. Design structure of miniaturized CO shaped patch antenna.

Figure 2 shows the lumped port (1) of the proposed antenna through which the antenna is simulated with 50 ohm impedance to radiate.

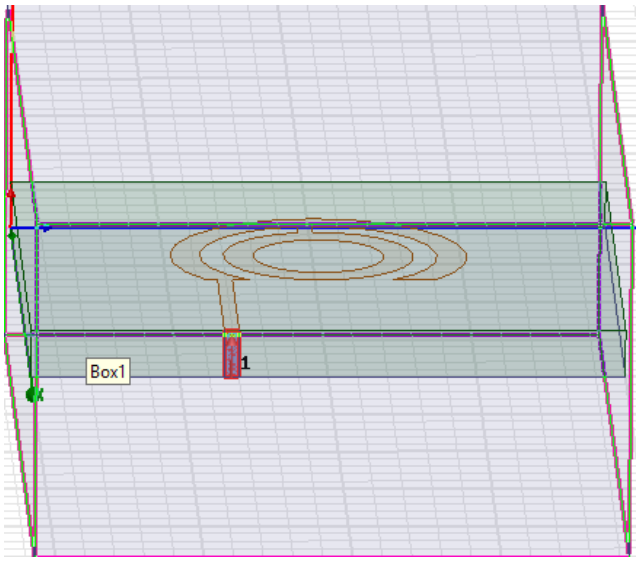

Figure 2. Input ports with feed line of miniaturized micro strip patch antenna.

4. Simulated Results and Discussions

The miniaturized micro strip patch antenna for UWB applications has been simulated by using High Frequency Electro Magnetic Fields Structure Simulator (HFSS). By determining S-parameters the return loss and the reflection coefficient of the proposed antenna are obtained. The proposed C interconnected with O shaped patch antenna operates at the frequency of *10.3GHz* with low return loss which is estimated about *-20.63 dB*. The antenna performance is analyzed by measuring the antenna parameters such as Gain and VSWR.

4.1 Frequency Response

The impedance matching results presented in Figure 3 illustrates the return loss behaviour which shows the effect of amount of signal radiated in backward direction.

4.2 Gain of the Miniaturized Micro Strip Patch Antenna

The Figure 4 represents gain plot of the proposed antenna. The gain obtained by the proposed antenna is *3.65 dBi*.

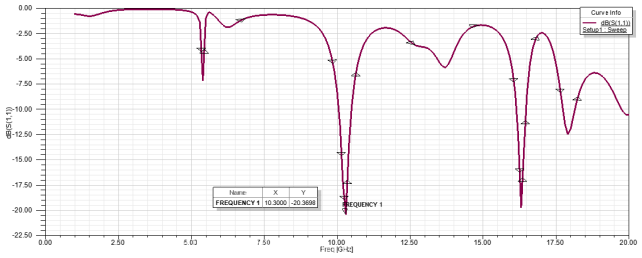

Figure 3. Frequency response of the miniaturized micro strip patch antenna.

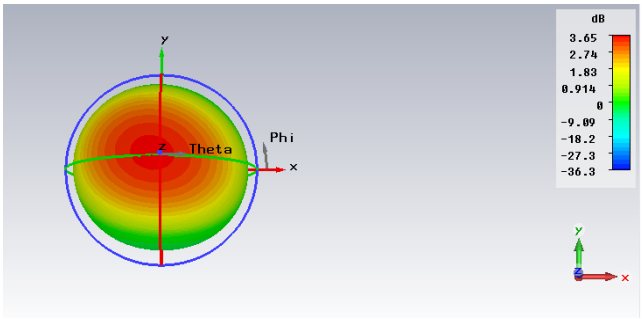

Figure 4. Gain of the miniaturized micro strip patch antenna.

The array of antenna element pattern can provide much higher gains than a single element pattern at additional cost.

4.3 VSWR of the Patch Antenna

The Figure 5 represents the Voltage Standing Wave Ratio of the proposed antenna. The VSWR value analysed based on the reflection coefficient. The Standing waves produced due to Impedance mismatches result in transmitted waves does not travel further. Here the simulated graph shows that it is *0.8* for *10.3GHz* frequency.

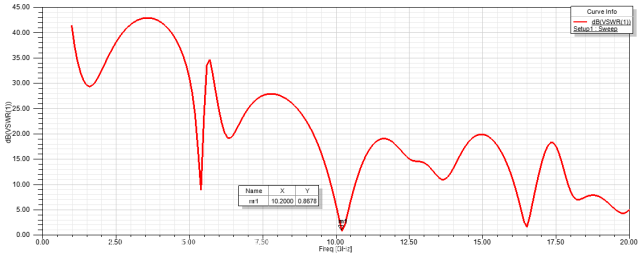

Figure 5. VSWR of the proposed antenna.

5. Conclusion

The micro strip patch antenna having CO shaped element pattern with Teflon as a dielectric substrate material for Ultra Wideband applications has been designed. The antenna design is proposed with good return loss, VSWR, Radiation Efficiency and gain. The proposed antenna is cost effectual and in miniaturized size with the dimension of *20mm X 20mm*. The antenna has been designed to operate at a frequency of around *10.3GHz* used for various Ultra Wideband applications with the gain of *3.7 dBi*. The designed antenna applications are Military areas, Medical imaging and Medical Monitoring.

6. References

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