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Slot Based UWB Radiating Patch Antenna for Future Wireless Applications

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Abstract:

This work presents a novel slot based microstrip antenna structure for future wireless applications in the UWB operating range. The letter proposes a effective radiating patch design to cover the applicating ranges for wireless sensor networks and position tracking systems used commonly today. A operating range of 3 GHz to 10GHz is desired for the mentioned application. The return loss and radiation pattern of the proposed design are to be analysed for improved performance in the real time operating conditions.

Keywords — **Ultra Wideband (UWB), Microstrip Antenna, HFSS, Slot Antennas, Low Profile .**

I.Introduction

Ultra Wideband Band is a Radio Technology that uses low energy level for short range and also high bandwidth communications over a large position of radio spectrum. UWB antenna has low power requirements and also reduce fading from multipath. In UWB systems the signals are pulse based waveforms compressed in time rather than sinusoidal waveforms compressed in frequency. The FCC set aside the frequencies 3.1GHz to 7 GHz for UWB use in US. Usually Frequency above 10.7GHz are used in satellite TV and military radars. Even UWB antenna plays a major role in various applications as it behaves like a bandpass filter and reshapes to avoid undesired distortions. The information can be modulated on UWB signals by encoding the polarity of the pulse, its amplitude. Another feature of UWB is that pulses, are very short (less than 60cm for 500 MHz pulse). UWB range applications range from sensor networks to various position and tracking systems, where low rate communications are combined with precise radar systems with high speed spatial resolution. Various research works have addressed the design challenges faced by rf front end Engineers working on designing these systems. A wideband circularly polarized antenna in the 3.5GHZ and 7GHz range is discussed in [1]. Various UWB based antennas have been discussed [2] and [3] , their performance over the operating range have been calculated and presented. A wideband Y slot antenna has be realised in [4] to improve the bandwidth of the operating range in addition to the achieved compactness f the micsrotrip antenna. An L shaped UWB antenna is presented in [5] and broadside radiation characteristics have been achieved as a result. In addition to the antenna design, [6] presents an band reject radiating patch in the said frequency range. The effects on the VSWR performance by the antenna structure in discussed in [7] and the antenna is realised.

II. Design Methodology and Results

The Proposed Ultra wideband antenna is designed on an FR4 laminate board for better performance and ease of fabrication. The overall dimensions of the antenna were found to 20*20mm, which is desirable for the proposed UWB based compact wireless transceivers.

The antenna is designed based on the transmission line theory, and we have calculated the dimensions based on various design equations put forth by the theory. The length the the patch can be calculated based on the Equation 1 and Equation 2 given below.

$$\Delta L = (0.42(\varepsilon reff + 0.3)(w/h+0.264))/(\varepsilon reff + 0.258)(w/h+0.8)) \ldots (1)$$

$$L = Co/(2fo\sqrt{\varepsilon reff}) - 2\Delta L \ldots (2)$$

Figure 1 shows the Current distribution of the proposed UWB based slot antenna. It can be seen the the patch radiates more in the feed region and still improvements need to be implemented to improve the performance.

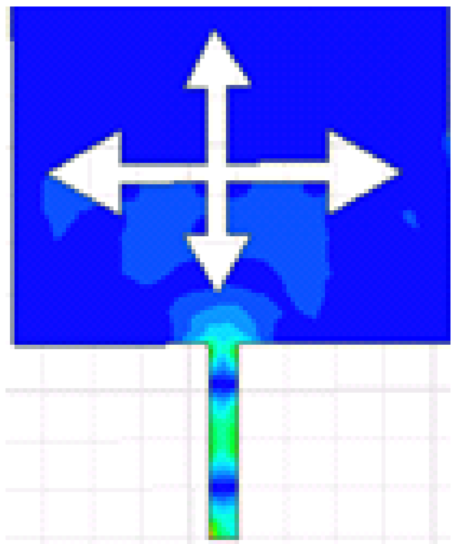


Figure 1: Current Distribution Diagram for the Proposed UWB Antenna.

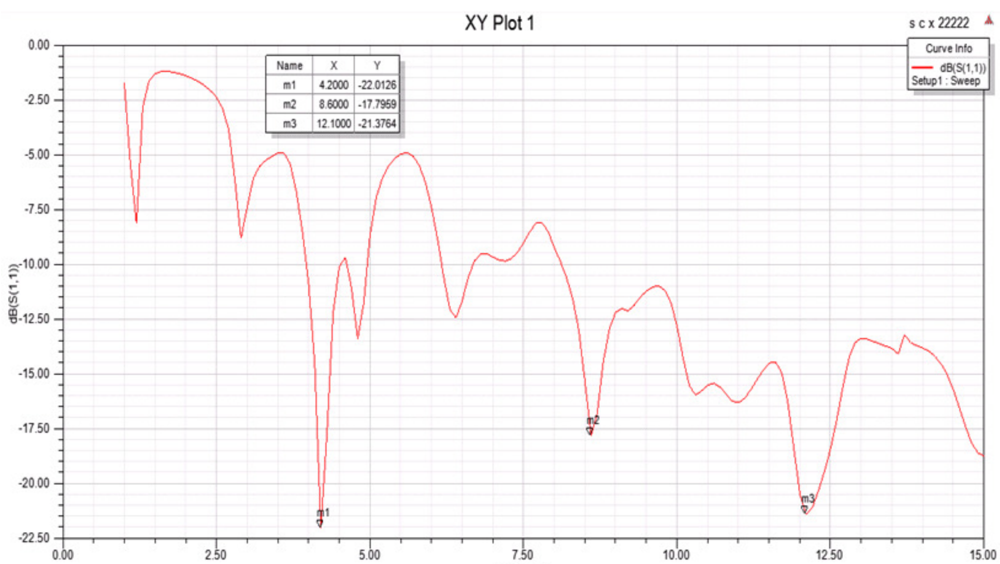
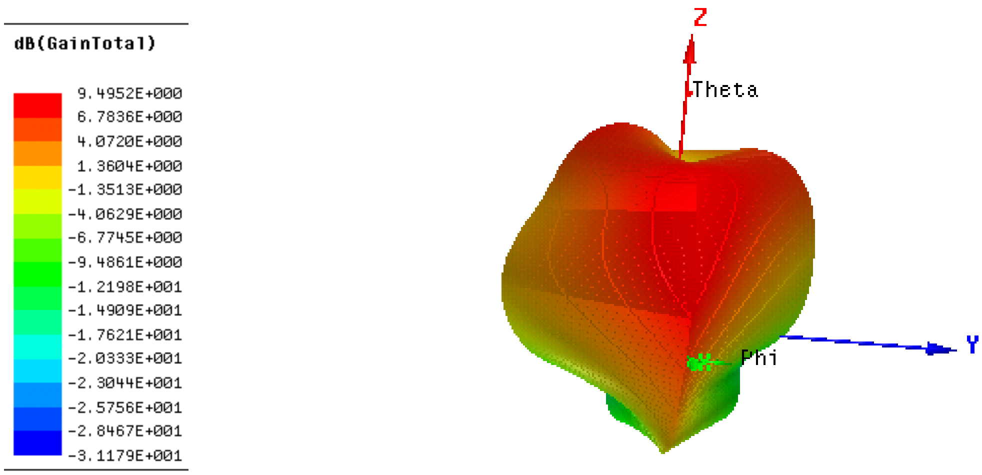


Figure 2: Return Loss Parameters of the Simulated Antenna

The return characterics have been realised as shown in Figure 2. The required return loss characterics have been realised in the frequency bands of 4.2GHz, 8.5GHz and 12.1 GHz, as -22.01dB, -17.79dB, -21.37dB respectively. The said antenna is designed on FR4 substrate, with a dielectric constant of 4.6/ The microstrip antenna layout provides a low profile antenna design for the said applications such as wireless sensor networks and Position tracking systems in real time applications.



(a) **(b)**

Figure 3: (a) Gain Value for the Slot Simulated Slot Antenna ; (b) 3 D Plot of the Gain realised

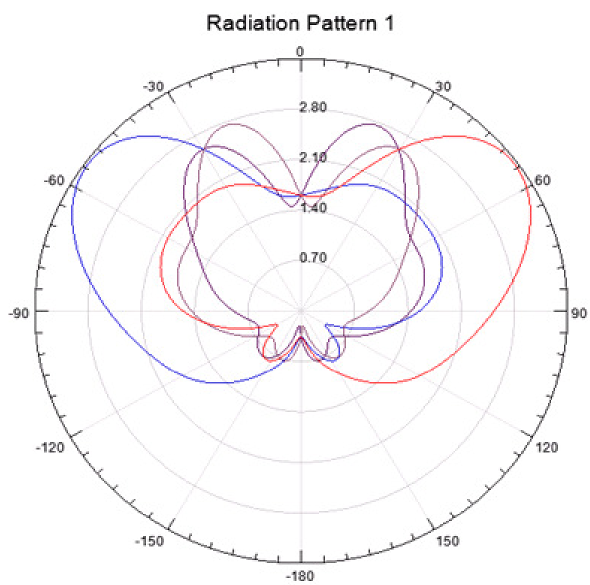


Figure 4: Broadside Radiation Pattern of Simulated Radiating Patch

Figure 3 (a) and (b) depicts the Gain plot of the realised antenna at 9.49dB for the required frequency range. And Figure (4) we can see broadside radiation pattern been realized from the proposed slot antenna UWB antenna structure. The gained performance metrics have been found to be as required in the said application standards.

III. Conclusion

A broadside slot based mircostrip antenna structure was realised using FR4 laminate board with copper radiating patch. The return loss characterics were found to be in the required performance levels. The gain of 9.49dB was achieved for the plus shaped microtrip antenna. Further, the various antenna parameters still require improvements in the required frequency band. The dimensions of the realised antenna were found to be 20*20, making it a compact antenna candidate for future wireless applications.

IV. References

[1] Wanjun Yan, et al. *"A Low Profile Wideband Circularly Polarized Crossed Dipole Antenna",* III Antennas and Wireless Propagation Letters, Vol 16, 2017

[2] Ubaid Ullah, et al, *"A Review of Wideband Circularly Polarized Dielectric Resonator Antennas"* Communication Theories and Systems Chinna Communications, June 2017

[3] Son Xuat, Ikmo, Park, *"Compact Wideband Circularly Polarized Patch Antenna Array Using Metasurface",* IEEE Antennas and Wireless Propagation Letters, Vol 16, 2017

[4] Mehrdad Nosrati, Negar Tavasolian,*"A Y-Slot Wideband Circularly Polarized Antenna for NON Contact Health Monitoring Applications",*978-1-5090-288-3/16, IEEE 2016

[5] Yanfang Wang, Fuguo Zhu, Steven Ga.*"Design of a Low Profile 2-10 GHz Ultra Wideband Antenna Array",*Progress in ELectromagnetic Research Symposium (PIERS), August 8-11, 2016

[6] Asim Quddus, et al. *"Ultra Wideband Antenna With Quad Band Rejection Characteristics",* Proceedings of ISAP, Japan 2016

[7] Yunfei Qiang, Wei Wang, Yufan Yao,*"A Printed Ultra-Wideband Antenna with C-Shaped Ground Plae for Pattern Stability",* 978-1-4673-8983-9, IEEE 2016