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Design and development of a novel and compact ultra wideband printed monopole antenna

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Abstract
In this paper the plan of a little and minimal U space UWB printed monopole microstrip antenna of size 19.2 × 28.8 mm2 has been introduced for remote applications. The planar, little and meager UWB radio wire configuration comprises of a U space radiator took care of by a solitary 50ω microstrip line with shortened ground plane is energized by a coaxial SMA connector. The recreations are finished utilizing the Ansoft High Frequency Structure Simulator (HFSS) programming instrument. The recreated consequences of impedance data transmission are very much upheld by estimation. The deliberate gathering deferral and radiation design results are likewise introduced and execution of the radio wire is dissected/examined.

Keywords: Ultra Wideband, Antenna

Introduction
The Federal Communications Commission (FCC) endorsement of the recurrence band in the scope of 3.1 to 10.6 GHz in 2002 [1], has spurred both scholarly and mechanical networks to create minimized reception apparatuses for UWB radio applications. It is foreseen that UWB innovation empower rapid information transmission rate with low force utilization. Minimal effort UWB reception apparatuses are attractive for different applications, for example, remote correspondences, clinical imaging, radar and indoor situating [2]. The benefits of printed recieving wire, for example, light weight, little size and low profile make them an appealing possibility for UWB reception apparatus advancement [3].

Similar to the case in any traditional remote correspondence frameworks, a radio wire additionally assumes an extremely crucial function in UWB frameworks. Then again the difficulties looked in planning a UWB reception apparatus are some more. A decent contender for UWB applications are printed monopole radio wires because of their minimization, light weight and basic structure [4, 5, 6, 7, 8, 9, 10].

The plan of a tightened U space printed monopole microstrip reception apparatus is accounted for in ultra wideband for remote applications in this paper. First the planar PCB recieving wire configuration is presented. Additionally the different plan contemplations and measurements are summed up. At long last the reproduced and estimated results have been thought about and in the process a novel recieving wire is acknowledged and manufactured.

UWB Antenna Geometry
The planar, little, flimsy UWB recieving wire is carved on a 19.2mm × 28.8mm FR4 substrate having an overall permittivity of 4.4 and a substrate stature of 1.6mm. The math of the proposed recieving wire is appeared in figure 1 and the photo of the manufactured reception apparatus is appeared in figure 2. The U opening emanating patch and transmission line are associated by tightened edges to acquire better impedance coordinating. An incomplete ground plane having the length of 9.2mm is utilized on the opposite side of the substrate.

It comprises of an opening of measurements 2.8mm × 1.2mm simply behind the transmission line to improve the transfer speed.

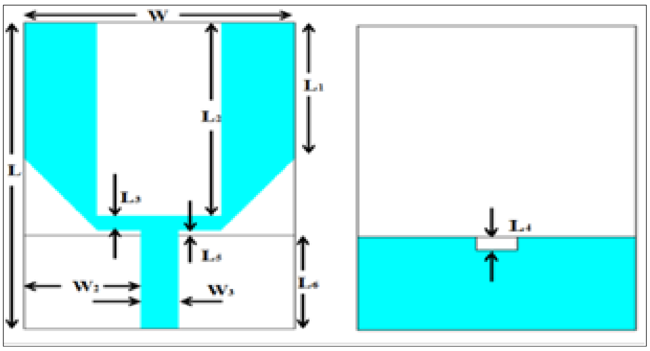

Fig 1: Geometry for the proposed antenna

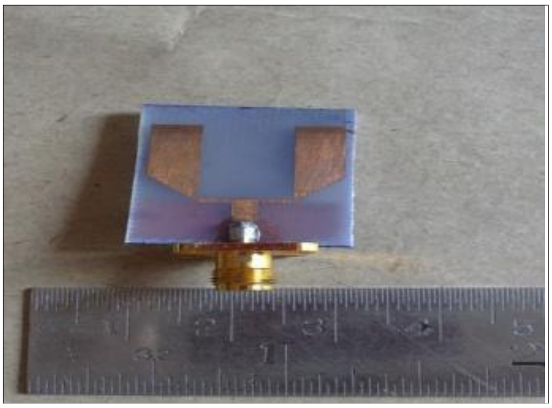

Fig 2: Fabricated UWB Antenna

The resounding length of a microstrip fix can be acquired by utilizing basic relations of the viable relative dielectric consistent as an element of the substrate boundaries and the working recurrence as follows [11].

$$\epsilon_{\text{reff}} = \frac{\epsilon_{\text{reff}}+1}{2} + \frac{\epsilon_{\text{reff}}-1}{2}\left[1+12\frac{h}{W}\right]^{-\frac{1}{2}} \quad (1)$$

$$W = \frac{c}{2f}\sqrt{\frac{2}{\epsilon_r+1}} \quad (2)$$

$$L_{\text{eff}} = \frac{c}{2f\sqrt{\epsilon_{\text{reff}}}} \quad (3)$$

$$\Delta L = 0.5h \quad (4)$$

$$L = L_{eff} - 2\Delta L \quad (5)$$

where c is the speed of light in free space, L and W are the length and the width of the resonant patch antenna respectively. By simulating different patches with substrate parameters, it is possible to obtain the appropriate values as the patch does not have a ground plane on the other side of the substrate as shown in figure 1. The center frequency used in the simulations is 6 GHz. For this operating frequency and substrate parameters which are discussed before, the dimensions of the patch are calculated to be W = 15.21mm and L = 11.98mm. These dimensions represent the starting point for the present design of the UWB antenna as shown in figure 1. The parameters of the proposed antenna are given in Table 1.

Table 1: Prameters for the antenna

Serial No.	Symbols	Size(mm)
1	L	28.8
2	W	12.8
3	L_1	18.16
4	L_2	1.04
5	L_3	1.2
6	L_4	0.4
7	L_5	9.2
8	L_6	19.2
9	W_1	5.2
10	W_2	8.2
11	W_3	2.8

Some modifications are introduced on this patch to improve its operating bandwidth. The first once is to taper the patch near the feeding microstrip line. Due to the tapering effect of that part connected to the microstrip line, the dimensions of the patch are modified through simulations to be matched with the line such that the length L of the patch is changed to be 12.8mm and the width W is changed to be 19.2mm as mentioned in table 1. Using these dimensions with tapering length L_{taper} = 6.4mm are adequate to introduce an UWB patch antenna that operates in the frequency range from 4.1 to 14.0 GHz as is shown by the simulated result in the following section.

Results and Discussion

Figure 3 shows the variations of the measured and simulated results of impedance bandwidth (VSWR< 2) for the proposed UWB antenna. The measurements were done using vector network analyzer (VNA, PNA N5230A, Agilent Technologies).The results show that the proposed fabricated antenna achieves an impedance bandwidth (VSWR< 2) from 3.4 – 14 GHz. Some differences in the simulated and measured return loss curves (S_{11} plots) are seen. The main reason is that measurement is done in a non-controlled environment.

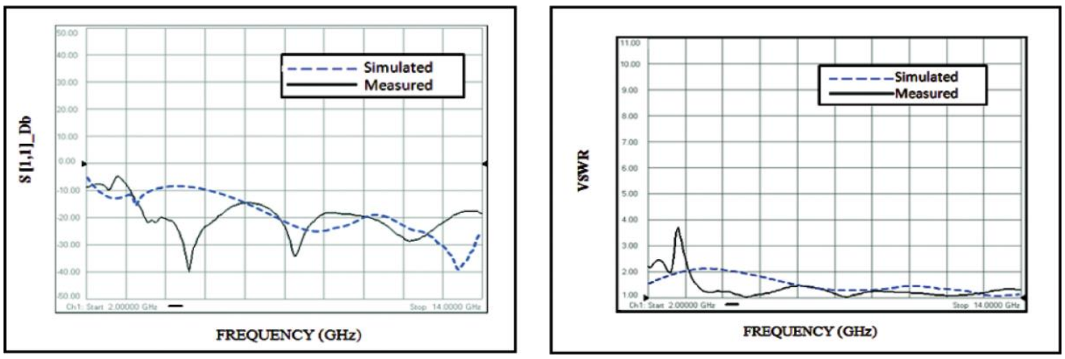

Fig 3: Simulated and measured return loss and VSWR curves

Figure 4 show the simulated radiation patterns of the proposed antenna at 4.5, 6.5, 8.5 and 10.5GHz. The far field radiation patterns measured using C-band (4-8GHz) and X-band (8-12.4GHz) Microwave benches at 6.5, 8.5 and 10.5GHz are plotted in Figure 5.

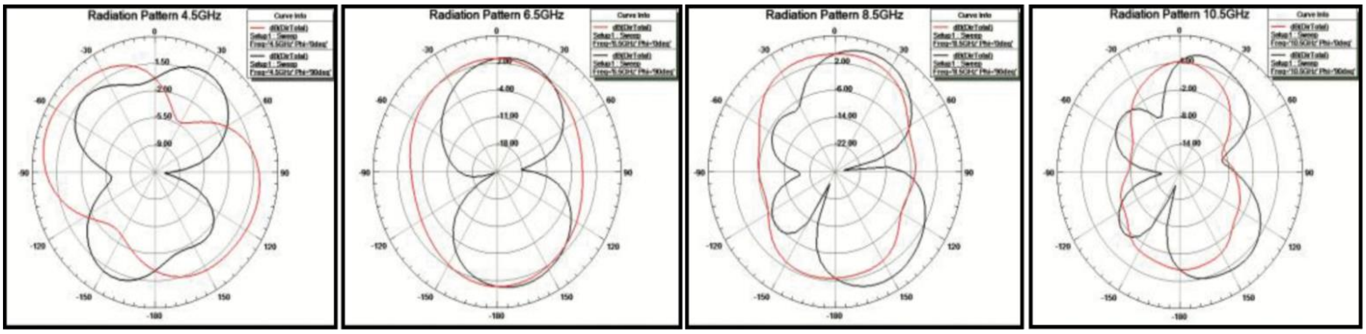

Fig 4: Simulated Radiation patterns at 4.5, 6.5, 8.5 &10.5GHz

It is plainly observed that the radiation examples of E-plane are monopole like and H-plane radiation designs show nearly omni-directional qualities, particularly at lower frequencies. Anyway the radiation designs begin to change in higher frequencies and UWB radio wire gets order. At high frequencies (for example from 7GHz onwards) on account of fake radiation side projections show up as appeared in figure 4.

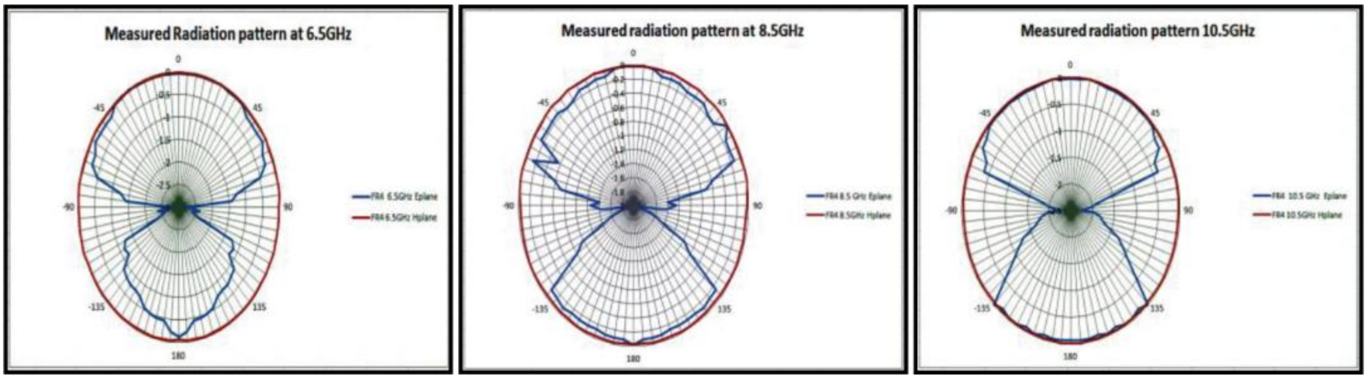

Fig 5: Measured Radiation patterns at 6.5, 8.5 & 10.5GHz

The simulated antenna gain varies from 4.4dB to 6dB over the operating UWB frequency range as shown in figure 6. Another important parameter in UWB antenna design is the group delay. From the measured results the antenna group delay is approximately constant and within the frequency band of interest as shown in figure 7.

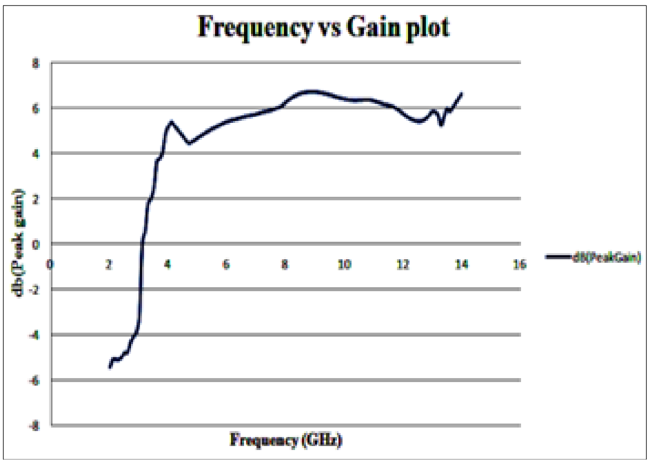

Fig 6: Simulated antenna gain

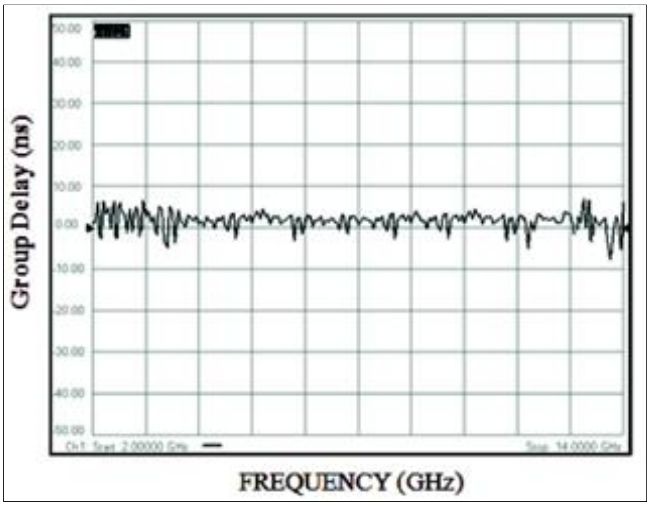

Fig 7: Measured group delay for fabricated UWB antenna

Conclusion

An epic smaller UWB reception apparatus has been planned, reenacted, estimated and created. The recreation results acquired by Ansoft HFSS programming show great concurrence with the deliberate outcomes. Gathering postpone which is more significant boundary to show great time space trademark in UWB reception apparatus is explored and the varieties acquired are additionally acceptable and inside as far as possible. To scale down

UWB radio wire, tightening and shortened ground fields are utilized. It is seen from the deliberate outcome that extremely huge transfer speed is gotten for the proposed reception apparatus which can be utilized in UWB correspondence frameworks.

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