PERFORMANCE AND IMPROVEMENT OF ARS ULTRAWIDEBAND ANTENNA

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Abstract: ***In this paper, a compact style and experimental study of microstrip-Line fed annular-ring formed (ARS) antenna is conferred. The antenna consists of two ARS that area unit diagonally connected to every different with a curving ring and a changed L-shaped ground plane. The antenna provides an extremist wide information measure with return loss, which apparently covers entire UWB band. Additionally, the antenna incorporates a considerably compact size. The measured and simulated results ensure the quality of the antenna for ultra-wideband applications.***

I.INTRODUCTION

UltraWideband technology includes a big variety of applications in short-range high rate communications and microwave radar near-field imaging. As an example, microwave optics is employed for tissue imaging, microwave radar near-field imaging in fossil oil pipeline imaging to check the corrosion, and observance the submarine conditions of various objects. The important demand for pipeline review victimization microwave radar imaging is that antenna must be operated in fossil oil of insulator constant 2.5, and also the size of the antenna ought to be as tiny as doable. Because the image resolution is directly proportional to the information measure of the heartbeat, all the imaging applications need wide information measure. Microstrip antenna with completely different shapes like octagonal-shaped, arc-shaped, M-shaped, ring-shaped slot, polygon formed, M-shaped, triangular geometries has been projected for UltraWideband application. In, a C-shaped radiator with Associate in nursing inverted L-shaped coupled strip extending from the bottom plane is employed for information measure improvement, whereas coupling impact between the structures is employed to enhance the electric resistance matching. A plate like crossed monopole antenna and an oblong patch with U-shaped open-slot structure are rumored for the triangular geometries UltraWideband application. Doubled ramp-shape feeding techniques square measure used for increased information measure, and shorting pins square measure accustomed miniaturize the scale of the patches. A unique compact microstrip-fed UltraWideband step-slot antenna with a revolved patch for increased electric resistance information measure is incontestable in. All the antennas mentioned on top of square measure larger in size and offer a comparatively lower electric resistance information measure than the projected antenna style. Additional reduction of the antenna size would face a challenge because the sizes of those antennas are set by the longest electrical length of the surface currents at very cheap frequency. During this chapter, a miniaturized style is projected and investigated for broadband applications employing a microstrip-line fed annular-ring monopole radiator for line imaging. Within the projected style, an angular-ring formed diverging patch and defected ground plane is employed with an embedded curved stub within the feed-line to get increased information measure. The slotted ground-plane has 2 extended rectangular strips on each side that excites a further resonance at the lower frequency. The antenna is often simply matched into a pipeline while not obstructing the flow of the liquids. The antenna is additionally able to give seamless operation in fossil oil.

II.DESIGN STRATEGY

Figure 1 show a schematic configuration of the proposed geometry which is fed by a 2.4 mm wide microstrip line. The antenna is fabricated on an epoxy FR4 dielectric substrate (loss tangent, tan δ =0.02, relative permittivity, εr =4.4) with very small dimensions of 15×12×1.6mm3. The radiator consists of two annular-rings that are printed one over the other along with a rectangular strip of width Wf and length Lp2.

Table.1: Comparison of the Proposed Antenna with Other Reported Antennas

Reference	Size	Operating
8	70×60	2.5–18
3	30×30	3.02–13.27
7	36×36	2.38–12.40
6	80×80	3–12
5	25×23	2.71–12.61
9	23×41	2.3–20
10	30×30	3–12
4	25×40	3.1–5.15
1	20×20	3.1–10.6
2	24.5×24.5	2.95–12.1
Proposed	15×12	3.0-25

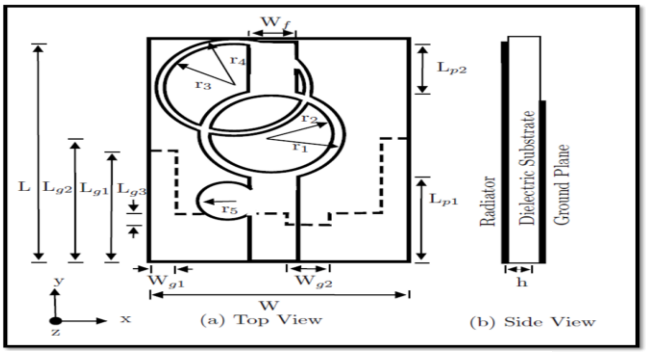

Figure 1: Schematic Configuration of the Proposed Prototype

The feed is modified by attaching a semicircular stub of r5 to provide 50Ω feed and to improve impedance matching. The slotted ground plane of the proposed antenna is printed on the other side of the dielectric substrate to improve impedance matching at the lower middle band. Further, two rectangular strips of lengths Lg1 and Lg2 of width Wg1 are connected at the edges of the ground plane to excite lower frequency band. It is clearly observed from Table 1 that the proposed antenna has the smallest size with enhanced bandwidth from the above-reported designs.

Table 2: Design Parameters of the Proposed Antenna shown in Fig.1

Parameters	L_{p1}	L_{p2}	W_f	r_1	r_2	r_3	r_4
Unit(mm)	4.53	4.28	2.4	3.2	2.8	3.2	3.5
Parameters	W_{g1}	W_{g2}	L_{g3}	L_{g1}	L_{g2}	r_5	W
Unit (mm)	1.5	1.5	1	7.0	7.5	1.3	12

The antenna style was enforced in 3 steps, as incontestable in Fig. 5.2. The 1st step involves a construction of the feed-line with an easy rounded formed patch; the second step is changed by attaching a curving conductor to the feed line, and also the final step involves making associate other rounded-ring on a top side of the annular patch. The come loss responses of the antenna altogether 3 steps area unit represented in Fig. 2. Therefore, the projected antenna provides an UltraWideband with a usable incomplete information measure of over 157% (3-25 GHz). The parameters of the projected pure mathematics area unit optimized to realize a miniaturized style, and optimized dimensions area unit listed in Table.2.

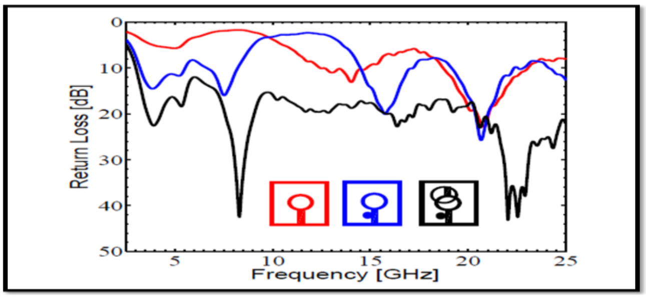

Figure.2: Simulated Return Loss against Frequency for Three Steps that are used for designing the antenna

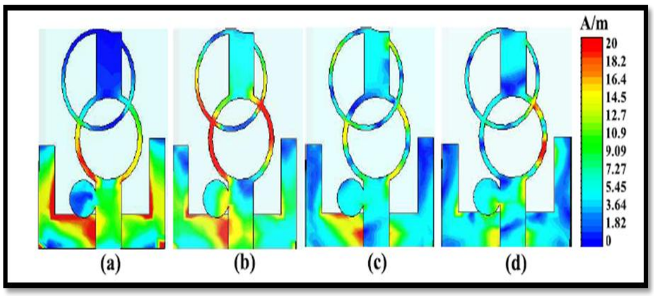

Figure.3: simulated surface current distribution of the proposed antenna at (a) 3.9GHz (b) 6GHz (c) 16GHz and (d) 22GHz frequencies

The various simulated current densities square measure planned in fig .3 to know the improved broadband behavior of the antenna. Fig. 3(a) depicts that the surface current is principally distributed over the whole ground plane and also the lower rounded ring of the patch. It clearly indicates that the lower band is worked up because of each the oblong strips hooked up to the bottom plane and a lower rounded ring. The surface currents square measure primarily distributed over the bottom plane and central elements of the radiator for the frequency around 6 gigahertz. For middle frequencies around sixteen gigahertz, this is focused around rounded rings of the patch and feed-line as shown in Fig.3(c). Finally, Fig. 3(d) shows that this is distributed over entire patch and ground plane.

III.PARAMETRIC STUDY

Simulated return loss curves for various parameters of the antenna are discussed in order to show the effectiveness of the designed antenna. Fig.4 depicts the variation of the outer radius (r1) of the annular ring with frequency. It is observed that for the outer radius r1 = 3.2 mm, the antenna shows enhanced impedance bandwidth from 3-25 GHz. Therefore, r1 is used to enhance impedance bandwidth and improve impedance mismatch that mainly occurs at the middle (7-13 GHz) and higher frequency bands. Figure .3: Simulated Surface Current Distribution of the Proposed Antenna at (a) 3.9 GHz (b) 6 GHz (c) 16 GHz and (d) 22 GHz Frequencies The various simulated current densities are plotted in Fig.3 to understand the enhanced

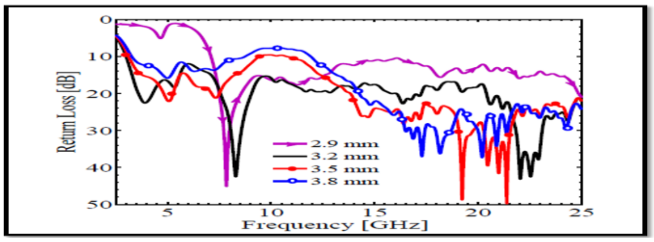

Figure.4:Simulated Return Loss against Frequency of the Proposed Antenna with Radius r1

Fig. 5 depicts the return loss curve of the parameter (r5), i.e., the radius of the semicircular stub attached to the feed-line with frequency. As the value of r5 increases from 0.9 mm to 1.3 mm, impedance matching greatly improves. It is found that return loss of the antenna remains below 10 dB for r5 = 1.3 mm. Further increment in the value of r5 degrades the performance of the antenna. Therefore, at r5 = 1.3 mm the antenna shows enhanced impedance bandwidth from 3-25 GHz.

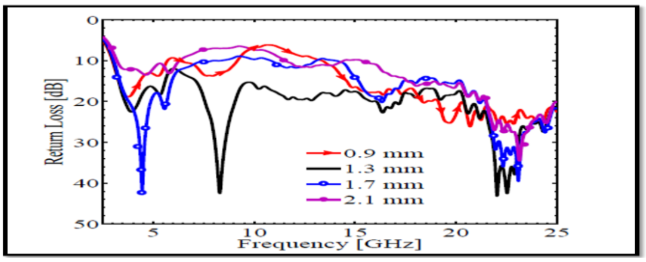

Figure5:Simulated Return Loss against Frequency of the Proposed Antenna with Radius r5

In the proposed antenna design, the ground plane parameters significantly control the impedance bandwidth of the antenna. In order to get the best performance, various simulations were carried out. The rectangular strips extended on both sides of ground plane excite the first resonance in the proposed antenna. Fig.6 shows the return loss curves of the proposed antenna for various ground strip lengths (Lg1) with frequency. It is observed that for length Lg1 = 7 mm, the antenna shows enhanced impedance bandwidth from 3-25 GHz. Therefore, Lg1 is used to improve impedance matching at the lower and middle-frequency bands. The width Wg1 of the rectangular strip also affects the performance of the antenna. Fig. 7 shows the simulated return loss curve of the proposed antenna for various ground strip widths Wg1 with frequency.

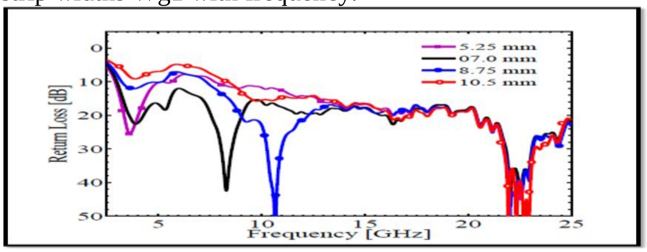

Figure6:Simulated Return Loss against Frequency of the Proposed Antenna with Length Lg1

As the value of Wg1 increases from 0.3 mm to 2.1 mm, the impedance matching mainly at lower frequency band improves. Therefore, at Wg1 = 1.5 mm the antenna shows enhanced impedance bandwidth from 3-25 GHz.

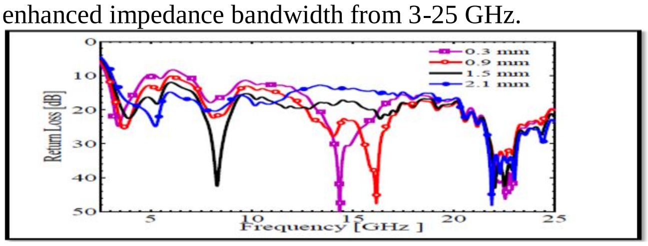

Figure.7:Simulated Return Loss against Frequency of the Proposed Antenna with Width Wg1

ANALYSIS

The pulse handling capability in conjunction with at the fidelity issue calculation of the projected antenna is measured by time-domain analysis victimization Central Standard Time MWS. These studies area unit distributed by inserting 2 antennas within the far-field region. The transmitter is worked up by a Gaussian signal that complies with the FCC indoor and outside power spectrum mask. Fig.8 shows the input and received signals within the far-field region. The low-distortion time-domain performance of the miniaturized antenna is additionally confirmed by scheming the fidelity issue. Fidelity issue is employed to live the degree of similarity or correlation between the transmitted and received pulses. The fidelity factors within the case of face-to-face and side-by-side area unit obtained as seventy three and sixty one, severally.

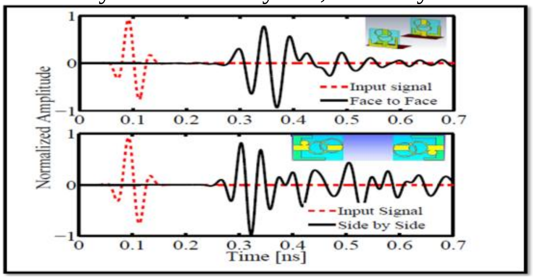

Figure.8: input and received pulse in different orientations of proposed antenna

The group delay is another parameter in time domain analysis, which shows the distortion of the transmitted pulses in the wideband communication. Therefore, the group delay shall be almost constant in the entire operating band for a good pulse transmission. It is seen from Fig. 9 that the group delay of the proposed antenna remains constant as it shows a variation of 1ns only. The group delay characteristics discussed above demonstrate that the proposed antennas exhibit phase linearity at desired operating frequencies. It is found, from the aforesaid parametric studies in the time domain, that the antenna has a good pulse handling capability in the entire operating frequency band.

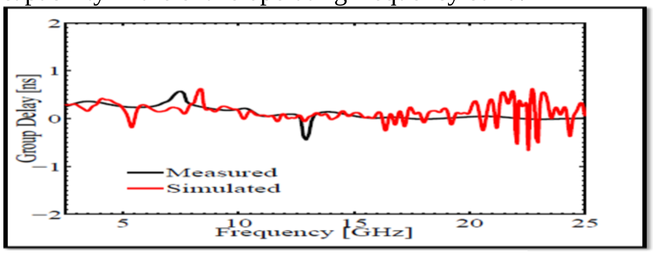

Figure.9: Group Delay of the Proposed Antenna

RESULTS&DISCUSSION

After optimization, the proposed antenna was fabricated with the MITS Eleven Lab PCB machine. Then to validate the simulated results, the antenna return loss is measured by submerging the antenna in diesel using the Agilent N5230A vector network analyzer. Diesel has the same dielectric constant as crude oil [158]. Fig. 5.10 shows the variations of the return loss with frequency for the proposed enhanced bandwidth antenna. It is found that the antenna shows an enhanced wide bandwidth for return loss <10 dB of 22 GHz (from 3-25 GHz). The measured result shows good agreement with simulated one Some deviation in result may be due to fabrication tolerance or measurement as it is carried out in the scattering environment.

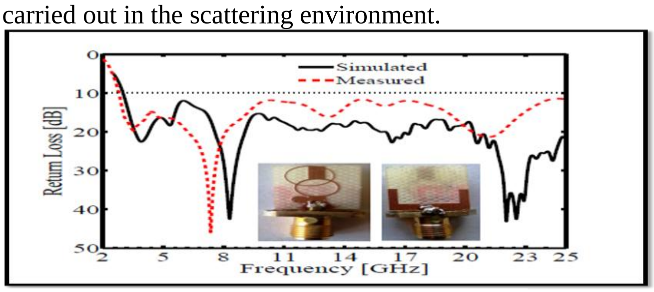

Figure10: Return Loss Variation with Frequency

The variations of the gain and the radiation efficiency with the frequency of the proposed antenna are shown in Fig. 11. It is evident that the antenna shows a good radiation efficiency for the entire band of operation within 75% to 90%. It is also observed in Fig. 11 that the gain of the proposed antenna varies from 2.8 dB to 5.8 dB. Thus, the gain of the proposed antenna remains stable, and its low value is due to the very compact size of the antenna.

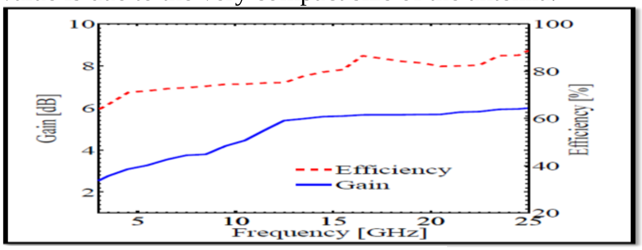

Figure 11: Gain and Radiation Efficiency

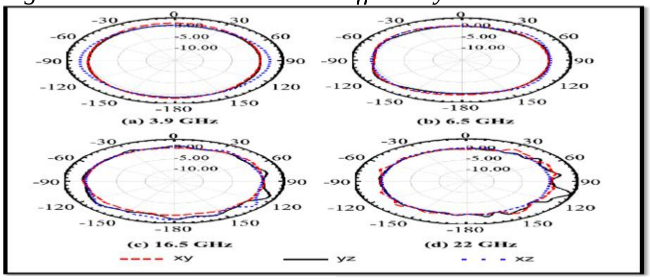

Figure 12: RPs at Various *Freq*

Figure 12 shows the measured radiation patterns in the xy-, yz- and xz- planes at various sampling frequencies (3.9, 6.5, 16.5 and 22 GHz). It is seen that the radiation pattern is like a monopole antenna pattern at the lower frequency side (3 GHz). At higher frequencies, the radiation is due to the higher order modes which are responsible for a splitting of the radiation lobe.

CONCLUSIONS

In this section, a novel miniaturized design of UltraWideband monopole antenna for enhanced wide bandwidth performance is successfully presented. The designed antenna offers an impedance bandwidth of 22 GHz with a good impedance matching and stable radiation pattern. As the size of the antenna is very small, it is a potential candidate for pipeline inspection using radar imaging. Moreover, the main application of UltraWideband antenna is in indoor surroundings where multipath propagation leads to detrimental Inter-Symbol Interference (ISI). In the next chapter, therefore, multiple or multiple-input and multiple-output antennas will be designed in order to turn this drawback into an advantage.

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