Review of Modified CPW-Feed Polarization Diversity Ultrawideband Antenna

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Abstract-*A new modified compact coplanar-fed antenna suitable for polarization diversity in ultrawideband (UWB) applications is praposed.The antenna consists of two identical monopoles that are printed on a low-loss substrate with 3 mm spacing and positioned perpendicular to each other. Both frequency- and time-domain results have been measured and presented to validate the design. Results show that the proposed antenna has not only ultra-wide bandwidth(% for port 1 and % for port 2 , but also good port isolation above 22 dB over the entire band of interest.*

Moreover,radiation patterns demonstrate good orthogonal polarization operation. Furthermore, the system fidelity factor is adequate for pulse transmission with averages of 85% and 75% for port 1 and port 2,respectively. Finally, the envelope correlation coefficient has been calculated to evaluate the diversity performance. Results indicate that 20 dB across the ultra-wide bandwidth. These results show the suitability of the proposed antenna for future UWB diversity applications.

Keywords- Microstrip patch antenna, UWB antenna, CPW Feeding Technique, ISM band.

I. INTRODUCTION

Ultra-wide band (UWB) technology is in wireless body area network (WBAN). A great deal of research effort has recently been conducted on this subject in several directions, such as in-/on- or off-body wearable antenna design and optimization, channel modeling and links performance affected by the human body. It is generally known that printed UWB antennas attached to the body with *E*-field polarization parallel to its surface highly reduce the matching bandwidth. Most of these antennas use microstrip-line (MS) or coplanar waveguide (CPW) as their feeding structures, in order to have all conductors in a single or at most two planes. The field distributions,show that in an MS crosssection. the *E*-field lines pass substantially through the substrate while in a CPW cross-section the path in the substrate is smaller. In printed UWB designs, the ground of MS-fed antennas needs to be truncated (called finite or partial ground planes) to obtain the intended UWB bandwidth and the ground(s) acts as a radiator. This may lead to fields coupling to the body which are stronger in the MS- than in CPW-fed antennas. Therefore, this paper aims at investigating theinfluence of the feeding structure on the behavior of such antennas when placed near a human arm. For this purpose, two identical loaded UWB monopole base designs were considered with the two different feeding structures under analysis.

Antenna diversity is an effective solution to mitigate multipath fading signals and enhance the system capacity. Several types of diversity such as spatial/space, pattern, and polarization diversity have been proposed and implemented to simultaneously receive multiple transmissions. Recently, ultrawideband (UWB) has become one of the most favorable technologies for wireless communications owing to its promising features such as low susceptibility to multipath fading, reduced probability of detection and intercept, and potentially high data rates. These make it attractive for wireless body area networks (WBANs).

A suitable UWB-WBAN diversity antenna should have low mutual coupling, i.e., high isolation, between its branches. The higher the isolation, the better the diversity performance and the higher the efficiency of each branch. Various types of printed UWB diversity antennas have been investigated and presented aiming at reducing the antenna size and increasing the isolation. UWB systems are often realized in an impulse-based technology, and therefore the time-domain effects and properties have to be known as well. In body proximity scenarios, UWB-WBAN antennas excited by coplanar waveguide (CPWs) are preferred to microstrip (MS) feeding structures as they detune less near the human body. A few antenna used CPWs as the feeding structure.

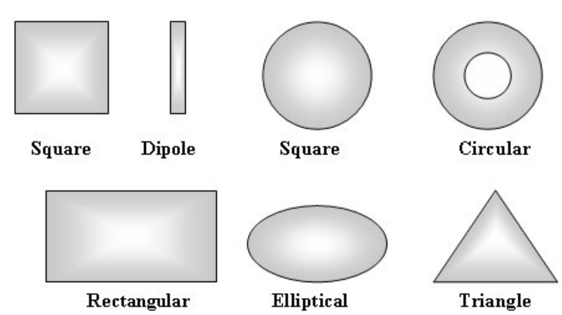


Fig.1 Different Shapes of Patch

In this project a new modified compact coplanar-fed UWB antenna aimed at applications requiring polarization diversity, like body-centric and multiple-input–multiple-output (MIMO) communications, is considered to be present. The whole structure has the same width as the antenna presented in [14], but has a larger length (52 mm), with the advantage of lower mutual coupling (isolation dB) in its entire bandwidth. The proposed antenna is smaller than other previous UWB diversity CPW-fed designs. In this work, both frequency- and time-domain results are considered to be measured in terms of -parameters, radiation pattern, impulse response, and system fidelity factor. We also focused on the diversity performance of the proposed antenna by calculating its envelope correlation coefficient. The antenna consists of two identical monopoles that are printed on a low-loss substrate with 3 mm spacing and positioned perpendicular to each other. The proposed antenna has expected to have not only ultra-wide bandwidth (~115 % for port 1 and 107 % for port 2), but also good port isolation above 22 dB over the entire band of interest. Moreover, radiation patterns demonstrate good orthogonal polarization operation.

UWB Definitions And Antenna Parameters

The desired operating frequencies are given by:

- U.S. FCC regulation as 3.1 to 10.6 GHz;
- European regulation as 6.0 to 8.5 GHz;
- special allocations, e.g., ground penetrating radar or wall radar; But not limited to these. A general definition of UWB is stated with the relative bandwidth

$$\frac{2(F_H - F_L)}{F_H + F_L} > 0.2 \qquad (1)$$

where f_H and f_L are the upper and lower band limits, respectively. Relative bandwidths in excess of 100% are possible for some antenna types.

UWB ANTENNA PRINCIPLES :

The radiation of guided waves that the key mechanism for radiation is charge acceleration. The ultra-wide bandwidth radiation is based on a few principles:

- Traveling-wave structures
- frequency-independent antennas (angular constant structures)
- Self-complementary antennas
- Multiple resonance antennas
- Electrically small antennas

In most cases the radiation starts where the electric field connects 180 degree out-of-phase currents with half a wavelength spacing. Many antennas radiate by a combination of two or more of the above principles and can therefore not be simply classified. The monocone properties can be well approximated by the planar structures like planar monopoles. These are very well suited for short-range communications, as they can easily be integrated with different planar lines and circuits.

In practice from a system point of view, two cases for UWB have to be distinguished:

- Multiple narrow bands, e.g., OFDM (ECMA-368 Standard)
- Pulsed operation (IEEE 802.15.4a)

The first case can usually be treated like the well-known narrow-band operations. The second case needs a closer look. If in a pulsed operation for radar or communications the full FCC bandwidth from 3.1 to 10.6 GHz, i.e., 7.5 GHz, is covered.

II. ANTENNA STRUCTURES

BLOCK DIAGRAM OF PROPOSED ANTENNA

The geometry of the proposed antenna. It comprises two identical monopoles which are perpendicular to each other.

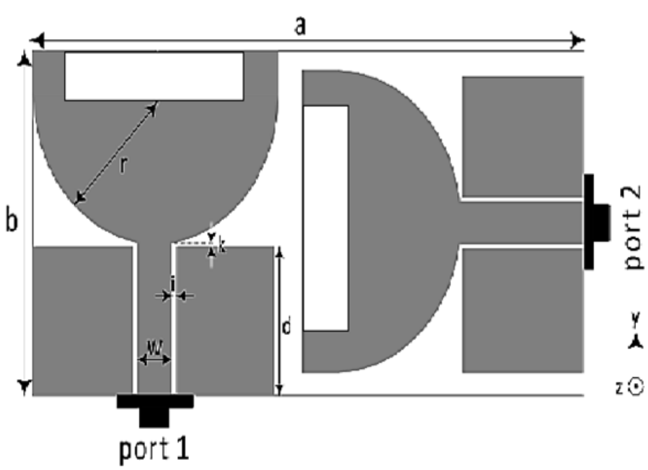


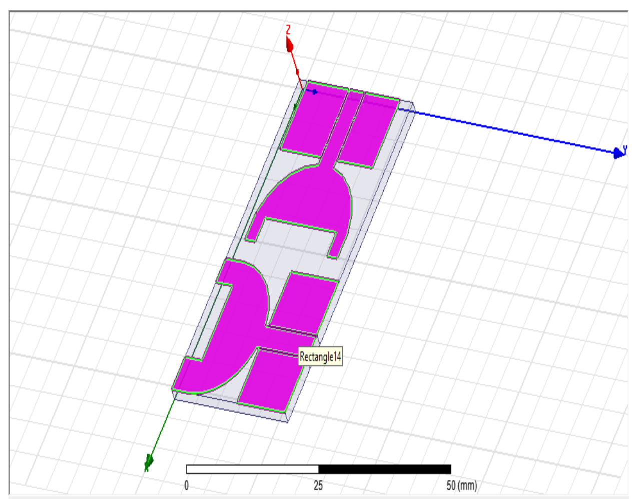
Fig. 1 proposed antenna geometry

The proposed antenna comprises two identical monopoles are perpendicular to each other with a spacing of 3 mm (0.68 λ_0). The substrate used is low-loss RT/DUROID 5870 substrate (ε_r = 2.33mm, h= 1.57 and tan δ = 0.0005). Each patch comprises a semicircle with a rectangular section on the top. The two branches' are fed through 50-Ω coplanar lines. he back side of the substrate is devoid of metallization. The total area of the antenna structure is 27 ×52 mm^2 ; the detailed dimensions are given in Table I. When the antenna port 2 is matched, the current vector is aligned with the -axis, which leads to an -field linear -polarization; with a port 1 matched,the current vector is aligned in the -axis, which leads to a linear -polarization. It is also seen that the coupled fields to the adjacent branch are aligned with the excited port fields. As shown in Fig. 2 below.

TABLE I
PARAMETER VALUES OF THE FABRICATED ANTENNA

Parameter	a	b	c	d	r	w	i	k
value–*mm*	52	27	4.5	11.4	11	3.2	0.15	0.1

each other and printed on a low-loss RT/DUROID 5870 substrate(mm, and) with a spacing of 3 mm (0.68). Each patch comprises a semicircle with a rectangular section on the top. The two branches' are fed through 50- coplanar lines. The back side of the substrate isdevoid of metallization. The total area of the antenna structureis 27 52 mm ; the detailed dimensions are given in Table I. Aphotograph of the fabricated antenna is shown In order to demonstrate the antenna operation, the simulated current distribution on the antenna at 6.85 GHz is depicted. The colors representing the current distribution go from dark blue (weak current density) to green, yellow, and red (strong current density). Fig. 2(a) and (b) shows the surface current vector when ports 2 and 1 are terminated with a 50-load, respectively. It is observed that when the antenna port 2 is matched, the current vector is aligned with the -axis, which leads to an -field linear -polarization; with a port 1 matched,the current vector is aligned in the -axis, which leads to a linear -polarization. It is also seen that the coupled fields to the adjacent branch are aligned with the excited port fields. In order to show how the antenna was designed aiming at optimizing its performance, the effects of key parameters on the antenna -parameters are examined. To understand the effect of the radiating element, the semicircle radius " " and width of the rectangular section " " are parameterized. By changing the radius, the length of the rectangular section is also modified.Parameter " " was kept constant and " " changed, and then vice versa. Fig. 3 shows the -parameters results as these parameters vary. As observed, decreasing " " from 11 mm to 9 and 7 mm leads to 9.3% and 14.8% upshift in the 10-dB lower frequency edge of and , respectively, which reduces Simulated antenna reflection coefficients (and) and mutual coupling as a function of antenna parameters " " and " ." Simulated antenna reflection coefficients (and) and mutualcoupling as a function of antenna parameter " ."each antenna port matching bandwidth. Moreover, decreasing" " (which increases the spacing between the two branches) from 4.5 mm to 2.5 and 0.5 mm results in a lower-frequency edge upshift of 12.8% and 15%, and a upshift of 17% and 22.7%, significantly reducing each antenna port bandwidth. It is also seen that is below 20 dB for these parametersvariations.Another important parameter needing investigation is thefeed-gap distance (" ") between the radiator and the CPW ground. For this purpose, the CPW ground length " " is varied. Simulation results depicted show that decreasing the value of " " leads to losing the ultra-wide bandwidth behavior of port 1 and to decreasing both lower- and higher-frequency edges of port 2, while the isolation is at any case above 20 dB. In order to validate the proposed design, both frequency- and time-domain measured results including -parameters, radiation pattern, impulse response, and system fidelity factor, arepresented. Measured and simulated antenna -parameters are depicted. As it can be seen, reflection coefficient impedancebandwidths, based on and 10 dB (almost in the entire band except at 7–7.4 GHz where reaches a maximum of 9.5 dB at 7.2 GHz), of port 1 and port 2 are 3.25–12 GHz % and 3.55–11.7 GHz % , respectively. Moreover, is lower than 22 dB over the entire range of frequencies. The discrepancy between simulated and



measured -parameters responses is attributed to factors such as imperfect solder joints of the SMA connector to the feedline and manufacturing tolerances. Additionally, the induced currents on the feeding cable, due to the ground issues of small antennas , cause the extra resonances in fig. However, when the antenna is connected to the transceiver systems, there will be no feeding cable. The experimental results confirm the ultra-wide matching bandwidth of the proposed diversity antenna with a good isolation between its ports.

III. CONCLUSION

Compact CPW-fed antenna is proposed for ULTRA WIDEBAND applications. The return loss and VSWR and gain, Bandwidth are all meets of the acceptable antenna standards. The proposed antenna has a simple and effective feeding structure has adequate operational bandwidth, and has radiation patterns such that it is suitable for use in ULTRA WIDEBAND applications. Here the gain and bandwidth of the antenna are in very good promising condition so advantages of these antenna are easy to construct, simple structure, and low cost.

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