Reduction of Mutual Coupling for UWB MIMO Antenna With a broadband balance T-line

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***Abstract*—A broadband balance T- type line is proposed to decrease the Mutual coupling of a smaller ultra-wide band (UWB) multiple-performance (MIMO) receive antenna. With the decoupling technique presented, the UWB MIMO receiving antenna described covers the 3.1-9.4 GHz band with a decoupling of more than 17 dB. The proposed broadband balance T-line is not actually set in the margin area between two MIMO components and can be placed on the copper ground. Some margin (radio antenna range) of 20*10mm^2 is achieved. The UWB MIMO receiving antenna is simulated. S- Parameters, radiation patterns, add to productivity, and it is recognized that model collection is simulated.**

Keywords—component; Mutual coupling, Ultra-wide band, Multiple-Input-Multiple-Output

I. Introduction

MIMO (Multiple-input Multiple-output) innovation has always been an incredible keenness of interest for researcher, due to its huge focal points of multitrack decline and expansion of the channel capacity. Almost all everyday gadgets, like PC, printers, and cameras all include ultra-wide band MIMO radio antennas which are connected to offers a high rate of information within a short range.

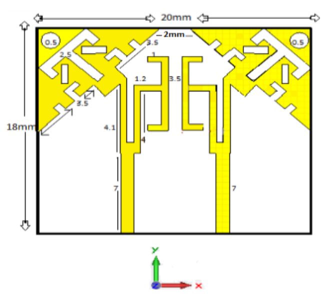

Figure 1a Geometrics of the Antenna

In a compact device, the mutual broadband coupling between the UWB(Ultra-wide band) MIMO components influence the execution of the radio antenna structure. In addition, the improvement of wideband segregation is an exceptional test problem, particularly in the lower UWB band.

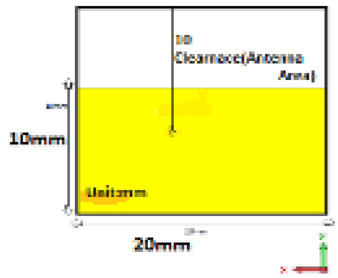

Figure 1b Geometrics of the Antenna

To Date several techniques have been introduced for reduction of mutual coupling of UWB MIMO antenna. A parasitic element was placed between the monopole elements [1]. A capable technique was first raised in for mitigation of coupling effect [2]. In [3] different polarization with a metal stripped was applied. The reduction of broadband mutual coupling [4] Electro-Band Gap (EBG) were etched on the ground plane, by using a metal stripped with a circular disc inserted between UWB MIMO antenna elements [5]. However, the challenge to mitigate mutual coupling effect with a predictable broadband line still exists.

In this research , a T-type broadband line is used between the two antenna elements for reduction of coupling effects shown in figure 1a&b. The planned UWB antenna can cover the band of 3.1-9.4 GHz with decoupling effect more than -17 dB. The suggested T-type neutralization line employed above the ground plane, a small clearance area (antenna area) of 20*10 mm^2 is achieved in the considered antenna.

This technique helped out the reduction in mutual coupling and size of the antenna overall which can improve the performance of the antenna, especially in the lower band. This research focuses on designing a antenna using Computer simulation technology (CST) and comparing S-parameters with and without T-type broadband line with the existing antennas as shown in figure 2. S-parameter, Far-field effect and size is compared with current UWB antenna with the recently designed antennas. In this reseach, all numerical calculation are carried out using CST [6].Table 1 shows the different parameter like width, Length, Radius and Thickness of the substrate Feed line T-type broadband line.

	Length	Width	Thickness	Radius
Subtrate	18mm	20mm	0.9mm	
Ground	10mm	20mm	0.028mm	
Feed Line	7mm	1.5mm	0.028mm	
Triangle	8.5mm		0.028mm	
T-Line	3.5mm	1mm	0.028mm	
Circle			0.028mm	0.5mm
U-shaped	4.1&4mm	1mm	0.028mm	

Table 1 Different parameter of the substrate Feed line T-type broadband line.

II. T-TYPE BROADBAND LINE FOR UWB MIMO ANTENNA

The proposed T-type Broadband Line for this antenna are given in figure 1. Two triangular spaced elements 2mm are produced on a 20*10mm^2 FR4 substrate and the permittivity, thickness and tangent loss of the subtrate are taken 4.3, 0.9mm, 0.025 respectively. The clearance area size of this Ultra-wide band antenna is planned above ground level which is 20*10mm^2. A T-type broadband line is inserted between two triangular spaced elements to reduce the mutual coupling effect. This broadband line is composed of two metal strips that are connected to T-type metal strips as shown in figure .1, which helped out in the reduction of mutual coupling between the antenna elements. The ground plane of the antenna with no slot and composed of copper annealed (lossy metal). The ground plane without any slot are composed of copper annealed(lossy metal).

The simulated S-parameters of the proposed MIMO UWB radio antenna are given in figure 2. The intended MIMO UWB receiving apparatus covers the 3.1-9.4 GHz band with a shared coupling much lower than 17 dB. As a correlation, the parameters without the broadband balance, the line is also given, and with the planned decoupling system, the segregation between two MIMO components of UWB can be productively improved by 12-22dB. In addition, a substantial part of the equilibrium line is above the ground plane, which

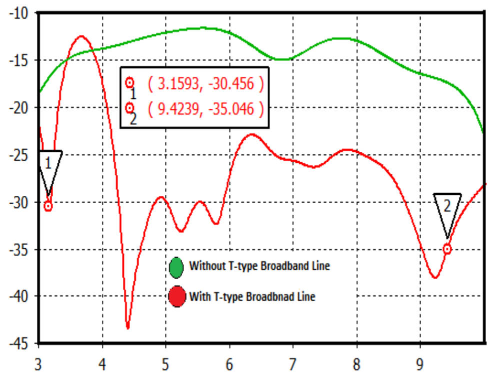

Figure 2 Simulated S-Parameter of UWB MIMO antenna with and without broadband line

will grow the capacitance between the ground and the equilibrium line. Since the broadband balance line is associated with two MIMO components, it will eventually marginally increase the Q-element of the MIMO radio antenna components and will somewhat decrease the data transfer capability. In any case, the transfer speed of the proposed UWB MIMO cable can in any case effectively cover the lower UWB band of 3.1-9.4 GHz.

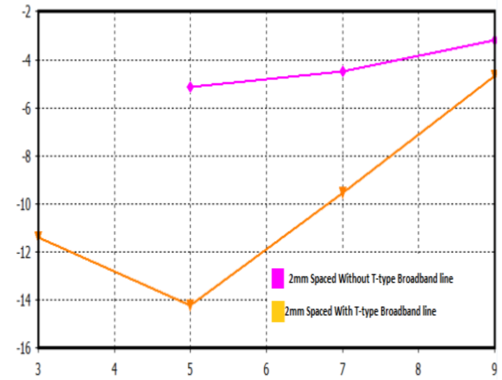

Figure .3 Simulated total efficiency of proposed UWB MIMO with or without T-type broadband Line

Generally, when the antenna that receives MIMO operate in a high recurrence band, i.e, greater than 1.7 GHz, most of the time the connections between the MIMO components are low due to the high radiation capacity. The aggregate efficiencies of the components of the MIMO receiving apparatus are shown in figure 5 with the limits of execution of MIMO while varying qualities in the upper band. The proposed broadband balance line can effectively upgrade disconnection between MIMO components so that the aggregate productivity of the receiving UWB MIMO antenna receives the possibility of advancement. The addition reproduced to the efficiencies of the proposed MIMO UWB receiving apparatus with and without a broadband (NL) balance line are shown in figure 3. The aggregate change of competition with the broadband T-type line is clearly seen. It shows that even in the large space between elements, the proposed dissociation strategy can work productively.

The current allocations of the present MIMO UWB radio antenna proposed with and without a broadband balance line are shown in figure 4 to shown the feasibility of the decoupling. The current allocations are obtained when Port 1 (the left MIMO component in figure 5) is energized at 3.3, 4 and 4.7 GHz. With the broadband balance line, the coupling current that flows out from port 1 to port 2 can suffocate significantly, which causes the lower common couplings. The current allocations at the rear of the proposed MIMO UWB receiving apparatus at 4 GHz are given in figure 5. Within the ground plane, the current is extremely impotent. In fact, for the different frequencies in the 3.1-9.4 GHz band, the currents in this range are also fragile. In practical terms, this zone can be used for RF circuits, where circuits affect the non-side in the execution of the receiving cable. In this letter, we will use it to establish the encouraging link to diminish the impacts of the link in the MIMO proposal that receives the execution of the cable.

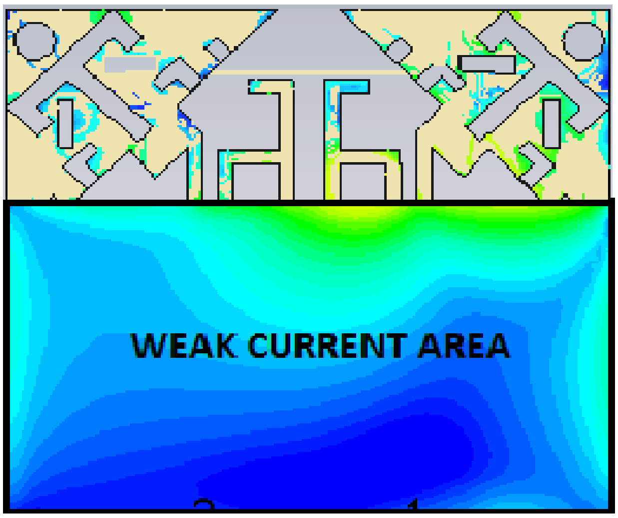

Figure 4 Current distribution on Ground of Proposed UWB MIMO Antenna (color slab is same as shown in figure 5)

III. Results and Discussion

When comparing antenna area clearance, isolation in dB and bandwidth in GHz for our proposed antenna versus the existing antenna as shown in table 2 below, it can be

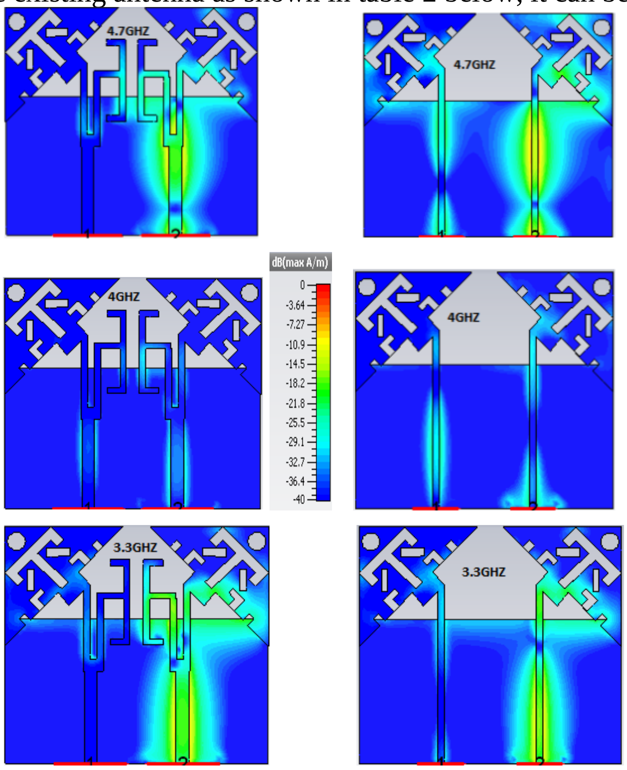

Figure 5 Proposed UWB MIMO Antenna current distributor with or without T-type broadband line

observed that the antenna area clearance is the least, isolation is average which is very good and the bandwidth coverage is also from 3.1 – 9.4 GHz.

Reference	Antenna Area Clearance Size mm^2	Isolation (dB)	Bandwidth (GHz)
[1]	35*27.25	-16dB	3.1-10.6
[3]	32*26	-15dB	3.1-10.6
[4]	60*40	-20dB	3-6
[5]	35*16	-22dB	3.1-5
This work	20*10	-17dB	3.1-9.4

Table 2 Comparing antenna clearance, isolation and bandwidth of proposed antenna with existing antennas.

IV. CONCLUSION

In this research, a UWB MIMO antenna has been designed which is smaller than another previous antennas. It mitigates the coupling effect more efficiently and covers a band of 3.1-9.4 GHz with the isolation of -17dB. The clearance size area of proposed antenna is 20*10 mm^2, this clearance area is by far the least according to the current antennas commercially available, which can be used in situations where a small antenna is required. The parametric revision and current circulation have been explored and the decoupling effect has been removed from the new proposed T-Type is compared to other previous design antenna in which the broadband line is existed.

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