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Bandwidth Enhancement of Π Shaped Stub Structure in Uwb Mimo Antenna for Wireless Applications

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Abstract

A compact Π Shaped Stub Structure of Multiple Input Multiple Output (MIMO) with enhanced band of operation is Ultra Wide Band (UWB) system is projected. The projected system involves double port excitations in addition of common earth or zero (Ground) elements with dimensions of 50×30mm2. Π designed stubs are presented on mutual earth element of the projected Π designed structure. The projected antenna like "pi" designed stubs Ultra Wide band multiple input Multiple output has enhanced Bandwidth, Mutual coupling reduction over the complete UWB range of frequencies. This proposed antenna covers Ku band of operation. The proposed Π Shaped Stub element is simulated the results like VSWR, S-Parameter, Radiation Pattern, Surface current distribution.

Keywords; *UWB MIMO Antenna, Π Shaped Stub, micro strip Patch*

I. INTRODUCTION

UWB MIMO antenna has been developed in wireless and mobile communication systems. It permits multiple antennas at transmitter and receiver to implement transmission consistency.one of the drawback in the UWB technology is the multipath fading. To eliminate this problem, MIMO has been presented as a most effective technology to increase the UWB system process. MIMO technology also has been used to improve the network capability. Finally low mutual coupling is attained by the usage of "pi" designed structure of multiple input multiple output ultra-wide band element.

A compact "pi" designed stub element of antenna array involves different monopole radiators and mutual earth element. Wireless local area network frequency range of operation is eliminated with the usage of UWB MIMO antenna. These results fulfill the return loss, isolation and bandwidth [1].A Compact UWB MIMO technology has been technologically advanced for UWB applications. To increase the impedance matching, various slots are designed on the earth element [2]. The Multiple Input Multiple Output antenna involves double spanner designed excitations alienated with an expanse of one fourth of λ inaddtion of micro strip feed. By using spanner shape antenna, there is a substantial development in range of frequencies, S parameter, power radiation, effectiveness and ECC [3].Polarization diversity technique is mostly preferred in UWB MIMO antennas. In MIMO antenna array different ports are to be considered. For example 4-port MIMO antenna array contains four elements, these elements of ground apertures and stubs attached to earth element can be able to set up to decrease the energisation among four elements. To achieve high gain, Bandwidth and high efficiency, Wideband Frequency selective surface structure (FSS) structure is used. Other than this structure, arrays are used, for example printed micro strip reflect arrays are matched for satellite applications at Ka band. Micro strip reflect arrays has been used to project the flexibility of antenna.

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Radiation performs major roles in the UWB Multiple Input Multiple Output antenna. These emission performances are increased by raising the patch size as well as tunneling slots in the emission of patch antenna. To improve the performance of isolation, we use carbon block picture covered on UWB antenna element. The MIMO ultra wide band antenna elements are also used to reduce the distortion among number of antenna radiators [4]-[7]. One of the special types of 2 elements MIMO antenna was designed hepta band swastika arm antenna. This antenna provides constant radiation features with circular polarization. It also supports maximum isolation without using any extra structural elements. Different types of patches are to be considered for the improvement of bandwidth. One of the most involvements for the patch antenna is multiple parasitic patches. [8]-[9].In an UWB MIMO antenna, the zero plane of antenna components are presents a different designed stub structure, for example a T-molded stub is presented to produce narrow band filter at various frequencies. These notch bands remove interference caused by Wimax,LAN, X band ,Radio frequency identification facility frequency ranges, and also one designed shape is circular arcs shaped ground stubs are used to increase the isolation , individually the arcs are coupled over and done with the stub to create communal ground.it measures the isolation ,gain and bandwidth in addition to that Envelop Correlation Coefficient(ECC) are also to be restrained. Another type of ground stub is reversed triangular shaped ground stub can improve the beam width. For impedance matching enhancement, slots are introduced. In UWB MIMO antenna F designed Stubs are proposed in the zero element to generate high isolation among different antenna patterns, and hence the designed antenna has small mutual coupling, minimal ECC (envelop correlation coefficient), high power and high improvement over the complete ultra-band of frequencies. Stepped shape slot is utilized to increase the isolation. Without using any decoupling structures, we can produce the high isolation by using different feeding networks and tapered slots. The main purpose of shared planar multi antenna elements will increase the coupling between two ports. Surface Current distributions are distributed to different ports within the common ground element [10]-[15]. The notched antenna is used to reduce the interference from adjacent band and also used to improve the bandwidth and low mutual coupling. This notched antenna results demonstrate the current UWB MIMO Communication system. Different types of band notched characteristics performed in UWB MIMO antenna. In this MIMO antenna, three narrow band rejected filter performances can be obtained by expending different slots, slits and DGS (defected ground structure) techniques.In this first element is square element and second element is G shaped elements. The results are demonstrated omnidirectional patterns, gain and diversity implementations [16]-[18]. One of the different antenna configurations is the UWB MIMO dielectric resonator antenna (DRA). These numbers of DRA's are energized by number of micro strip feeds. Moreover different parasitic strips attached to the DRA for the diminution of interference.

Another type of resonator antenna is split ring resonator (SRR).feeding lines are to be influenced by the number of resonators used. UWB MIMO antenna technology not only expands the data transmission efficiency but also suppress the multipath fading. In four ports MIMO antenna, another type of resonator antenna is CSRR (complementary split ring resonator).This resonator antenna quenches the MIMO diversity implementation with reduced ECC.This is also used to suppress the mutual coupling. The near field resonators (NFR) can be simply applied to MIMO path antennas. There are two distributions applied to the decoupling network by using NFR Electric field distribution designate the NFR's and magnetic field distributions exhibit the magnetic fields in the [19]-[22].Minimization of common coupling between two antenna element methods can also be performed

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major role in Ultra Wide band Multiple Input multiple Output antenna elements Their reduction methods are defected ground structure (DFS), Slot antennas, decoupling mechanisms and split ring resonators. Furthermore Multiple Input Multiple Output antenna elements are used in various systems to increase the network size, consistency and improvisation of data. For the improvisation of gain with suppressed mutual coupling, we use special type of antenna array i.e. the AVA (antipodal Vivaldi antenna) array. These numbers of antenna elements are mainly used for 5G millimeter wave applications [23]-[24]. In modern years, software defined radio techniques have an endorsed response. A compact 'n' number of ports are integrated and these are expended for CR UWB MIMO antenna Applications has been used for the minimization of problems in conventional antennas. Therefore the complete ultra-range of frequencies are enclosed by Narrow band/ Wide band elements of antenna.Cognitive radio technology is one of the innovative technologies in Ultra Wide Band Multiple Input Multiple Output elements for software defined radio applications. There are 3 operating modes viz. UWB mode, Frequency reconfigurable mode, and UWB antenna. These modes are achieved by employing various on/off switches of PIN and varactor diode. The slot Structured multiple antenna system ensconcing a number of bands in Cognitive radio (CR) applications. It fabricated the reversed F antenna.It involves the frequency bands of 2 to 3GHz [25]-[27].

II. ANTENNA CONFIGURATION

A Compact Π Shaped Stub element of antenna array configuration is represented in figure 1. The projected antenna substrate material is FR4 and this dielectric constant (€r) is 4.4mm and height (h) is 1.6mm. In figure 1, there are two ports that are excited by giving feed lines to those ports, and the size of that width is 3mm& characteristic impedance is 50 Ω.Generally the substrate is inserted between the patch and the ground.

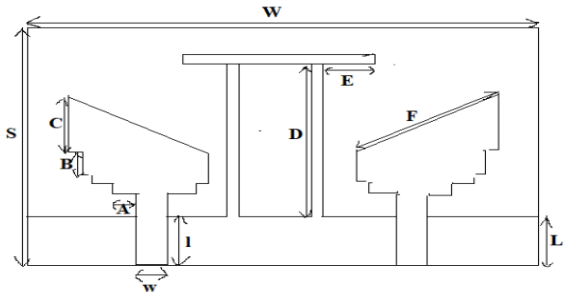

Figure 1. Geometric Representation of the projected Π Shaped Structure.

The patch is cut by step by step to produce enhanced bandwidth and impedance matching. The projected designed antenna is slightly identical to T shaped stubs to produce better isolation between two radiators and also achieve better impedance matching. Moreover the designed proposed antenna can achieve better gain by introducing Π Shaped stubs. Table 1 represents the values of the projected Ultra wide band antenna. Low isolation was achieved by using conventional rectangular radiators. To achieve better isolation between two radiating elements, we are introducing triangular shaped radiators rather than rectangular radiators. Each antenna element is fed by 50Ω impedance for proper impedance matching.

Table 1: Parameters of the projected PI Shaped Structure

A	B	C	D	E	F
3.54mm	4.31mm	11.46mm	23mm	5mm	22.3mm
W	S	L	w	l	
50mm	30mm	9mm	3mm	10.3mm	

Figure 2 shows the inverted L shape is altered by the use of F designed stubs in the mutual zero plane antenna. Low mutual coupling is one of the high performances for UWB MIMO antennas. This is obtained by adding T designed structure stubs elements in the common zero plane as shown in figure 3.Maximum beam width indicates the more isolation among two MIMO antenna radiating structures are attained by introducing Π designed

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element stubs rather than conventional antenna elements in the shared earth plane. Moreover for the better performance in gain is also obtained by using proposed Π Shaped stubs for Ultra Wide Band Antenna elements as shown in figure 4.

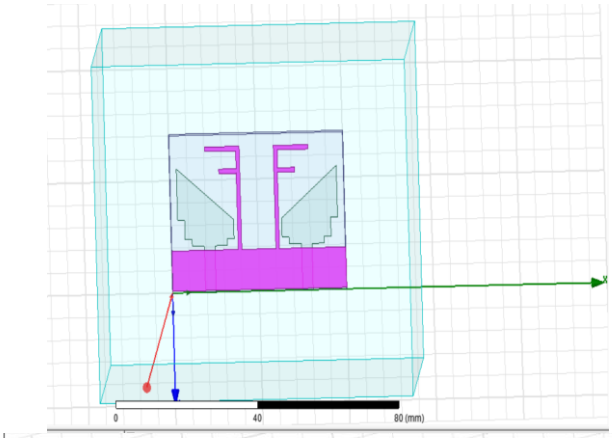

Figure 2. Existing system with F shaped Stub

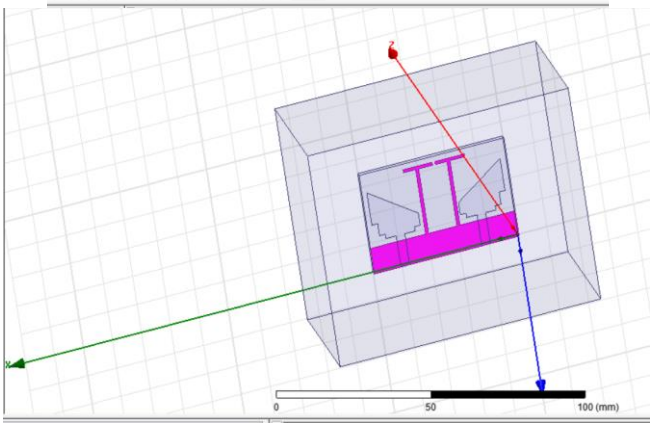

Figure 3. Existing system with T Shaped Stub

The existing system with F shaped and T shaped stubs covers the X band of operation. But in our proposed system designed with Π Shaped stubs, it covers the Ku band of operation.

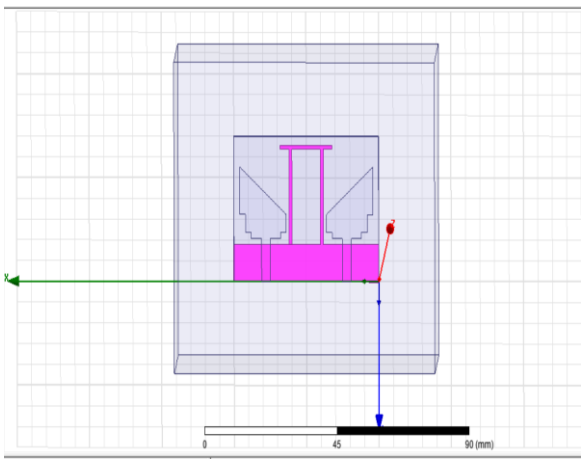

Figure 4. Proposed system with Π Shaped Stubs for UWB MIMO antenna.

By designing Π shaped stubs, small amount of current is distributed with another radiating element. Therefore maximum isolation, high bandwidth, and high gain can be obtained. Table 2 shows the improvement characteristics of projected system with existing systems.

Table 2: Characteristics of Projected and existing systems

Obtainable and proposed systems	Bandwidth(GHz)	Isolation (dB)	Gain(dB)
Existing system i.e. F shaped stub	2.5-14.5	>20	>7.4
Existing system i.e. T shaped Stub	3.0-16.2	>22	>7.8
Proposed system i.e Π Shaped Stub	2.0-19	>25	>8.2

III. RESULTS

3.1. S-Parameter

S parameter is measured interms of Return loss ,It is used to determine how much power is retransmitted back to the transmitter when there is a mismatch between the source and the load. It is also indicates the transmitted power and retransmitted power.

$$R = 10\log10(Pi/Pr)\ dB. \quad (1)$$

Figure 5 shows the results of S parameters(Return loss) of Π designed Stubs structure element for Ultra Wide band antenna.

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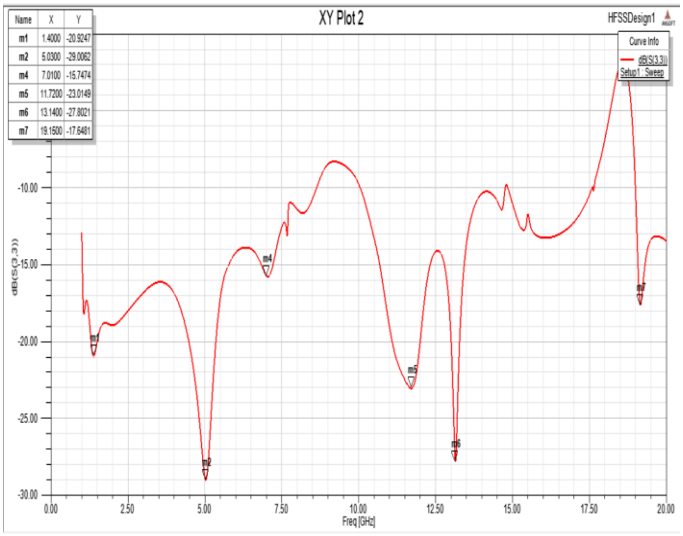

Figure 5. S papameters of II Shaped Stubs for UWB MIMO antenna

3.2.Vswr

It is defined as the relation between peak voltage to the valley voltage.Standing wave patterns will occur only when there is a impedance mismatch.Due to this mismatch reflected waves are transmitted back to the source,thus the incident and reflected waves will generate standing wave patterns.

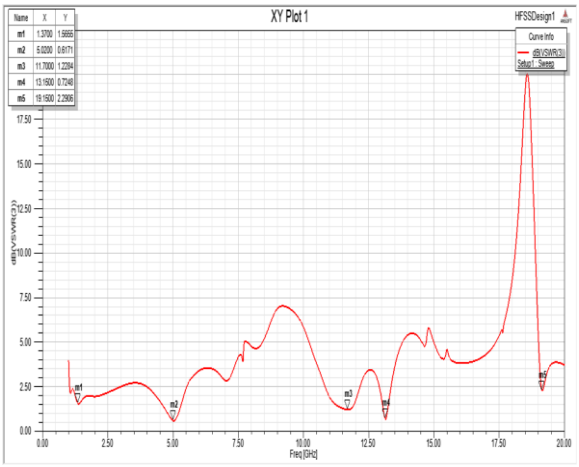

Figure 6.VSWR of II Shaped Stubs for UWB MIMO antenna

3.3.Radiation Pattern

Radiation pattern is to examine how much amount of energy can be radiated in particular directions. 3 Dimensional radiation patterns are to be represented in horizontal and vertical polarizations. Isotropic radiator is one of the improvement techniques in radiation patterns. It is used to radiate equally in all directions. Isotropic radiator achieves unity gain. This isotropic antenna is to produce maximum power density in the way of peak antenna gain is called isotropic equivalent radiated power.

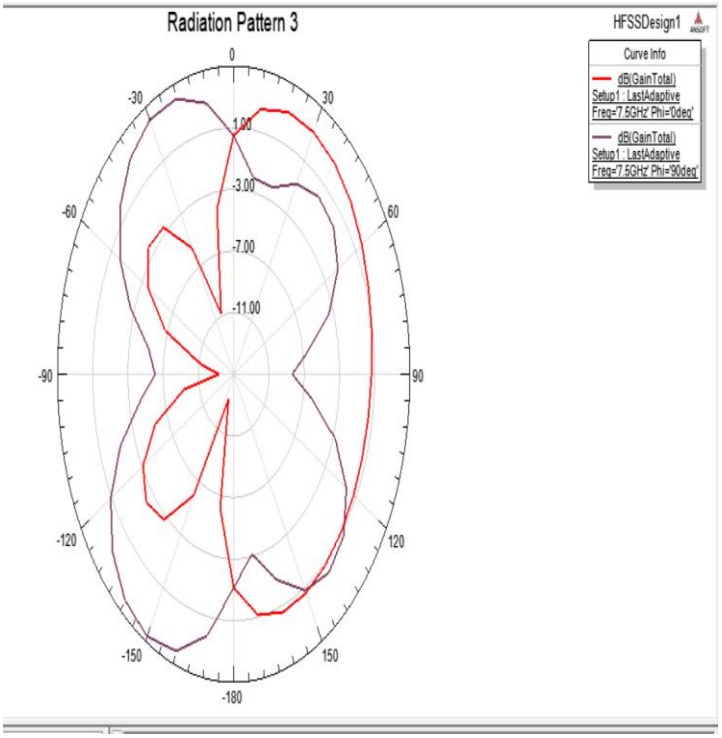

Figure 7. Radiation pattern of II Shaped Stubs for UWB MIMO antenna.

3.4.Gain

It is defined as the how much amount of power is radiated in certain directions.Effective radiated power(ERP) is to calculate the desirable gain.

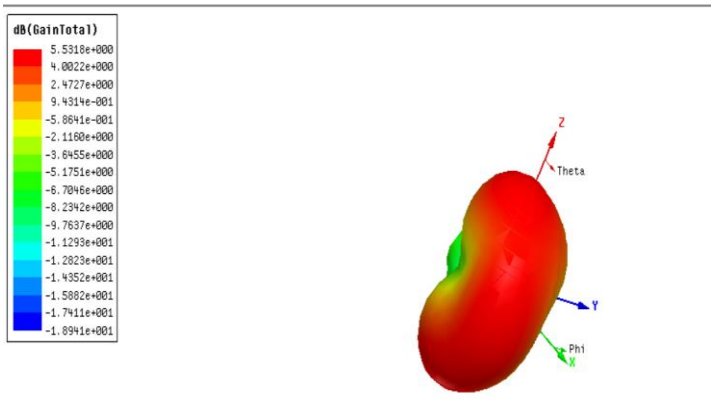

Figure 8. 3D polar plot of II Shaped Stubs for UWB MIMO antenna.

3.5.Surface Current Distribution

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In these electric surface currents are transmitted through the PEC (Perfectly conducting body) body. In addition surface currents are focused on dielectric surfaces can produce equivalent currents. These currents are fed by 50Ω impedance match.

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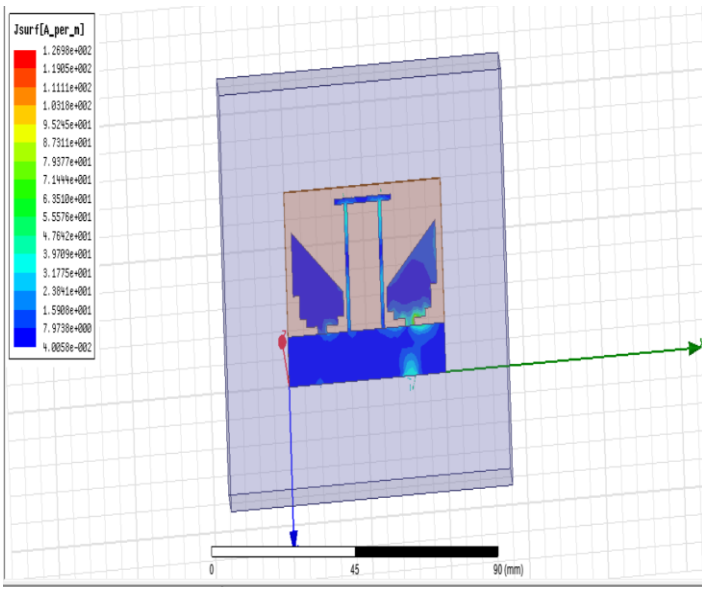

Figure 9. Surface current distribution of Π Shaped Stubs for UWB MIMO antenna.

IV. CONCLUSION

A compact Π Shaped Stubs Ultra Wide Band multiple antenna element with common ground plane has been projected for UWB applications. Improvement in isolation is obtained due to the occurrence of maximum beam width. Enhanced bandwidth can be occurred by implementing Π designed stubs structure elements in the zero plane of the Ultra Wide band multiple antenna elements. The proposed "pi" designed structure covers the Ku band of frequencies over the ultra-band of frequency ranges. Thus the parameters of projected antenna shows the simulated results like S parameters,VSWR,Gain and surface current distribution.

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