A Review Paper on Compact UWB MIMO Antenna for UWB Applications

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ABSTRACT

An ultra-wideband multiple-input-multiple-output antenna having compact size of only 22 × 36 mm^2 is proposed for portable ultra wideband (UWB) applications in this paper. The antenna consists of two square monopole -antenna elements, a T-shaped ground stub to improve matching of antenna, a vertical slot cut on the T-shaped ground stub is used for better isolation. The concept of DGS is also used to enhance the impedance bandwidth of antenna and to reduce mutual coupling.

KEYWORDS: *IE3D Software, Mutual Coupling, MIMO antenna, DGS, Isolation.*

I.INTRODUCTION

Ultra wide band (UWB) is a very promising technology for short range wireless communication systems which provides opportunity for higher data rate communications. UWB has proved itself a suitable candidate for its low power and low cost design. However, very low transmitted powers in UWB systems limit the applications to short range or to moderate data rate. Therefore it is crucial to find some solution that will make the best possible use of radiated and received power, for the feasibility and future commercial success of UWB communication systems [3]. In this context, research is carried out and MIMO has been found one of the best solutions. MIMO technique in UWB systems will improve link robustness of UWB or data rate. But some challenges arise in designing of the MIMO antenna systems for UWB applications.

These challenges include the reduction of the mutual coupling and the correlation between the elements of the antenna systems [4]. Proposed UWB-MIMO antenna systems in the frequency band of 3.1 –10.6 GHz are efficient in terms of diversity, radiations, size, etc. UWB communication systems have the promise of very high bandwidth.

1. It provides reduced fading from multipath.
2. It provides low power requirements.
3. The main concept behind UWB radio systems is that they transmit pulses of very short duration as opposed to traditional communication schemes which send sinusoidal waves.
4. The role that UWB antennas play in all of this is that they have to be able to transmit these pulses as accurately and efficiently as possible.

II.MATERIALS AND PARAMETERS

Here UWB MIMO antenna with two planar monopole antennas is selected for investigation. The MIMO antenna is designed using the IE3D tool on a Rogers FR4 substrate with a dielectric constant ε_r of 3.5, a loss tangent of 0.004, and a thickness of 1.6 mm. FR4 is used here because it has comparatively higher dielectric constant which results in reduction of size.

A. PARAMETERS:

W	**L**	**a**	**b**	**c**	**d**
36	22	8	6	3	3.5
e	**f**	**g**	**h**	**i**	
8	20	4	1	17	

Table 1 Parameters of antenna

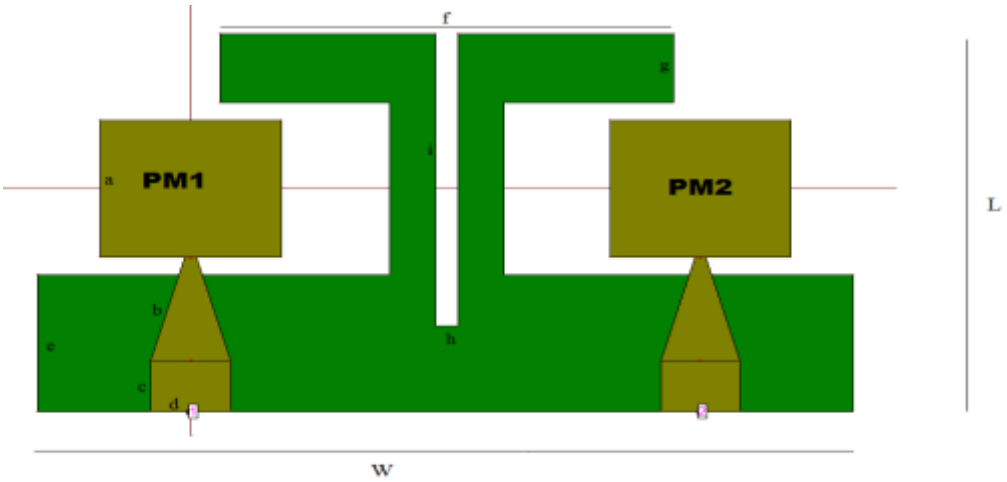

Fig. 1 Antenna Design Parameters

The geometry of the proposed MIMO antenna, as shown in Fig. 1, has two planar monopole elements, denoted as PM 1 and PM 2, with a very compact area of only 22 × 36 mm^2.

B. General Parameters Used in Antenna Design

1. Operating Frequency

The operating frequency is the frequency range through which the antenna will meet all functional specifications. It depends on the structure of the antenna in which each antenna types has its own characteristic towards a certain range of frequency. The operating frequency can be tuned by adjusting the electrical length of the antenna.

2. Bandwidth

Bandwidth can be defined as "the range of frequencies within which the performance of the antenna, with respect to some characteristics, conforms to a specified standard". Bandwidth is a measure of frequency range and typically measured in hertz. For an antenna that has a frequency range, the bandwidth is usually expressed in ratio of the upper frequency to the lower frequency where they coincide with the - 10 dB return loss value.

3. Power Gain

The power gain of an antenna is a ratio of the power input to the antenna to the power output from the antenna. This gain is most often referred to with the units of dBi, which is logarithmic gain relative to an isotropic antenna isotropic antenna has a perfect spherical radiation pattern and a linear gain of one. The directive gain of an antenna is a measure of the concentration of the radiated power in a particular direction. It may be regarded as the ability of the antenna to direct radiated power in given direction. It is usually a ratio of radiation intensity in a given direction to the average radiation intensity.

4. Polarization

Polarization is the orientation of electromagnetic waves far from the source. There are two fields that will radiate from the antenna, the electrical field and the magnetic field. Polarization of the antenna or the orientation of the electric filed (E- plane) of the radio wave is determined by physical structure of the antenna and its orientation with respect to the surface of the earth. There are several types of polarization that apply to antennas. They are linear, which comprises, vertical, horizontal, and circular polarization is most important to get the maximum performance from the antennas. For linear polarization, the antenna radiates the electric field of the emitted radio wave to a particular orientation. For circular polarization, the antenna continuously varies the electric field of the radio wave through all possible values of its orientation with respect to the earth's surface. For best performance matching up the polarization of the transmitting antenna and the receiving antenna needs to be done.

C. DGS

A Defected Ground Structure (DGS) is an etched lattice shape, which is located on the ground plane. DGS has symmetric shapes and is located on the backside metallic ground plane. DGS is realized on the bottom plane with one island placed at both sides of the microstrip line on the upper plane[31]. DGS for the microtrip line, which has etched defects in the backside metallic ground plane, is one hotspot concepts of microwave circuit design. DGS has simple structure and potentially great applicability to design microwave circuits such as filters, amplifiers and oscillators.

DGSs have gained significant interests. It rejects certain frequency bands, and hence it is called electromagnetic band-gap (EBG) structures. The DGS cell has a simple geometrical shape, such as rectangle. Its band-gap and slow-wave characteristics are better than the conventional ground plane. DGSs have gained quite significance in filter design showing optimal pass-band and stop-band responses plus sharp selectivity and ripple rejection. Application of CPW-based spiral-shaped DGS to MMIC for reduced phase noise oscillator, active devices (BJT and FET) can also be mounted using DGS technique. High amount of isolation is achieved in microstrip diplexer and harmonic control can also be achieved on microstrip antenna structures using DGS. Fig. 2 gives the schematic of such a DGS with its approximate surface area. Vertically periodic DGSs (VPDGS) have been used in reducing the size of MIC and amplifiers, thus increasing SWF significantly. Harmonic control can also be achieved on microstrip antenna structures using 1-D DGS.

1. Disturbs shielding fields on the ground plane.
2. Increases effective permittivity.
3. Increases effective capacitance and inductance of transmission line.
4. Has one-pole LPF characteristics (3dB cut off and resonance frequency).
5. Size reduction for the component.

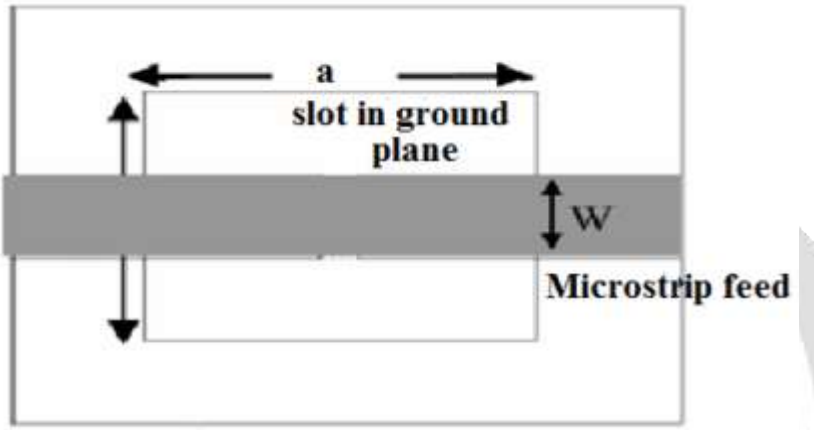

Fig. 2 Schematic of unit DGS Cell

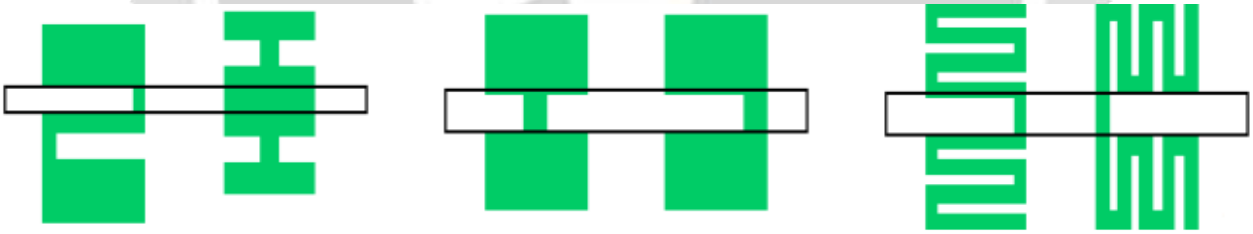

Fig. 3 Different Shapes of DGS Structure

III.CONCLUSIONS

A MIMO antenna with a very compact size of 22 × 36 mm^2 has been designed for portable UWB applications. Two square monopole elements are used to provide UWB operation from 3.1 to 10.6 GHz. A T-shaped ground stub with a slot is used between the monopole elements to reduce mutual coupling. The vertical slot cut on the T-shaped ground stub provides better isolation. The implementation of DGS in the antenna design helps to increase the impedance bandwidth of antenna. It also reduces the size of antenna. When DGS is implemented gain, directivity and return loss of antenna are also improved.

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