Design of EBG structure MIMO antenna and its analysis

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ABSTRACT: Two closely spaced printed meander line antennas(MLAs) are developed by using meta-material loading techniqueswith reduced mutual coupling. The antenna array built on themeta-material substrate showed significant size reduction andless mutual coupling compared to similar arrays on conventionalsubstrates.demonstrated to have left-handed magnetic characteristics, themethodology uses elliptical split-ring resonators(E-SRRs) placed horizontally between the patch and the groundplane with a row of the same type between antenna elements.Measured return loss of the printed antenna with this technique isless than 10 dB.Also this antenna has an omnidirectional radiationpattern, high gain, and very good pattern stability over the operating band. It is shown to have great impact on the antennaperformance enhancement in terms of high efficiency, low voltagestanding wave ratio, good bandwidth and less mutual coupling.

I. INTRODUCTION:

Tapered fed compact UWB MIMO diversity antenna with dimensions 18mm*21mm with 3 notches operating with a band width of 2.9-20 GHz with an isolation of -22 dB having Radiation efficiency of 75%-85%[1]. Triple band notched DGCEBG structure based UWB MIMO/diversity antenna with dimensions 58mm*45mm with 2 notches operating with a bandwidth of 2.3-10.6 GHz with an isolation of -15dB [2]. Compact offset micro strip-fed MIMO antenna with dimensions of 38.5mm-38.5mm with 1 notch operating with a bandwidth of 3.08-11.8 GHz with an isolation of -15 dB having radiation efficiency above 75%.[3]. A dual notched band MIMO slot antenna with dimensions of 30mm*60mm with 3 notches operating with a bandwidth of 2.8-11 GHz with an isolation of -20dB having radiation efficiency of 80% [4]Compact CPW-fed UWB MIMO antenna with dimensions of 26.75mm*41.5mm with 3 notches operating with a bandwidth of 3.1-11.5 GHz with an isolation of -15dB having radiation efficiency of 75% [5]Integrated diversity antenna with dimensions of 270mm* 210mm having isolation of 20 dB [6]. A four element antenna system with dimensions of 90mm*60mm having isolation of 11.5 dB [7]A dual polarized antenna with dimensions of 200mm*200mm having isolation of 24 dB [8]A compact planar MIMO antenna with dimensions of 60mm*80mm having isolation of 25 dB [9]A new wideband slot array for MIMO performance enhancement with dimensions of 112.3mm*112.3mm having isolation of 25 dB[10]Compact and low profile co-located MIMO antenna operating with a frequency of 3.1-10.6 GHz at lower energy levels [11]

Compact printed MIMO antenna having low efficiency and loss of bandwidth will degrade the performance of gain [12]Micro-machined micro-strip patch antenna having several modes and surface waves are excited in the patch antenna to reduce surface wave coupling [13].

II. Antenna Geometry

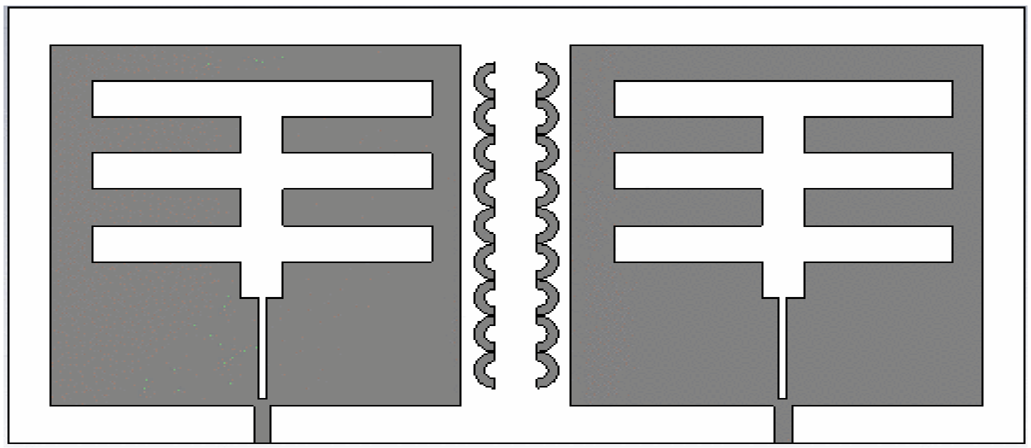

Fig.1 Construction of MIMO Antenna

The proposed MIMO system having a size of 70 x 40 mm^2 made with FR-4 substrate and ground plane and patch consider as a perfect electric conductor. The dimensions of the design listed in Table 1.

Table 1: Dimensions of proposed structure

Parameter	L	W	L_P	Wp	r_1	r_2	r_3
Dimensions (mm)	50.5	35	38	25	3	10	2
Parameter	a	b	c	d	e	W_s	L_s
Dimensions (mm)	10	9	7	7	4	18	10

III. Results & Discussion

Fig. 2 shows the S-parameters of transmission coefficient & reflection coefficient which are less than or equal to -10 dB at the resonating band of frequencies. It consists of multi-band of frequencies of the proposed design. At the resonating band of frequencies the mutual coupling is less than -40 dB. The parameter of mutual coupling reduced by inserted the EBG structure in between the patches. Fig. 3 shows the VSWR of the proposed structure at the resonant band of frequencies which is less than or equal to 2. Fig. 4 shows the group delay of the proposed structure resonant at multi-band frequencies having the values of 18 nsec, -7 nsec, -3 nsec, -6 nsec and -14 nsec. Fig. 5 shows the ECC at the multi-band of frequencies which is less than or equal to 0.002. Fig. 6 indicates the diversity gain is approximately equal to 10 dBi.

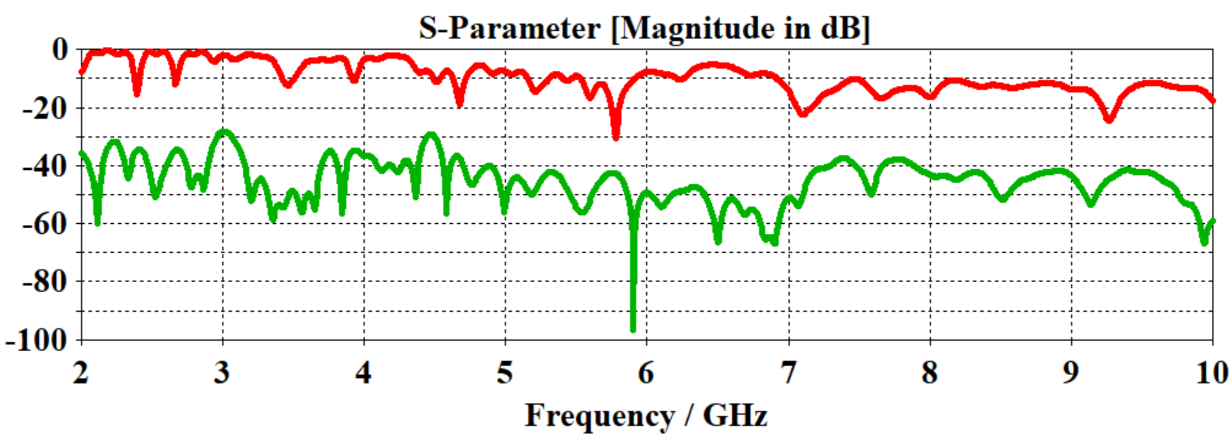

Fig.2 S-parameters comparison

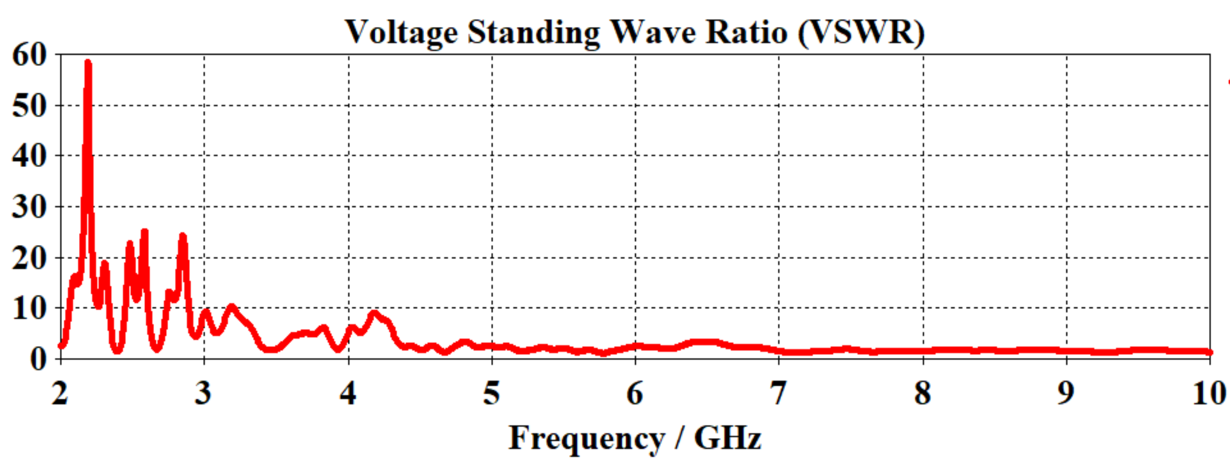

Fig. 3 VSWR graph

Fig. 7 shows the gain of the proposed MIMO structure at the multi-band frequencies are 2dBi, 4 dBi, 1.7 dBi respectively.

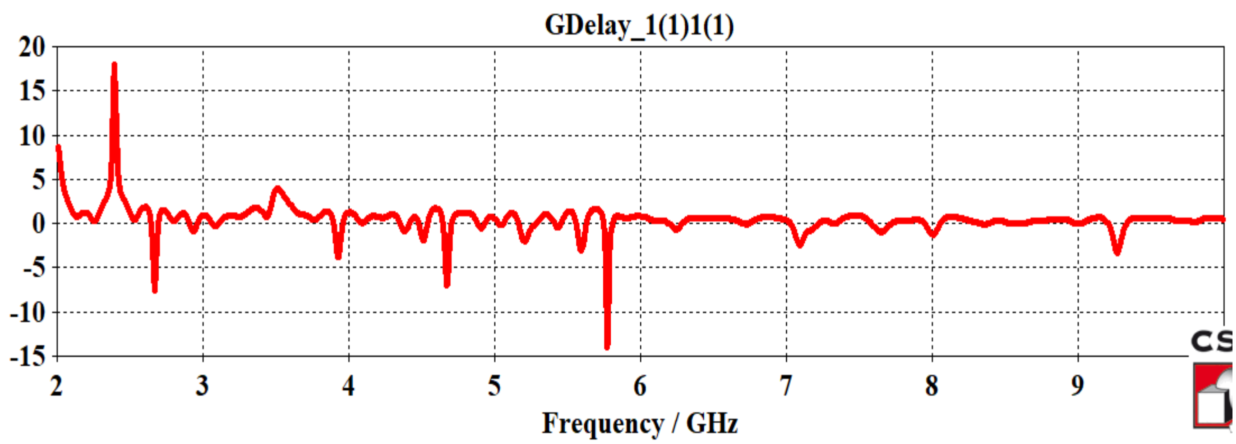

Fig. 4 Group Delay

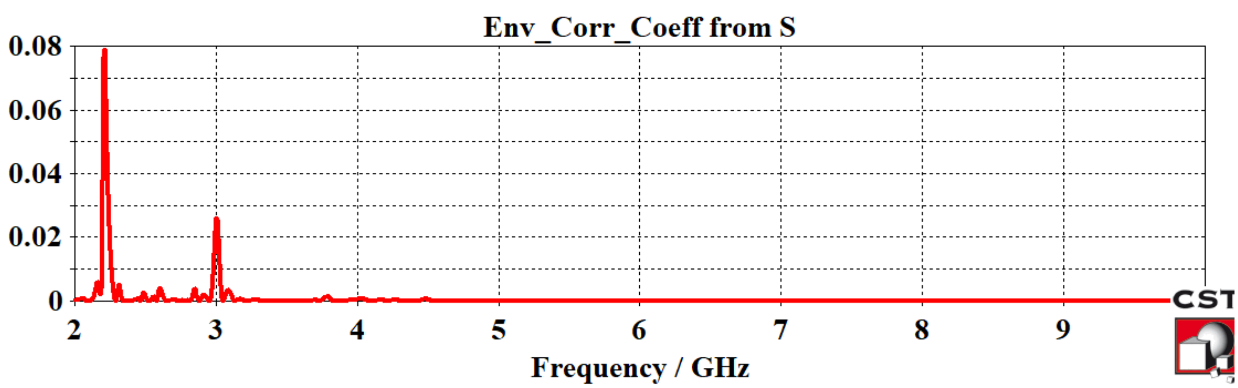

Fig. 5 ECC graph

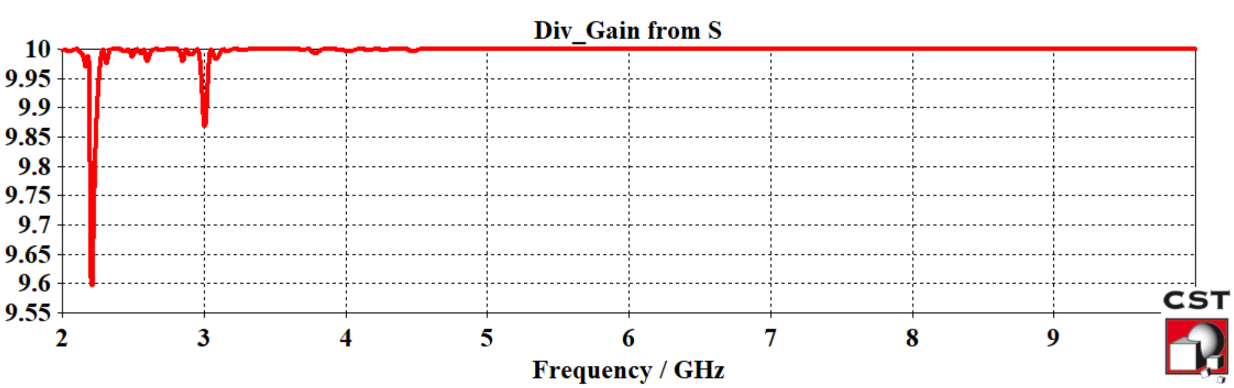

Fig. 6 Diversity Graph

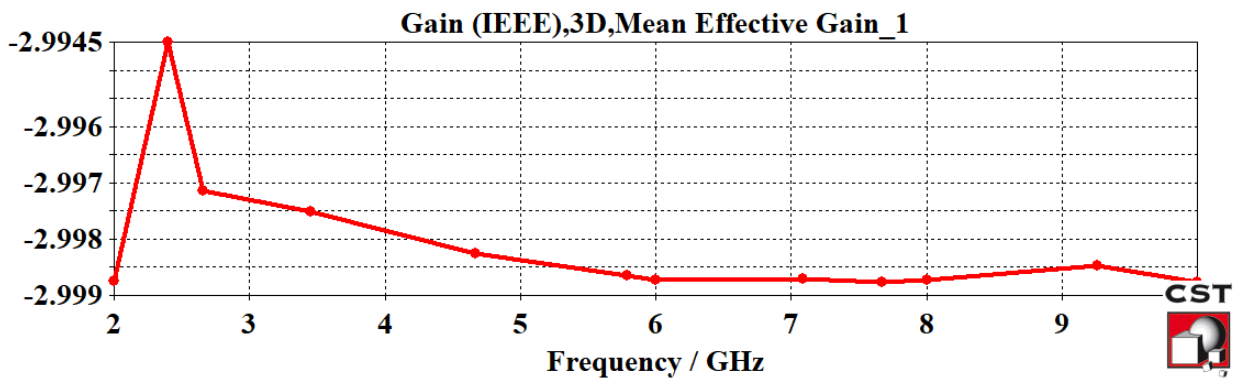

Fig. 7 Gain in dBi

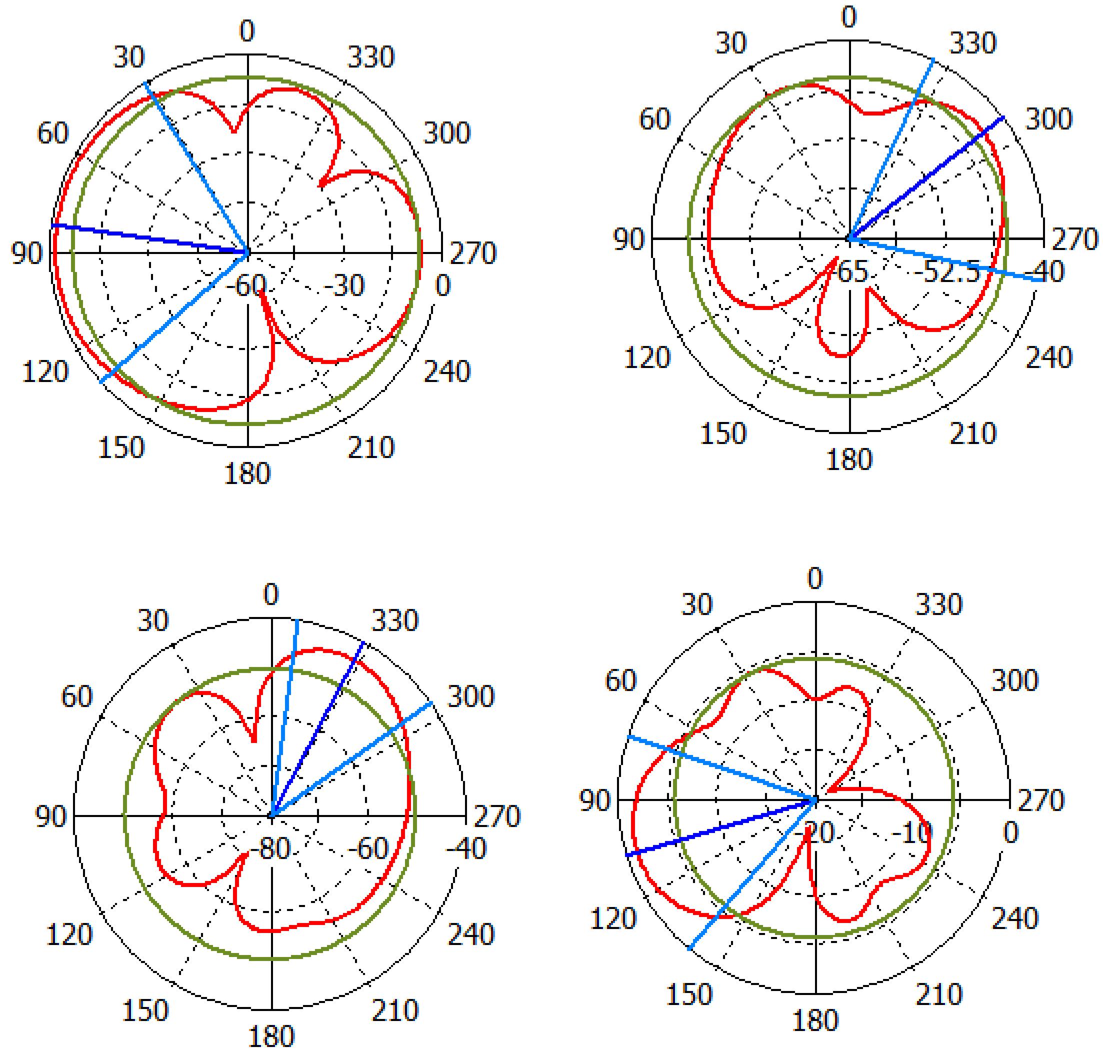

Fig. 8 Radiation Pattern graph

Fig. 8 shows the radiation patterns of the proposed MIMO structure having multi-band frequencies. Here we observed that the co-polarization is always greater than the cross-polarization. At the resonant band of frequencies linear polarization is observed with its value is approximately equal to 10 dB.

IV. CONCLUSION

The proposed model is to reduce the mutual coupling between closely spaced meander line antennas. Here we use two micro strip patch antennas with elliptical split ring resonators to achieve mutual coupling reduction. Compared with conventional array we can observe more coupling reduction in our proposed model. The mutual coupling in the array is suppressed effectively. A reduction in the mutual coupling of 18 dB was achieved with a return loss of less than 10dB for the antenna system compared with conventional array. The compact antenna can be integrated for various applications.

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