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Circularly Polarized MIMO Antenna Using F-Shaped Mirrored Structure

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Abstract. In MIMO(multiple input multiple output)system,antenna performance are degraded by mutual coupling hence to overcome this we go for circular polarization. In this paper we use planar,circularly polarized MIMO patch with three grounded stubs, F-shaped mirrored structure to achieve same time isolation &matching with offset feeding between two patches for circularly polarization.The elements of antenna are closely packed with 0.06λ0 of edge to edge distance at 2.5 GHZ frequency. The proposed antenna will results the impedance matching S11 < −10 dB and high isolation of S12 < −20 dB.

Keywords. CircularPolarization-CP, axialratio-AR, envelope correlation coefficient –ECC.

1. Introduction

MIMO (multiple input multiple output) antenna is a wireless communication technology which is used for both transmission and reception.In this paper we used circularly polarized (CP)MIMO antenna which will operate in 2.5 GHz for WLAN(IEEE 802.11b/g/n/a) applications.The main advantage for going Circularly polarized MIMO antenna is for Line of sight (LOS, point to point)& multipath (broadcast)communication. Rectangular patch is used to design antenna and polarization mismatches are reduced in transmitter and receiver side due to CP.Rogers substrate(RO4350B) is a dielectric constant which laminates and control losses for utilizing same processing as standard method for epoxy/glass.It is an active device for designing RF systems.It is also a low cost substrate like FR-4.Radiation pattern is the graphical representation of radiation charcteristics of antenna element and it states that power radiated in antenna is the funtion of direction away from the antenna.Dimensional stability is very good in rogers substrate. We can also minimize electrical noise in thissubstrate.

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2. Related works

Recently, MIMO technology has been increasing the link capacity mainly in multipath environments [1].Nowadays all wireless modern applications like LTE&Wi-Fi (IEEE 802.11ac, 802.11n) systems required MIMO systems[2]. polarization mismatches are reduced due to Circularly polarized antenna (CP)makes their own orientation in transmitter and receiver side[3].The study says that Circularly polarized MIMO antenna are linearly polarized (LP) [4]. line of sight (LOS, point to point)& multipath (broadcast)in both cases are investigated by camparison of diversity gain, channel capacity and ECC.For increasing radiation interaction antennas should be closely packet and coupled each other. some techniques to reduce mutual coupling are microstrip stubs [5],defected ground structure [DGS] [6], [7], electromagnetic band gap EBG[8], [9], parasitic elements[10],shorting pin [11], [12], etc.Few CP MIMO antennas are reported as high gain [13], [14], planar[15],[16] wideband [17],[18]applications.Simple feeding are used in dielectric substrate with polarization diversity. For planar applications 3D construction are not used. By offset feeding structure patch antenna is designed and analysed for cp operation[19]but it can be used only for SISO applications. Indications of above discussion states that realization of MIMO CP antenna is challenge for simple feeding & edge-to-edge structure separation.

3.Proposed Design

The design of antenna is taken from the paper[20].The modification what is done from that paper[21] is the top layer of the antenna design is taken and achieved those values by simulation in ADS software and simplifed the circuit design. By simplification, the antenna design size is reduced and cost for implementation is less .In this proposed paper compact MIMO CP antenna and planar antenna is used[22]. Rogers substrate(RO4350B) is used to design antenna. In circular polarization,high isolation is adopted in F-shaped mirrored structure & Three grounded stubs with simple feeding. The elements of antenna were closely packed with distance $0.06\lambda_0$ of edge to edge at 2.5 GHZ frequency. The antenna will results the impedance matching $S_{11} < -10$ dB and high isolation of $S_{12} < -20$ dB in simulation.

$$A = \frac{ZO}{60}\sqrt{\frac{\varepsilon r+1}{2}} + \frac{\varepsilon r-1}{\varepsilon r+1}\left(0.23 + \frac{0.11}{\varepsilon r}\right) \quad (1)$$

$$\varepsilon_{eff} = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2}\left(1 + 12\frac{h}{w}\right)^{-1}/_{2} \quad (2)$$

$$L = \frac{c}{4f\sqrt{\varepsilon_{eff}}} \quad (3)$$

$$\frac{w}{d} = \left\{\frac{8e^{A}}{e^{2A}-2}\right. \quad (4)$$

4. Proposed designs and implementations

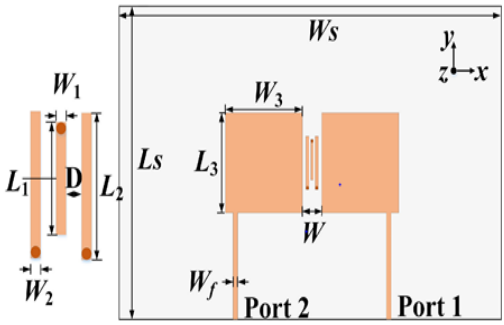

Figure 1. Antenna design[21]

parameters	Measurements (mm)
R	50Ω
W	1.8
ε_r	3.66
W_s*L_s	150*100
h	0.8
L_1	12.903
W_1	0.9614
W_2	1.2626
L_2	16.951
D	0.71
L_S	100
L_3	31.878
W_f	1.8
W	7.65
W_S	150
W_3	30.355

Table 1. Proposed values of antenna design

The fig.1 is says that Rectangular patch antenna is closely packed in the top layer of antenna and three grounded stubs are placed in between that. Ground plane is placed in bottom layer with mirrored F-shaped structure. Feed of patch is 50 ohms and thickness is 0.8mm, width is 1.8mm (150 mm ×100 mm) and dielectric constant is 3.66 . RO4350B is Rogers substrateisused.Dielectric constant εr=3.66 , loss tangent of 0.0037 and the thickness h=0.8 mm.Table1says that Proposed designs of antenna values W_1=0.9614, L_1=12.903, L_3=31.878, L_2=16.951, W=7.65, L_4=50, W_f=1.8, L_5=40, L_6=32, W_2=1.2626, W_3=30.355, W_6=9, W4=3, W_5=5.25, Ws=150, Ls=100, D=0.71, L_f=34.06.

Table 2. Comparison with before CP MIMO antennas

REFERENCE	SPACING (LAMDA)	S21(dB)	Isolation Technique	Feeding+ Complexity	Antenna height(mm)	Maximum gain(dBi)
[14]	0.19	-25	DGS	Microstrip+ Simple	7.6	4.7
[18]	0.3	-25	PE	Microstrip+ Simple	N.G.	4
[19]	0.5	-30	PE+DRA	Microstrip+ Simple	26.1	5.2
[20]	>0.6	-30	N.G.	Coaxial+ Complex	1.6	1.5
[21]	N.G.	-19	Orthogonal modes	Coaxial+ Simple	0.127	N.G.
Proposed	0.06	-17.266	CP	Microstrip+ Simple	0.8	6.1

5. Simulated design and Results

Figure 2. Layout of antenna

The antenna was designed in ADS software and the material used to design antenna is rogers substrate(RO4350B), the dielectric constant is 3.66 and the thickness is 0.8mm.

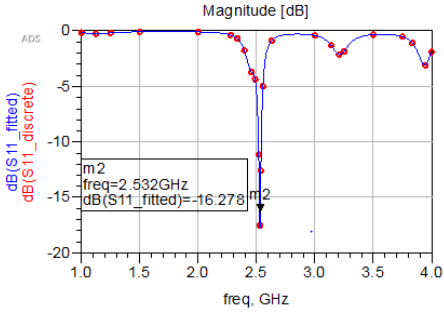

Figure 3. S_{11} simulation for 2.5GHz

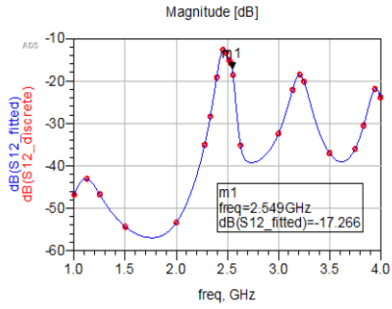

Figure 4. S_{21} simulation for 2.5GHz

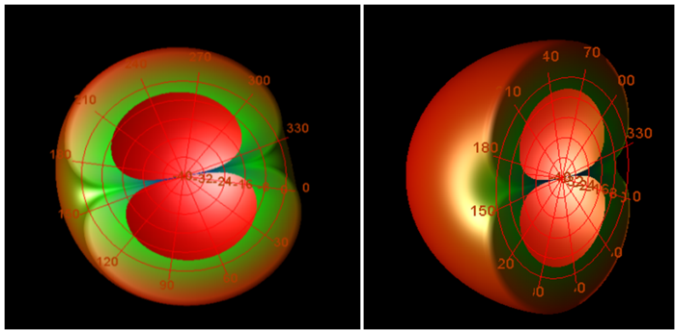

Figure 5. Radiation pattern of antenna

6. Conclusion

In this paper, MIMO CP(circular polarization) antenna and planar antenna is used. In circular polarization, high isolation is adopted in F-shaped mirrored structure& Three grounded stubs with simple feeding. The elements of antenna were closely packed withdistance $0.06\lambda_0$ of edge to edge at 2.4 GHZ frequency. The resultedimpedance matching antenna values for S_{11} values is -16.278 dB and S_{21} value is -17.266dB was obtained in simulation. Thus design of antenna in 2.5 GHz band 802.11n for Wi-Fi applications is achieved.

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