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REVIEW ARTICLE

MIMO SECTOR ANTENNA

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ABSTRACT

In this project, design of dual polarised MIMO sector antenna array is proposed to achieve high Gain of about 16dBi.The antenna is design for 4.9GHz to 5.9GHz Frequency band. It is design to achieve VSWR 1.9 for full band, return loss is of 15dB and isolation between 2 port is 28dB.A substrate material FR4 is used whose dielectric constant is 4.4. In practical it can be helpful to our hand-held device called mobile phones since there is a need of array of antenna in base stations. This antenna can be applicable to the wireless communication areas such as Wi-Fi and Wi-MAX. The parameters such as return loss, VSWR, mutual coupling, directivity and gain has been simulated and analysed.

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INTRODUCTION

The design of MIMO antenna in the form of array is a vital study for today's Wireless communication system for achieving high gain, highly directional beam; high data rate and also it counteract the effect of fading while signal propagates through various corrupted environments. In case of long distance communication, signal fading is a common feature for single-input-single-output (SISO) antenna system. Sometimes the received signal drops below the mean signal level and ultimately the communication is lost. In order to receive the required signal, the power level needs to increase which further invites the interference for other channels. To increase the power level some active devices are used which also introduces some non-linear behaviour of the channel. MIMO antenna system using spatial diversity reception or transmission increases the probability of reception, spectral efficiency and reliability as compared to single-antenna communication systems

MIMO Antenna

MIMO antenna is used to improve the communication performance, because without increases the transmitter power and additional bandwidth it offers significant increases in data throughput.

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Generally MIMO can be sub divided into three categories i.e. pre-coding, spatial multiplexing, diversity coding. First of all pre-coding is nothing but a multi stream beam forming. It is a signal processing technique it control the directionally of transmission and reception of radio signal over other direction. Then the spatial multiplexing is used to divide high data signal into various lower data streams it is transmitted in same frequency in different transmitted channel. Other one is diversity coding method. It is used when no channel knowledge at receiver.

Feeding Method

A feed line is used to excite the radiator by direct or indirect contact. The most popular feeding techniques are coaxial probe feed, micro-strip line, aperture coupling and proximity coupling. Here the coaxial probe feed is used as a feeding technique It is simple to model and easy to match by controlling the inset position. However the disadvantage of this method is that as substrate thickness increases, surface wave and spurious feed radiation increases which limit the bandwidth.

Calculation of 2 element Printed Dipole antenna

Given relative permittivity εr, height h of the substrate and the operating frequency fr the design of the strip dipole proceeds as follows.

Finding the width of the Printed Dipole:

W=0.17λ0=0.17c/f

Here c is speed of light and fr is the resonant frequency.
Taking into account the fringing effect:

The fringing fields along the width of the structure are taken as radiating slots and the patch antenna is electrically seen to be a bit larger than its physical size.

Calculating the length of the Printed dipole:

L=0.55λ0

W, L, h, f, Ɛr, care width of strip dipole, length of strip dipole, height of substrate, resonant frequency, dielectric constant of substrate, and speed of light in the vacuum respectively.

Calculating the ground plane dimensions:

Size of the ground plane should be greater than the strip dipole dimensions by approximately six times or twelve times the substrate thickness so that results are similar to the one using infinite ground plane. From the above length and width equations, the width and length of the ground plane are determine.

Wg=6h+W

Lg=6h+L

Lg, Wg, are length of ground plane, width of ground plane respectively.

Finding the impedance of stripline:

Z0=60/√Ɛr*ln[(1.9(2h+t)/(0.8w+t))]

Finding the Distance between two printed dipole:

d = 0.55λ0

Calculation of Coaxial feed line

Given relative permittivity εr, height h of the substrate and the operating frequency fr the design of the strip dipole proceeds as follows.

Finding the impedance of the feed line:

Z0=138Ω/√εr*log10D/d

Where D=Inner conducter diameter

d=Inner surface shield diameter

According to all the equations and calculations we find all the parameters as given in below table.

Parameters	Measured value
Length of printed dipole	14.6mm
Width of printed dipole	4.5mm
Distance between two printed dipole	14.6mm
Lengh of 73Ωstripline	39.9mm
Width of 73Ωstripline	0.75mm
Length of 36.5Ωstripline	14.88mm
Width of 36.5Ωstripline	2.5mm
Length of 50Ωstripline	15.22mm
Width of 50Ωstripline	1.5mm
Inner conducter diameter(D)	1mm
Inner surface shield diameter(d)	5.754mm

Simulation of two element printed dipole antenna in HFSS

Design of two element printed dipole antenna using substrate material FR4 with given measured parameters in above table in HFSS is shown in below figures in different views.

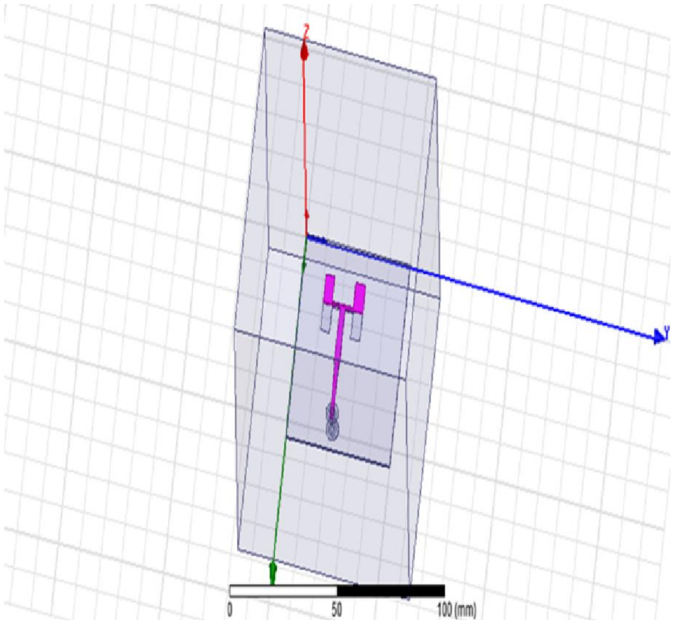


Figure 1. (Top view of Design)

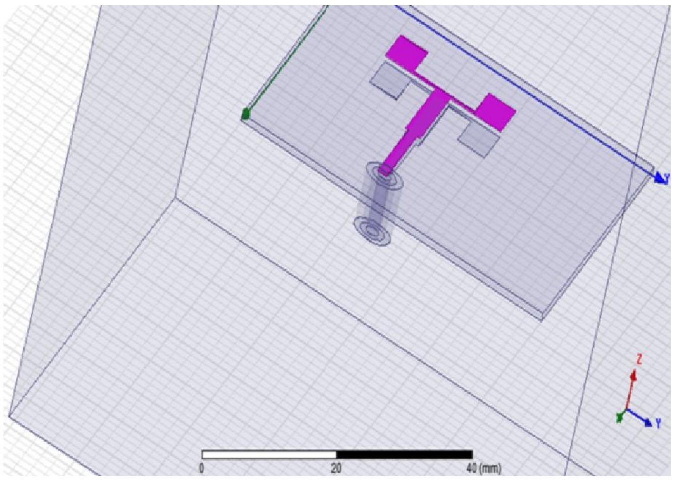


Figure 2. (Side View of Design)

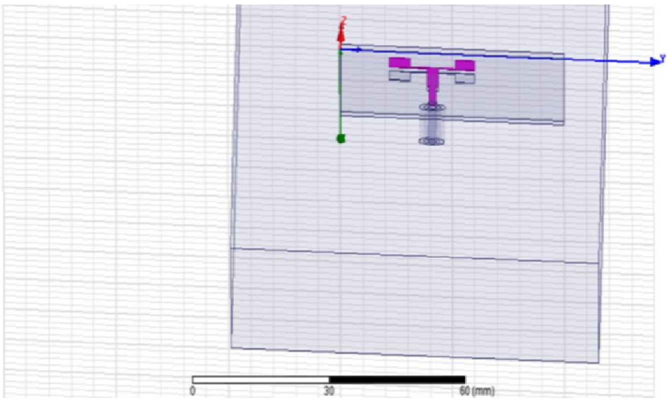
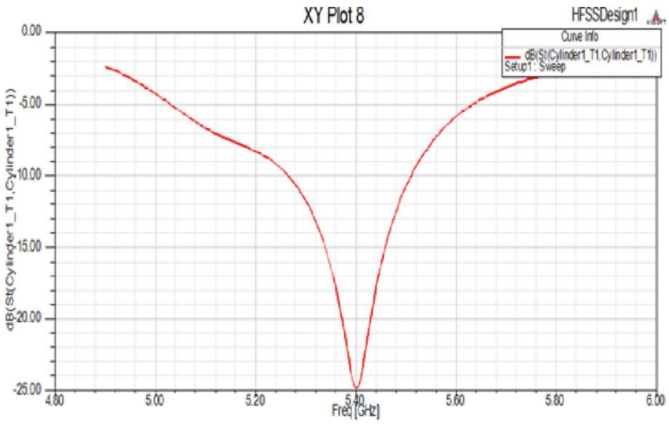


Figure 3. (Front view of design)

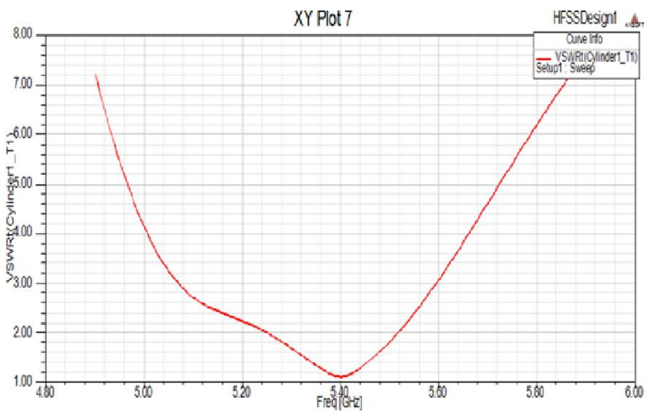
Simulation Results

The simulation results of Return loss, VSWR and Gain is shown in below figures.

Return Loss



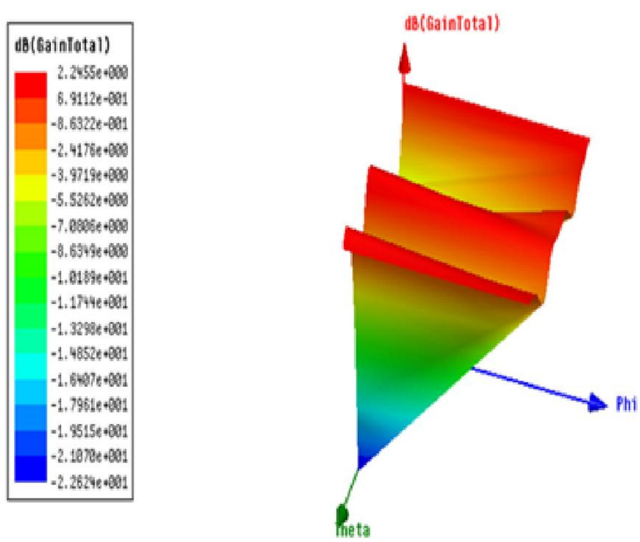
VSWR



Conclusion

Printed dipole antenna for MIMO application is designed and proposed. Design element for printed dipole is calculated and simulated. MIMO antenna is used to improve the communication performance, because without increases the transmitter power and additional bandwidth it offers significant increases in data throughput. The feed network is designed to divide power equally between the arms.

Gain



Applications

It is used in Mobile radio telephone standards such as recent 3GPP and 3GPP2. It is used in 3GPP, High-Speed Packet Access plus (HSPA+) and Long Term Evolution (LTE) standards. It is used in the home networking standard ITU-T G.9963. It is used in wireless communication standards including IEEE 802.11n(wi-fi), IEEE 802.11ac(wi-fi),WiMAX(4G).

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