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OPTIMISATION OF MIMO ANTENNA FOR 5G APPLICATIONS

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ABSTRACT

Nowadays, intensive research on 5G MIMO Rectangular Microstrip Patch Antenna is increasing due to its high data rate required. Due to their smaller size of Microstrip patch antenna, that is widely used in the design of portable wireless communication equipment. We designed Rectangular Patch Antenna with 56 radiation element and 2X2 MIMO microstrip antenna with 112 radiation element using microstrip line feeding are designed for 5G wireless communication. An approach was developed to enhance the Bandwidth, Gain, VSWR and Return Loss. The 2X2 MIMO microstrip antenna provides the most optimum results with bandwidth impedance of 0.7GHz and reaches the return loss of -32dB at 7Ghz.The gain reaches 6dB. The antenna meets the required 5G antenna requirements. We designed and simulated 2X2 MIMO Antenna using Ansoft HFSS which can be used for 5G Applications.

Index Terms: *Microstrip patch antenna, MIMO, Ansoft HFSS, Line feeding.*

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1. INTRODUCTION

The antenna is our electronic eyes and ears of the world. They are our links with space. With the rapid growth of the wireless communication system the future technologies need a very small and multiband antenna. Antenna plays a vital role in the field of wireless application. The reflected based antenna are commonly used because they satisfy all the requirements, but they are not practical due to their relatively big size and their 3D geometry. So we are moving to MIMO antenna. MIMO antenna is one of the promising technology for 5G. MIMO technology can enhance data transmission speed and give a resistant to multiple path fading which has been widely investigated. The MIMO wireless system has demonstrated the capability to increase the communication spectral efficiency in a multipath environment. By using MIMO technology, we are designed microstrip patch antenna. The rectangular microstrip antenna is used in wireless communication due its low profile, small size and light weight. A microstrip patch antenna consist of a radiating patch on one side of a dielectric substrate which as a ground plane on the other side.This antenna depends on the line feeding technique and its performance characteristics which include return loss, bandwidth, gain and VSWR are obtained from the simulation.

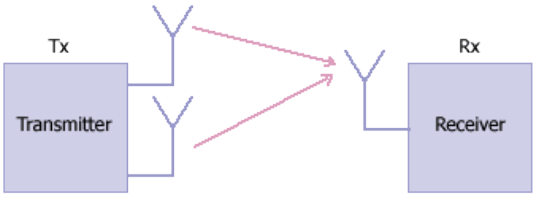
2. MIMO TECHNIQUE

To accommodate the higher capacity and a large number of connected devices, MIMO technique was largely used. MIMO have multiple antenna in single layer and are designed for 5G network. In MIMO antenna, transmitter or the receiver needs two or more antenna elements. MIMO specifically refers to a practical technique for sending and receiving more than One data signal simultaneously over the same radio channel by exploiting multipath propagation. MIMO brings the solution to address the challenge. This technology, which multiplies the capacity by transmitting different signals over multiple antennas .

In this designing, analysis we are designed 2X1 (Multiple Input Single Output) and 2X2 (Multiple Input Multiple Output) and calculate the antenna parameters such as gain, bandwidth, VSWR, return loss.

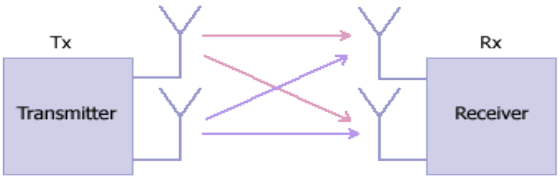
2X1 (Multiple Input Single Output)

A system which uses multiple antennas at the transmitter and a single antenna at the receiver is named Multiple Input Single Output (MISO).



2X2 (Multiple Input Multiple Output)

A system which uses multiple antennas at the transmitter and a multiple antenna at the receiver is named Multiple Input Single Output (MIMO)



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3. SOFTWARE TOOL:

HFSS (High Frequency Structured Simulator) is the software used for simulation

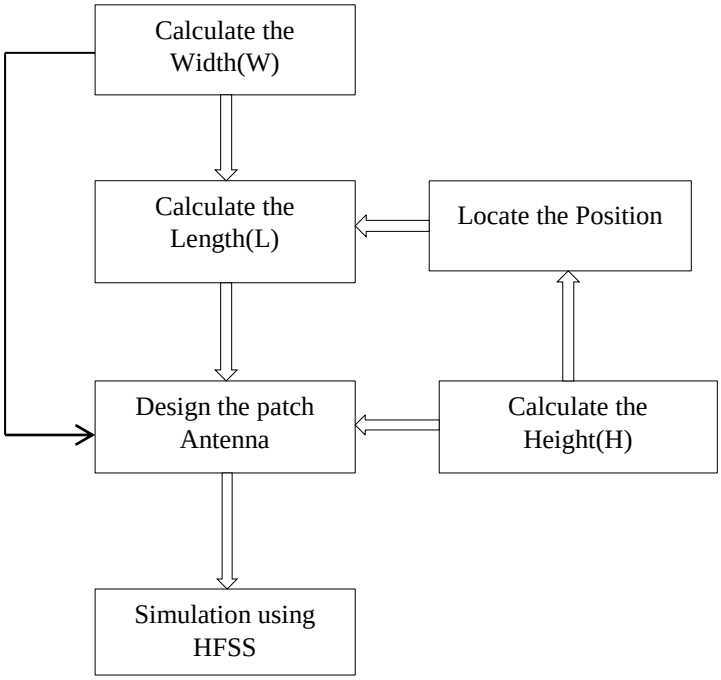
And modeling of the antenna. It is one of antenna designing tool and it is a high performance full wave Electromagnetic **(**EM**)** field simulator for the 3D volumetric passive device. It follows a simple procedure for designing the microstrip patch antenna.

3.1 ANTENNA DESIGN

Microstrip Patch Antenna

A patch antenna which is also known as a rectangular microstrip antenna is a type of radio antenna with a low profile,can be mounted on a flat surface. It consists of a flat rectangular sheet or patch of metal, mounted over a larger sheet of metal which is called as a ground plane.

Design flow of Microstrip patch antenna

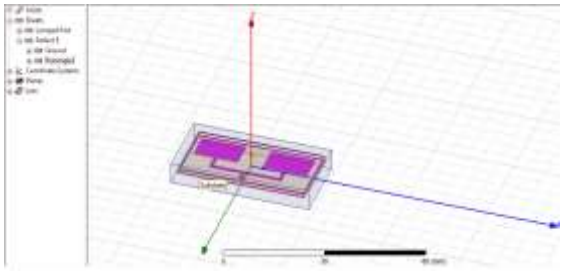


Substrate

The substrate is present in between the rectangular patch and ground plane. There are so many substrate materials are available. We are considering FR4 epoxy. Its relative permitivity is 4.4 and dielectric loss tangent is 0.02. FR4 has much more dielectric loss and good microwave substrate. The substrate in microstrip antenna is principally needed to provide the mechanical and electrical support of the antenna.

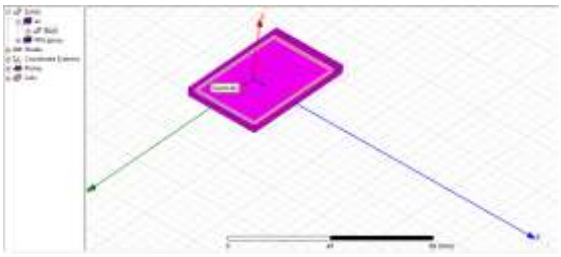
For2X1:Substarete size x=20,y=40,z=1.2

2X1



2X2

For 2X2:Substrate size x=50, y=30, z=1.2



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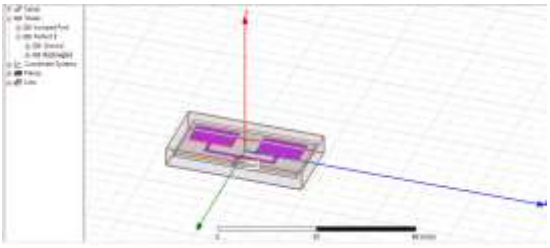
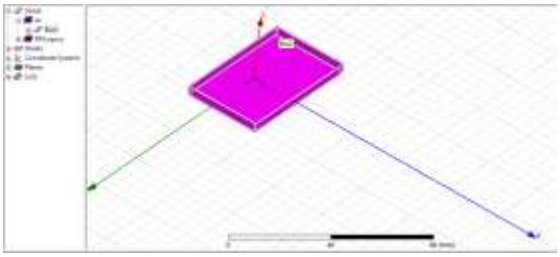
Radiation Box

HFSS needs a radiation box to model free space radiation. A radiation boundary is used to emulate free space by truncating infinite free space for a finite calculation domain. This minimizes reflections from outer surfaces and ensure maximum absorption. It should be defined as L+λ/2, W+λ/2, H+λ/2. Where the L,W,H are the substrate length, width, height and thickness respectively. The box should be λ/4 distance away from all the outer faces of the substrate.

2X1



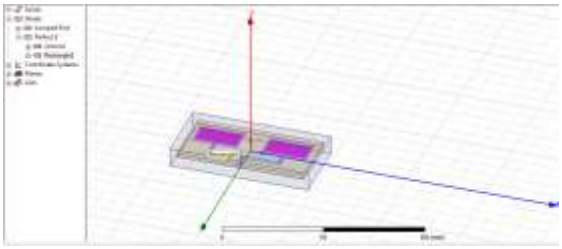
2X2



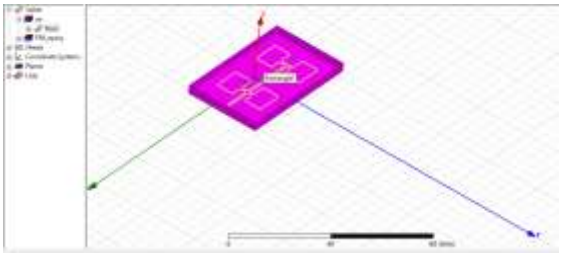
Rectangular Patch

Microstrip patch antenna consists of a flat rectangular sheet or patch ,metal present at the top surface which is positive (+). In this patch surface, we are designing 2X1 and 2X2 MIMO antenna and input is given by the line feeding method. For 2X1: Patch size x=5, y= -1, h=1.2. For 2X2: Patch size x=12,y=8, h=1.2.

2X1



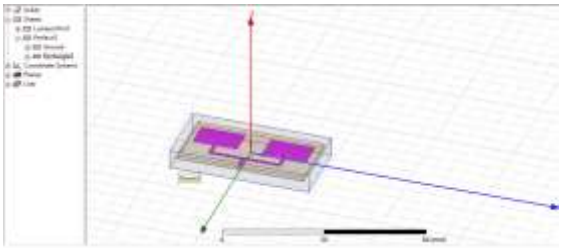
2X2



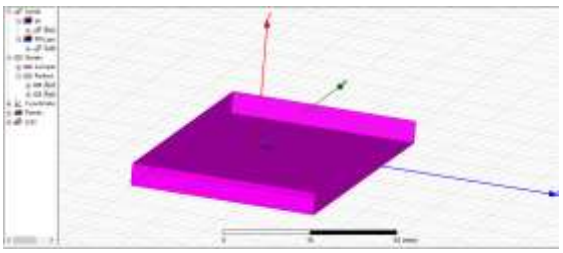
Ground

The bottom surface is called ground. It is negative (-). It can be constructed in the air medium. The transmission line model is suitable for infinite ground planes,but practically we should have a finite ground plane. The size of the ground plane is greater than the patch dimensions of six times the substrate height similar result can be obtained as with the infinite ground plane.

2X1



2X2



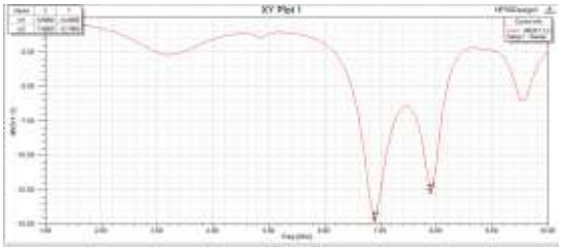
4. SIMULATION RESULT USING HFSS

Now a day it has become common to check the system performance through simulation before making, it has a real time application. A simulator "Ansoft HFSS" is used to check the gain,bandwidth,return loss and VSWR. This simulator helps to reduce the cost of the fabrication.

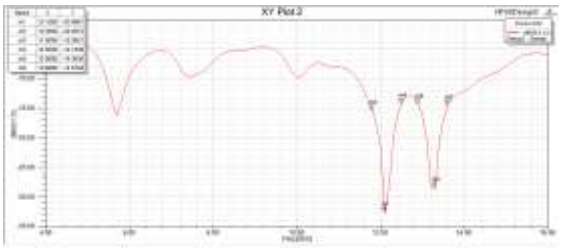
RETURN LOSS

The return loss is the loss of power in the signal returned/ reflected line or optical fiber. This discontinuity can be a mismatch with the terminating load or with a device inserted in the line. It is usually expressed as a ratio in decibel (dB).Return loss is -13dB for 2X1 and -32dB for 2X2.

2X1



2X2



VSWR

Voltage Standing Wave Ratio is a measure of how efficiently radio frequency power is transmitted from a power source through a transmission line, into a load . Due to mismatches in impedance within the connector, some of the signals are reflected the ratio of the input to the reflected signal is VSWR.

VSWR = 1+|r|/1-|r|

It is the function of reflection coefficient, which describes the power reflected from the antenna.

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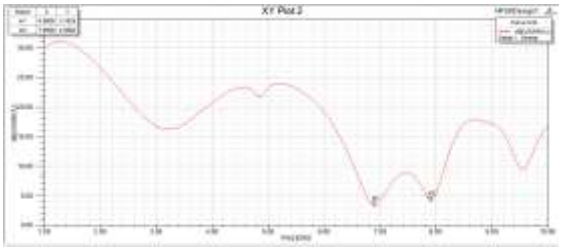
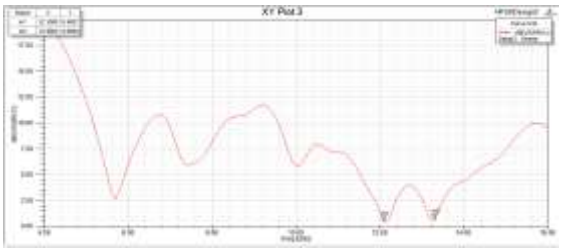
2X1



2X2



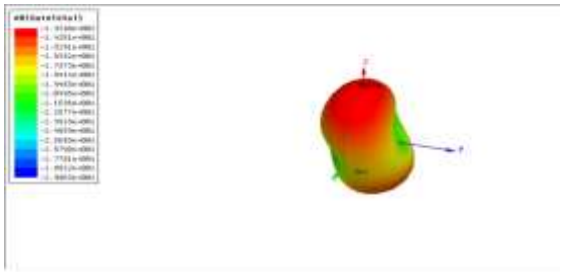
BANDWIDTH

It is the amount of data that can be transmitted in a fixed amount of time. Another important parameter of any antenna is the bandwidth it covers. Only impedance bandwidth specifies most of the time. To realize that several definitions of bandwidth exist impedance bandwidth, directivity bandwidth, polarization bandwidth and efficiency bandwidth. Directivity and efficiency are often combined as gain bandwidth. The bandwidth obtained for 2X1 is 1Ghz for 4Ghz and 2X2 is 0.7GHz for 7Ghz.

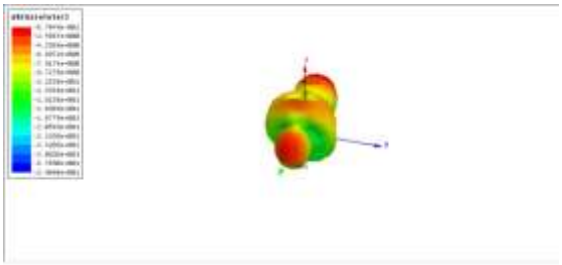
GAIN

The gain of the antenna is defined as the ratio between the maximum radiation intensity in a given direction to the maximum radiation intensity from a reference antenna in the same direction. The achieved gain of the microstrip patch antenna for 2X1 is 1dB for 4Ghz and 2X2 is 6dB for 7Ghz.

2X1



2X2



5. CONCLUSION

The rectangular micro strip antenna was designed and analyzed with a frequency range of and is simulated by using the Ansoft HFSS Software. The Gain value is 6dB for 7Ghz, Bandwidth value is 0.7GHz for 7Ghz and Return loss is -32dB.

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