Rectangular Microstrip Patch Antenna for Global Position System

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Abstract*— *The robust working and speed of a wireless communication and navigation system will depend on the speed of the signal we can receive and transmit. Antenna selection can therefore have a significant impact on the working and speed of a wireless link.

A microstirp patch antenna has a low profile and weight along with low fabrication cost. In this project, ANSYS HFSS is used to develop and simulate a Microstrip Line Feed Linearly Polarized Rectangular Microstrip Patch Antenna for a navigation system (GPS) at 1.7 GHz.

Keywords— *Wireless communication, Navigation system, Microstrip patch Antenna, Wireless link, Communication systems*

I. INTRODUCTION

Global Positioning System are now in use everywhere and the advantages they bring to us are enormous. All GPS devices and systems rely on the Global Positioning System to operate. This is a system of 24 satellites in orbit around the earth. Because the GPS satellites cover the whole planet this means that everyone in the whole wide world can benefit from GPS and this is a major advantage for many individuals, small businesses ,larger companies and obviously government departments and the military for whom the system was originally designed and built. In this synopsis; compact rectangular microstrip patch antennas are designed using HFSS and tested for GPS devices at 1.7 GHz for a robust working and high speed communication between the satellite and the device while encompassing the benefit of a low cost light weight antenna.

A. MICROSTRIP PATCH ANTENNA

The advantages and performance of rectangular microstrip patch antennas such as low cost, low profile, and low weight make them the perfect choice for a communication systems engineer. A microstrip patch antenna consists of a thin metallic patch placed above a conducting ground-plane. The ground-plane and patch are separated by a dielectric. The conductor of the patch is generally copper and can be made in various shapes. The microstrip patch is generally photo etched on the dielectric substrate. The substrate of the antenna used is often non-magnetic in nature. A range of 2.2 to12 is chosen for the dielectric constant (r ε) of the substrate, this helps in improving the fringing fields that produce radiation, but higher values may be used in special circumstances. A microstrip patch antenna is the most commonly used antenna due its simple geometry. The width thickness and length characterize the antenna. Under operating conditions a microstrip patch antenna is used to send onboard parameters of article to the ground. The purpose is to fabricate and design an microstirp-fed rectangular Patch Antenna and study the antenna parameters over the GPS range at a given frequency.

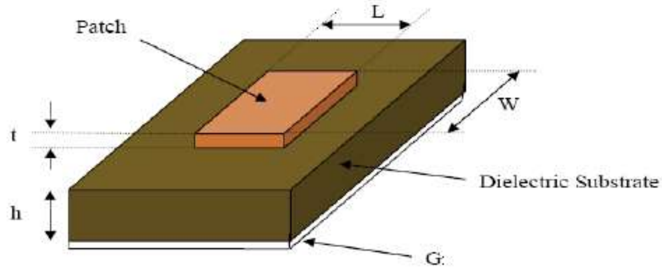

Figure I: Structure Of Microstrip Patch Antenna

B. ADVANTAGES OF RECTANGULAR MICROSTRIP ANTENNA

Due to low-profile structure of Microstrip patch antenna it is specially favoured for use in wireless applications. This makes them exceedingly reliable for embedded antennas used for wireless handheld devices like GPS tracker, electronic pagers, mobile phones etc. The communicating and remote measuring antennas in defence applications like missiles need to be thin and conformal thus patch antennas are often employed. They also have been used successfully in Satellite communication.

Some of their principal advantages are given below:

• Ease of manufacturing

• When mounted on rigid surfaces they are mechanically robust

• Can be easily conformed to a host due to their low profile planar configuration.

• They can be produced in large quantities due to their low cost of fabrication.

• They allow two type of polarization-Linear and circular.

• They are easily adopted into MICs.

• Can conform to multiple frequency requirements.

C. FEEDING TECHNIQUES

There are various methods of driving power(feeding) to Microstrip patch antennas. The 2 main categories of feeding a patch antenna are- non-contacting and contacting. In the non-contacting scheme there is transfer power between the Microstrip line and the radiating patch by using electromagnetic field coupling. In the contacting method, the RF power is fed directly to the radiating patch using a connecting element such as a Microstrip line or a coaxial feed cable. Commonly used feeding techniques are the coaxial probe and Microstrip line which are contacting schemes while proximity coupling and aperture coupling are without contact. We have employed MICROSTIP LINE Feed Technique , because they have a simple modelling technique, easy to fabrication and provide high impedance matching.

D. LINEAR POLARIZATION

Polarization of an antenna is a key characteristic for an antenna to be chosen. Vertical, horizontal or circular polarization are the type of polarizations exhibited in a communication system. An antenna with linear polarization radiates completely in the plane of propagation .While the polarization plane rotates in a corkscrew pattern completing one revolution during one period of the wave in a circularly polarized antenna. When the electric field of the antenna is perpendicular to the Earth's surface then it is said to be vertically polarized (linear) antenna.

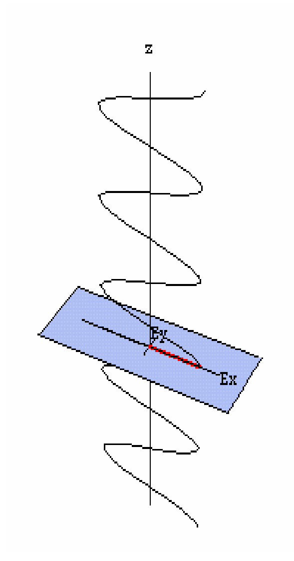

Figure II: Linear Polarization

II. PROPOSED WORK

Figure II shows design & simulation of Rectangular Microstrip patch antenna which support only one frequency. The microstrip antenna is first designed using the estimated values through the required formulas. In simulation of both the patch and the antenna, the proposed values are simulated using the software HFSS. Thus, the characteristics of gain, efficiency etc. are noted. The fabrication process involves PCB development steps. The hardware implementation is followed by testing using VNA

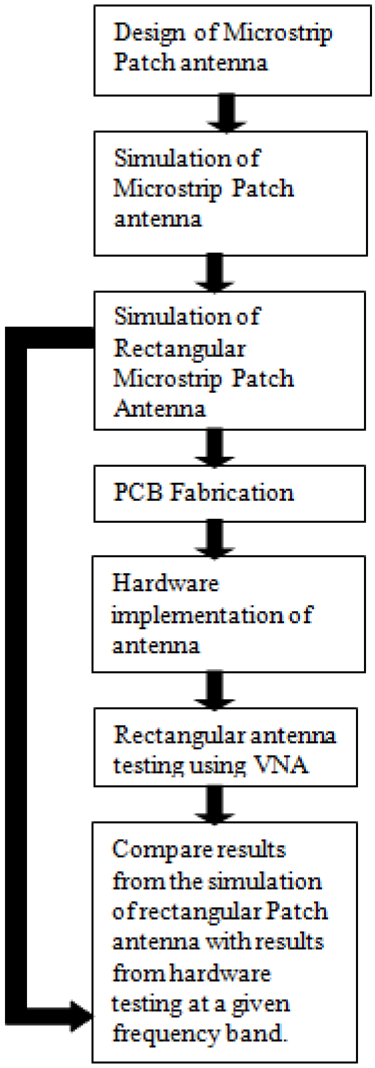

Figure III

In view of the above it will be apparent that, there exists a need of antenna system that enables efficient access of user location as well as wireless communication. For increasing compactness of electronic systems, there is a need of embedding two or more narrowband systems together this can be achieved by an array of antennas. The array of antenna helps in extending the required range of the GPS (1.7GHz) network through the required distance. Thus, advancing the usage and providing more user interactions. Therefore, with the proposed frequency the two consecutive antennas should provide the required phase difference between the arrays furthermore making the user to handle the power which needs to be applied. Within these frequency bands, the patch and the antenna, the proposed values are simulated using the software HFSS.

Applications	Type of Band	Frequency
GPS	L-band	1.7GHz

Table-I

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III. MICROSTRIP PATCH ANTENNA DESIGN AND RESULTS

A. *Specifications of Design*

Following are some essential parameters for the design of a rectangular Microstrip Patch Antenna:

1) *Dielectric constant of the substrate (εr):*

We have selected **FR4** as the dielectric material which has a dielectric constant of 1.7.This value helps in reducing the size of the antenna as a substrate with a higher dielectric value decreases antenna dimensions.

Position:(-59.59,-49.25,0)

X size:(110)

Y size:(98.5)

Z size:(-1.57)

Note: All dimensions are in 'mm'

2) *Frequency of operation (fo):*

The sonant frequency of the antenna must be selected appropriately. The resonant frequency selected for my design is 1.7 GHz.

3) *Microstrip Feed Line :*

Position: (-44.59,-1.5,0)

X size:(-15)

Y size:(3)

Note: All dimensions are in 'mm'

4) *Waveport:*

Position: (-59.59,-48.4/2,-1.57)

X size:(48.4)

Y size:(15)

Note: All dimensions are in 'mm'

5) *Quarter Wavelength:*

Position:(-20.54.-0.36,0)

X size:(-24.05)

Y size:(0.72)

Note: All dimensions are in 'mm'

6) *Patch:*

Position:(-20.54,-23.72,0)

X size:(40.625)

Y size:(47.5)

Note: All dimensions are in 'mm'

7) *Ground Plane Dimensions:*

A finite ground plane is essential for practical considerations. The dimensions of ground plane are:

Position:(-59.59,-49.25,-1.57)

X size:(110)

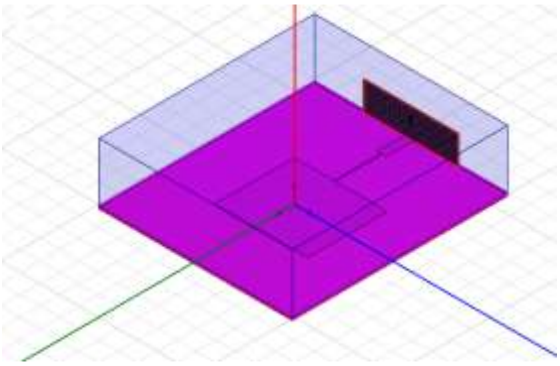
Y size:(98.5)

Note: All dimensions are in 'mm'

B. *Simulation Setup and Results*

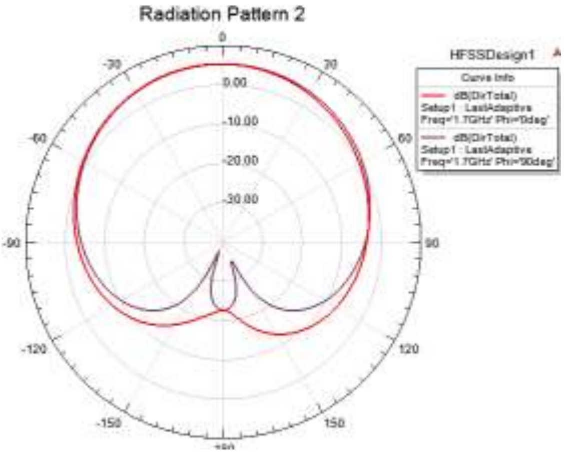
The essential parameters for the design of a rectangular Microstrip Patch Antenna:

1) *Design of Antenna*

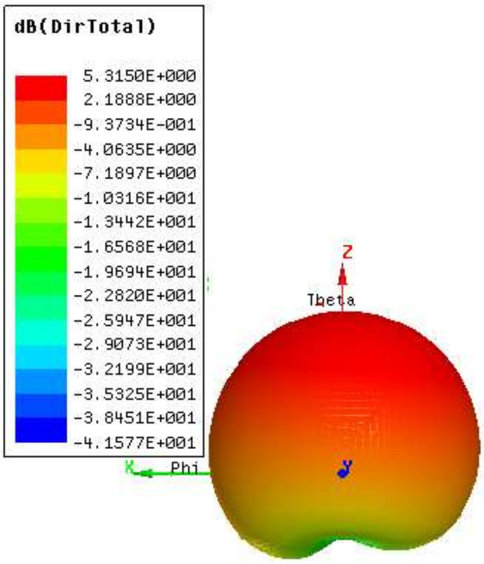


2) Radiation Pattern:

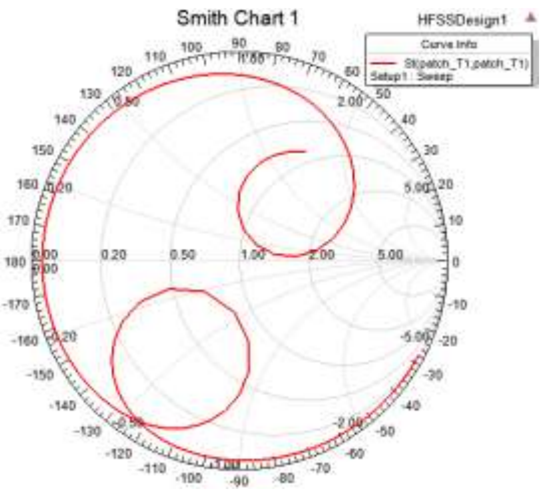
a) Gain radiation Pattern



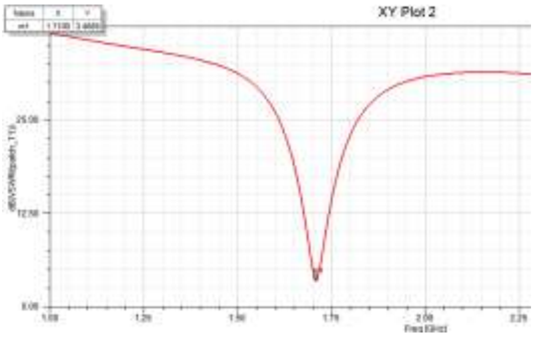
3) 3-D Polar Plot:



4) Smith Chart:



5) VSWR



IV. FUTURE PROSPECTS

The future scope of work revolves around with the fabrication of an array of Microstrip Patch Antennas to increase overall gain and improve the signal to noise ratio(SNR). It can be found that the resonant length of the patch can he reduced to a smaller value while maintaining greater bandwidth. The microstrip antenna can be modified to a planar inverted -F antenna (PIFA) for cellular communication purposes.
A further construction of phased arrays of this antenna can be used to reinforce the radiation pattern in the desired direction and suppress it in the undesired direction.

V. CONCLUSION

In this paper a design for small size patch antenna has been presented along with the development of the Microstrip Patch which correctly functioning code. The designs combine a rectangular microstrip patch with a microsrtip line feeding technique. The use of such an antenna would reduce the size of the wireless navigation setup significantly accompanied by a reduction in fabrication cost of the antenna. Also it is integral with the wireless setup, hence, improving system reliability. Rectangular Microstrip Patch Antenna is a narrowband antenna because of which it has low bandwidth. By increasing the width of the patch the Bandwidth can be increased but the impedance of the patch antenna will also get reduced.

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