Printed UHF Antenna for Satellite Communication

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A thesis submitted to the Department of Electrical & Electronic Engineering in partial fulfillment of the requirements for the degree of Bachelor of Science

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It is hereby declared that

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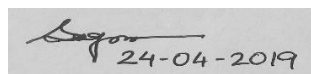

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Ethics Statement

We, hereby, declare that this thesis is based on results we found ourselves. The materials of work conducted by other researchers are mentioned in References. This is to affirm that this thesis report is submitted by the authors listed for the degree of Bachelor of Science in Electrical and Electronic Engineering to the Department of Electrical and Electronic Engineering under the School of Engineering and Computer Science, BRAC University. We, hereby, declare that the research work is based on the results found by us and no other. The materials of work found by other researchers have been properly acknowledged. This thesis, neither in whole nor in part, has been previously submitted elsewhere for assessment.

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Abstract

In our contemporary world satellite technology is one of the biggest invention for human being. There are thousands of satellite orbiting in the space now-a-days. Most of them are commercial satellite which have a large operational goal. But in recent years a new type of satellite is getting popular which is known as nano satellite or cube satellite. The reason behind this type of satellite is getting admired because it is cost efficient, light weight and focused in limited mission goal. Large satellite has different types of mission goal in one single satellite. But now multiple mission goals are being cut down in small goals and for achieving those small goals nano satellites are the perfect choice. For the nano satellite operation communication through the antenna is one of the major issue for successful mission. In this following research paper we have proposed a microstrip patch antenna with UHF band for nano satellite operations. For miniaturization of antenna in mm unit coaxial probe has been used. Experiment with different types of patch width, ground, feed point gives our design perfection. By comparing our design with pervious related works we get to know about the uniqueness of our design.

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Chapter: 1: Introduction

1.1 Introduction:

For exploring space and gathering data there is no better option than satellites. In recent years technology related to satellite has been emerge for the wellbeing of planet earth. There are different types of satellite available based on the operational goal now a days. Satellites can be classified by their work since they are moved into space to do a specific work. The follower must be sketched out specially to fulfill its portion. There are nine unmistakable sorts of satellites i.e. Communications Disciple, blocked off Identifying adj., Course Lackey, LEO, MEO, HEO, GPS, GEOs, Drift Disciple, Ground adj., Polar Follower. Communications satellites are fake satellites that exchange get signals from a soil station and after that retransmit the hail to other soil stations. They commonly move in a geostationary circle. A more distant Identifying instrument collects information roughly a challenge. If we list down the satellite types, then the list will be as follows

- Communications version Satellite
- Remote Sensing Version Satellite
- Navigation Satellite
- Geocentric Orbit
- Global Positioning System
- Geostationary Satellites
- Ground Satellite
- Polar Satellite
- Nano Satellites or Cubic Satellite

The large scale satellites have different mission plans and goals. But in recent years the practice of dividing the mission plans for achieving small goals has been increased. For this kind of focused mission nano satellites are being recognized in the contemporary world. As nano satellites are cost efficient so different universities from various countries are successfully approached to make and launch nano satellite in the space. BRAC University, Bangladesh is also one of them to launch nano satellite named BRAC Onnesha in the space. For nano satellite operation communication system through antenna has been an important section. As nano satellite is small in size so the size of the antenna needs to be small as well to fulfill the requirement. In this type of missions UHF band has been used worldwide. Microstrip patch antenna with millimeter unit are the best choice for the nano satellite related missions. In this following thesis paper we have approached a design of UHF microstrip patch antenna with frequency around 437 MHz for nano satellite related operations. In our design coaxial probe feeding has been used for minimizing the size. For achieving the required configuration, we have experimented with different patch design, ground design, substrate and feeding point. After different stage of simulation, we have also compared the design with other previous design to find out the uniqueness of our design.

1.2 Motivation

With the help of nano satellite technology now developing countries across the world can taste the satellite technology. As nano satellite is cheap comparing to the large scale satellite so many countries and also namy universities can also afford the technology now a days. BRAC University, Bangladesh is also one of the universities in the word which has built and deploy nano satellite in the space named “BRAC Onnesha”. As we are from BRAC University so we have gathered motivation from BRAC Onnesha to work with nano satellite. In our university we have a nano satellite ground station from where we can track the satellites and extract data regarding weather. So we are finding a scope to work with nano satellite technology. In near future the nano satellite technology will grow and for students like us will find chances for research works regarding nano satellite technology. So these are the reasons for choosing the topic related to nano satellite.

Chapter 2: Literature Review

Literature Review:

One of the main work in a research is to study about the previous works on the same or relatable topics. This practice can ensure an upgraded research with higher percentage of accurate result. While doing this following research we have also gone through some related research works to improve our system. We have selected sixteen different research papers to study and comparison with our work. Firstly, we have started with a paper titled Cube Sat – A Smart Device in Space Technology from [1]. In this paper different types of satellite have been described and a comparison has been showed based on different parameters like size, weight, power, cost, satellite type etc. One of the main concerns of this paper was cube satellite and it's regarding technology. As cube satellite is small in size so in this paper the miniaturization of satellite sub-systems like antenna, power system, communication system etc. has been described.

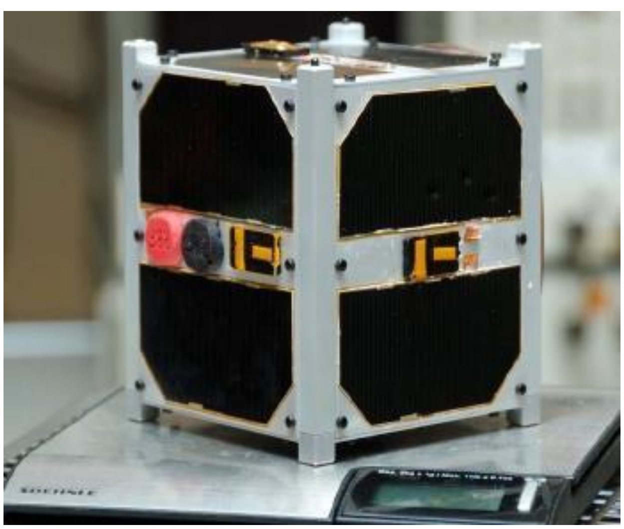


Fig.2.1. ESTCube 1 – 1U Cube Sat [1]

The next research paper we have studied titled Design with patch slots of hexagonal antenna array for satellite communication systems in [2]. In this paper a hexagonal fix cluster radio wire with stacking of spaces to improve the radiation pick up without expanding the fix estimate, band of Ku along with 14.5GHz thunderous recurrence has been portrayed. In this paper the bolstering Organize has been used because of the finest impedance coordinate for a coaxial bolstering line of 50Ω.

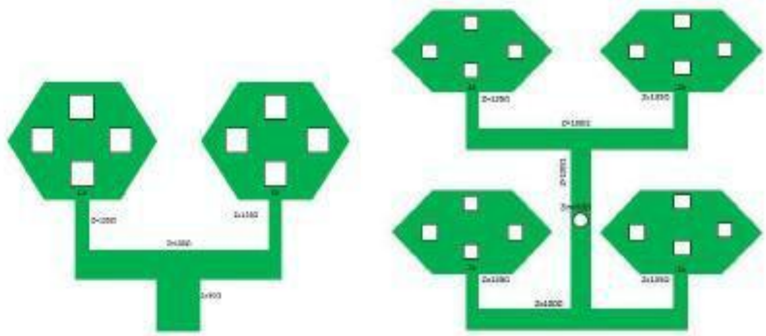


Fig.2.2. 1x2 & 2x2 hexagonal antenna patch [2]

Moving on to the next paper titled Antennas for Modern Small Satellites from [3]. In this research paper the challenges during design of the antenna for modern satellites has been described. For different type of task like TTC of modern small satellite, downlink of high speed pays load data from modern satellite, GPS & GNSS, inter satellite cross link etc. different types of antennas has been discussed in this paper. Some of the types of antennas are S-Band patch antenna, S-Band quadrifiler helix antenna, S-Band patch excited cup antenna, X-Band helical antenna, GPS patch excited cup antenna and many more.

The another paper we have gone through titled Plan and Advancement of Inter-Satellite Division Instrument for Twin Nano adj. – STUDSAT-2 in [4]. In this paper the nitty gritty plan, improvement and energetic examination of Division Component for double Nano-satellite

"STUDSAT-2" has been portrayed. The partition component framework is interfaces among the double cubic satellites, STUDSAT-2A and STUDSAT-2B. In both of the adj., the communication framework is Downlink (UHF: 433 MHz) Uplink (VHF: 144MHz).

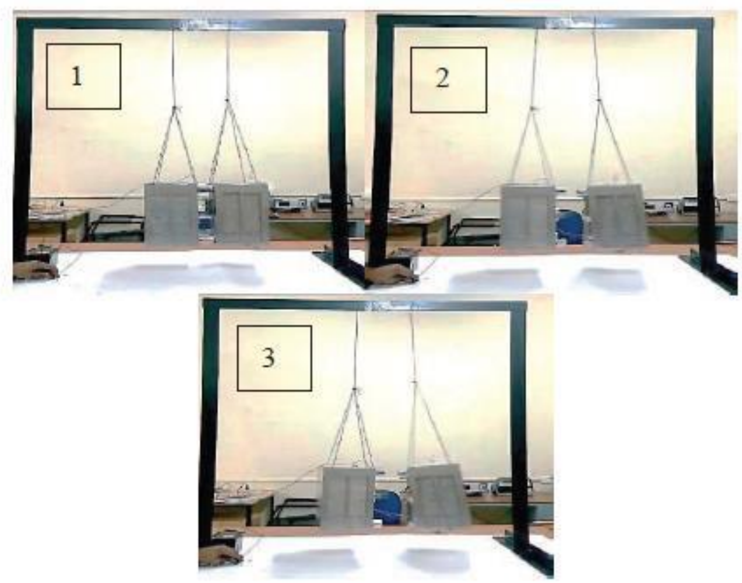


Fig.2.3. STUDSAT – 2 A and STUDSAT – 2 B separation testing [4]

The paper we have considered another named Improvement of Antennas Sending Circuit for Nano-Satellites from [5]. In this paper the plan and improvement of a profoundly productive, shrewd and solid control circuit model called the Antenna Sending Circuit has been portrayed by the creator. Nano Satellites ordinarily communicate within the Novice Recurrence Groups, these groups found in between 144 MHz to 146 MHz for VHF and in between 434 MHz to 438 MHz within UHF run. Planning radio wires at these frequencies ordinarily closes up being bigger in estimate than the real CubeSat itself. That's why a folded antenna has been used and after the ejection of the satellite into the orbit an antenna deployment circuit trigger the folded antenna to be into its actual size.

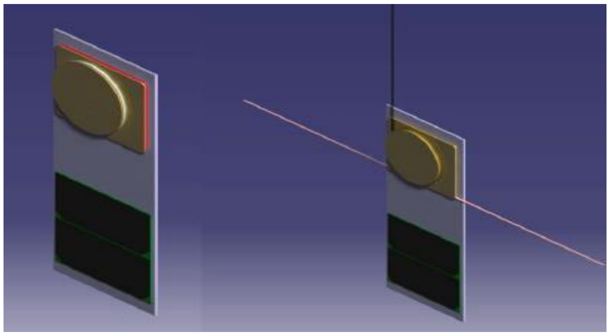


Fig.2.4. Simulation of antennas [5]

Moving on to the next paper titled Planar Inverted-F Receiving wire (PIFA) Cluster with Nano Fawning Application from because of the circular polarization [6]. In this paper a modern plan of an S-band, self-staged, planar Inverted-F receiving wire (PIFA) is proposed for moo circle nano disciple application. The receiving wire comprises of four PIFAs which are orchestrated in circular cluster to create circular polarization receiving wire. The receiving wire works at 2.35 GHz with 107 MHz transfer speed of Return Misfortune less than -14 dB. The proposed radio wire is moo taken a toll and compact in plan which is exceptionally much basic for the nano lackey operation.

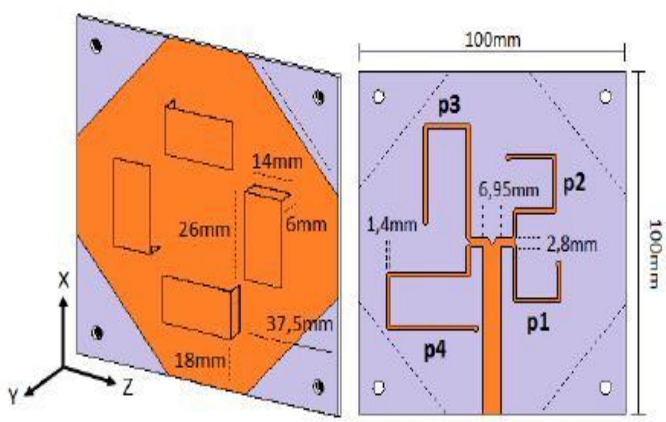


Fig.2.5. Design of antenna front & back view [6]

The another paper titled Plan and Investigation of Microstrip Antenna Clusters for Meteorological Nano-Satellites for UHF Uplink in [7]. In this paper, the think about of microstrip radio wire clusters for meteorological nano-satellites which is backed by the Brazilian Space Organization (AEB) has been portrayed. In arrange to survey the fix geometry that presents reasonable execution, microstrip antennas with straight and circular polarizations has been planned. The essential geometry chosen for the plan was the square fix bolstered electromagnetic coupling.

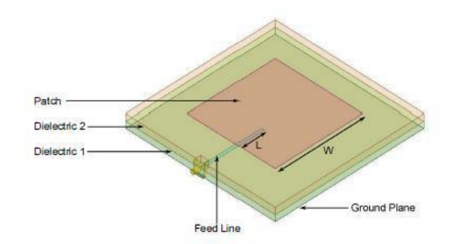


Fig.2.6. Dimension of the antenna with square patch [7].

The paper we have examined following titled Telemetry X-band Antenna Payload for Nano-satellites from [8]. Within the paper a compact X-band antenna with an isoflux radiation design and circular polarization has been displayed. The framework comprises of a miniaturized helix antenna associated to a strip line circuit that gives a consecutive revolution nourishing. The antenna is orchestrated over a vertically layered ground plane and it has been optimized for a CubeSat 3U nanosatellite stage.

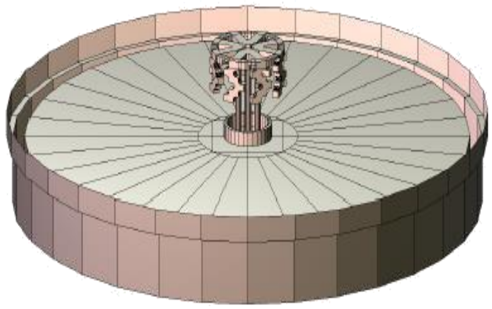


Fig.2.7. Proposed antenna architecture [8]

Moving on to the following paper titled Plan and Realization of Two Cluster Triangle Fix of Microstrip Receiving wire with Gold Plat at Recurrence 2400-2450 MHz for Hexagonal Nanosatellite in [9]. This investigate was consist of double clusters of microstrip antenna along a fix of triangular. This radio wire works on S-band recurrence, on 2400- 2450 MHz with VSWR ≤ 1.7. To meet a great information, transmit capacity, the receiving wire has been outlined with pick up over 6 dBi, with the transmitting extend of 700 km. On the surface of the fix radio wire, made of a plating of gold to amplify the life of the receiving wire from erosion.

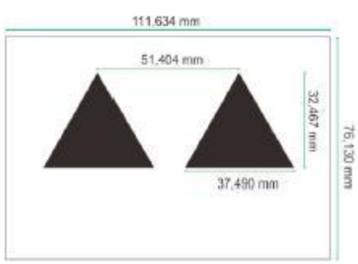


Fig.2.8. Antenna Dimension [9]

The another paper we have examined named State of mind estimation of nano-satellite "HIT-SAT" utilizing gotten control variance by radiation design in [10]. In this paper nano obsequious named HIT-SAT which was propelled on 2006 as a secondary payload of JAXA M-V-7 has been examined. The communication transport framework of HIT SAT comprises of a dipole antenna, a monopole radio wire, CWand FSK transmitter and recipient. The dipole radio wire was utilized for down-link of 430MHz band. The monopole antenna was utilized for up-link of 145MHz band. The antenna pick up was 2.15 dBi.

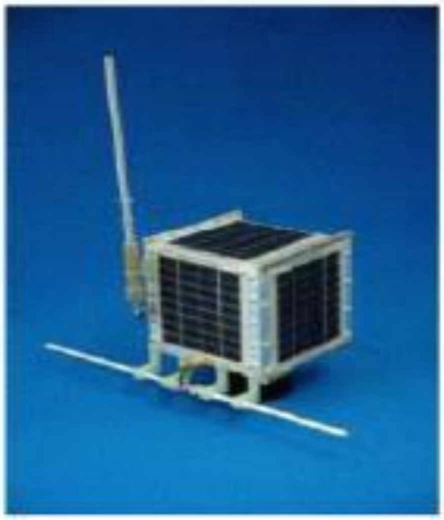


Fig.2.9. Flight Model of HIT – SAT [10]

The other term paper titled On Board Communication Subsystem for Satyabhama College Nano-Satellite from [11]. In this paper different equipment and computer program plan angles of the Satyabhama nanosatellite communication subsystem has been examined. Monopole radio wires has been outlined for the communication reason in this case. The outlined quarter-wave UHF monopole radio wires give around 3 dB of pick up at the 437.5MHz beginner band.

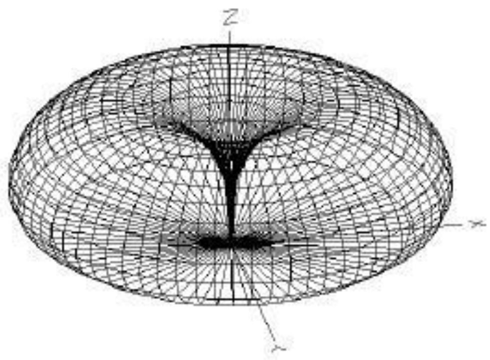


Fig.2.10. Radiation pattern of the designed monopole [11]

Moving on to the following paper titled Multimode Reconfigurable Nano-satellite Radio wire for PDTM Application from [12]. In this paper the plan of an unused reconfigurable pillar radio wire utilized to move forward the proficiency of spatial telemetry joins on Nano-Satellite has been examined. This dexterous pillar antenna isn't built on the well-known cluster concept: AESA (Dexterous Electronically Scanned Array) but employing a modern one called ARMA (Dexterous Network Emanating Radio wire).

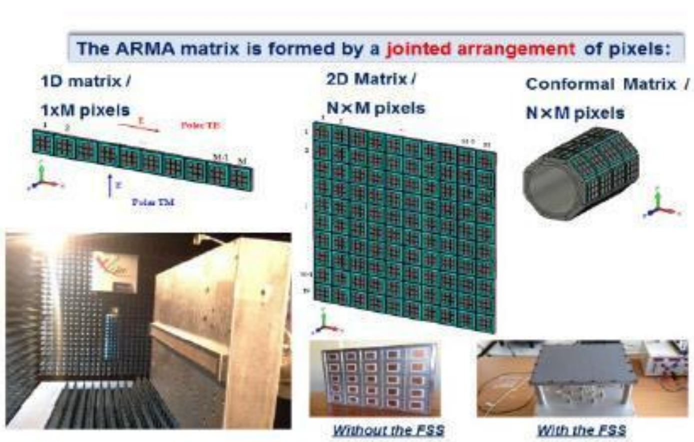


Fig.2.11. ARMA Antennas Architecture

The following paper that we have go through titled an S-Band Micro-Strip Fix Cluster Radio wire for Nano-Satellite Applications [13]. In this paper a microstrip fix antenna cluster working at 2.2GHz and 2.45GHz S-band frequencies has been proposed for nano adj. operation. This real-time extend work bargains with a rectangular fix antenna working at S-band frequencies which is primarily centered to be pertinent for the NIUSAT which may be a nano disciple. The substrate fabric being utilized is Alumina with dielectric steady 9.6. This radio wire is outlined to be utilized for TTC and payload downlink purposes.

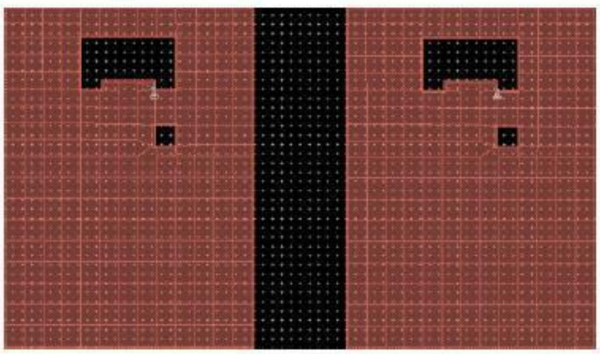


Fig.2.12. Geometry of S-Band Patch Micro-Strip Array Antenna [13]

The another paper titled Antenna Framework for Nano-satellite Mission GOMX-3 from [14]. In this paper the radio wire plan for a nano-satellite mission named GOMX-3 has been talked about. Four distinctive sorts of radio wire like helical antenna, GPS antenna, UHF monopoles, L Band antenna has been utilized in this framework for disciple communication. The execution of the antenna is expanded by up to 1.4 dB with a basic alteration to alter the reverberation recurrence.

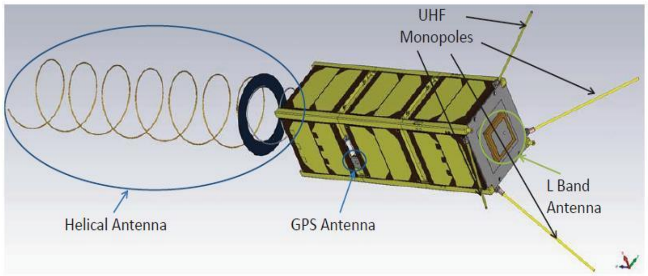


Fig.2.13 Satellite with multiple antenna [14]

The another paper that we have examined is titled UHF and S-band Antenna Clusters for Nano-Satellite-Based Data-Relay in [15]. In this paper two radio wire clusters to get and retransmit natural information over a nano-satellite has been displayed. In this inquire about work the most challenge was to coordinated a unidirectional antenna working in UHF onto the nano-sat. The reenacted pick up for the outlined UHF antenna was 3.75 dBi and the proportion 10.5 dB. Not with the ground expansion, these parameters were 1.3 dB and 4 dB for pick up and front-to-back proportion, individually. The S Band radio wire cluster has been built with dielectric covers of

200 mm×200 mm and with center-to-center inter-element dividing of 80.8 mm.

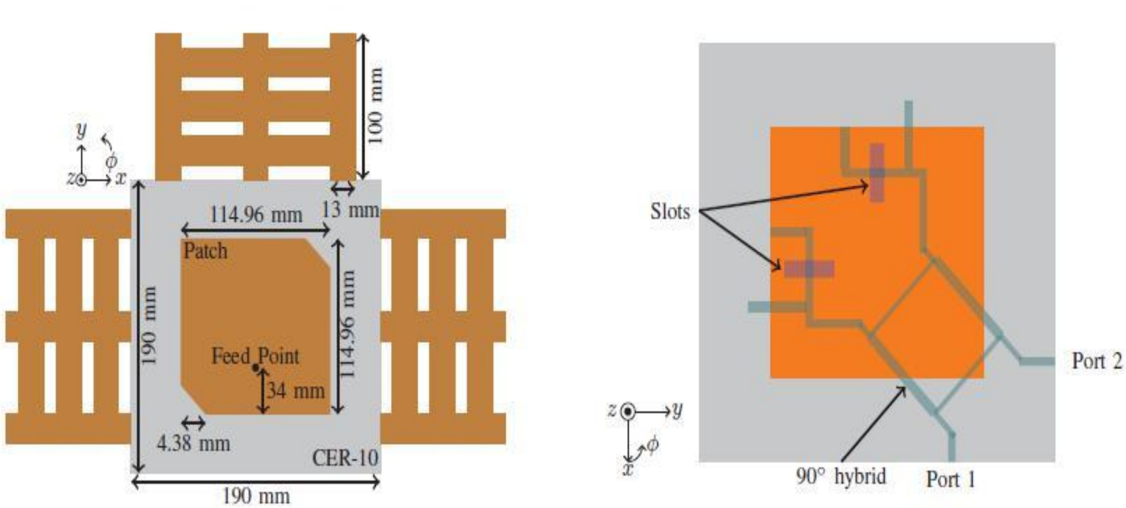


Fig.2.14. UHF & S-Band Antenna Array respectively [15]

Lastly we have studied the paper titled BIRDS-1 CubeSat Constellation Using

Compact UHF Patch Antenna from [16]. This paper was focused on the development of UHF patch antenna for cube satellite operation. The frequency requirement for the antenna development was 437.372 – 437.375 MHz. But after the development operating frequency becomes in between 418 – 448 MHz. The feed point of this antenna was in the lower corner. Different ground pattern has been used for achieving the required frequency.

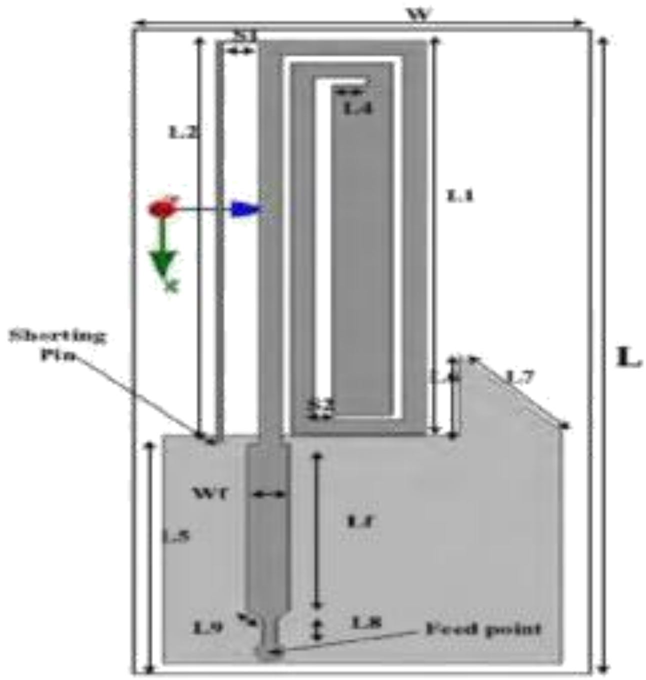


Fig.2.15. Schematic design of UHF patch antenna for nano satellite [16]

After critically analyzing all the research works, we have come up with a comparison between our systems from literature review. As we have seen that in most of the work patch antenna has been used for miniaturization of antennas. In our case we have used coaxial probe feeding for decreasing the size of the antenna. As our system is microstrip patch antenna so we have used different types of Ground and feeding point for increasing the operating frequency. In the following above mentioned papers the main concern was the patch antenna based miniaturization and working in different frequencies. While in our paper we are more concerned about achieving Ultra High Frequency – UHF range which is in between 437 MHz which is also used for satellite communication in amateur radio band. In our design as we are using coaxial probe feeding that's why we can reduce the size and weight of the antenna in a significant amount comparing to the other designs and this design will open the space of work for Nano satellite technology.

Beside nano satellite related papers we have also gone through papers with different topics to learn more about different kind of antenna design. For example, two of the recently published papers from BRAC University regarding metamaterials related topic [17] and [18]. In [17] a bland handle of adjusting the higher arrange common reverberation mode has been proposed by utilizing metamaterial. For this adjustment in a specific course greatest radiation has been accomplished but the pick-up of the side flap has been diminished. In [18] the plan of a straightforward and adaptable coplanar waveguide encouraged (CPW) radio wires working from 23 GHz to 29.5 GHz, covering the essential recurrence groups for 5G remote communications has been illustrated. The plan fitted for future 5G applications since of its straightforwardness, adaptability, light-weight and wide achievable recurrence transmission capacity close mm Wave recurrence band. We too considered few papers handled for mm Wave communications such as [19] titled V-Shaped Fix Antenna for 60 GHz mm Wave Communications to get it plan instrument of radio wires for mm Wave applications.

Chapter 3: Antenna Overview

3.1 Antenna Overview:

A metallic structure which transmit or gets radio electromagnetic waves is called a receiving wire. As appeared in figure 1 generally a radio wire works as transitional gadget between a guided gadget and free space. The line of transmission or the directing gadget may be turn into coaxial line for utilized to sending electromagnetic vitality from the source of sending to the radio wire or from the receiving wire to the recipient. Amid transmission swaying current is connected to the radio wire by the collector which makes a wavering and attractive field around the radio wire. Within the case of gathering inverse happens. A drive has been applied by the wavering electric and attractive radio waves field on the radio wire electrons, for development for electrons and in this way creating.

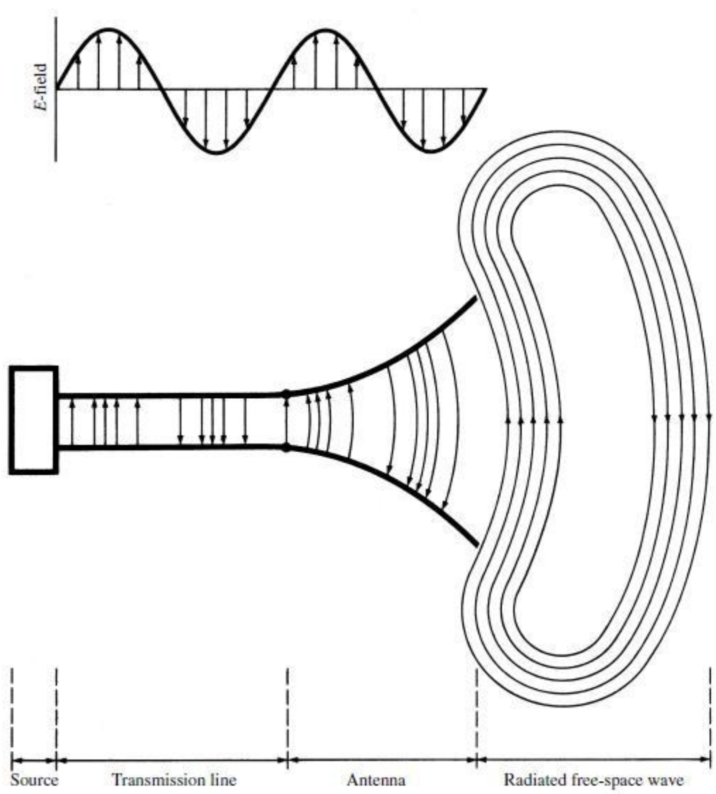


Figure 3.1: Antenna as a transition device

Wavering current.

Other than transmitting and getting vitality, a receiving wire is additionally utilized to concentrate radiation vitality in a specific heading whereas smothering it in others (directional) or it can indeed transmit and get in all headings (omnidirectional). In year 1888 German physicist Heinrich Hertz has built the primary radio wire. For demonstrating the expectation of James Receptionist Maxwell almost the presence of electromagnetic waves it was one of the test work [21]. Within the insurgency of communication radio wire innovation has played a major part over final 60 a long time. For improving the in general execution of a framework a great radio wire plan may be an obligatory prerequisite. Within the world of remote communication receiving wire is the foremost basic component. They are utilized in radio broadcasting, broadcast tv, communication recipients, versatile phones, radars and disciple communication. In this way receiving wires are the foremost imperative component within the field of communication.

3.2 Types of Antenna

1. Wire Antenna

One of the most seasoned, least difficult and taken a toll compelling radio wires are the wire receiving wires. They are utilized in car, airplanes, houses, ships, spaceships and numerous more. There are diverse molded wire radio wires in our environment. They are straight wire (dipole), circle and helix. It isn't obligatory for the circle radio wires to be circular, it can be in any shape like rectangle, oval, square etc.

Dipole Antenna: One of the foremost critical, basic and commonly utilized RF receiving wire is dipole radio wire. The dipole receiving wire comprises of two conductive components such as metal rods that are partitioned within the center and a separator is utilized to isolate the two fragments of the bar. At the conclusion they are connected with a coaxial cable. The feeder can apply radio recurrence voltage since of the part between the emanating components at the center.

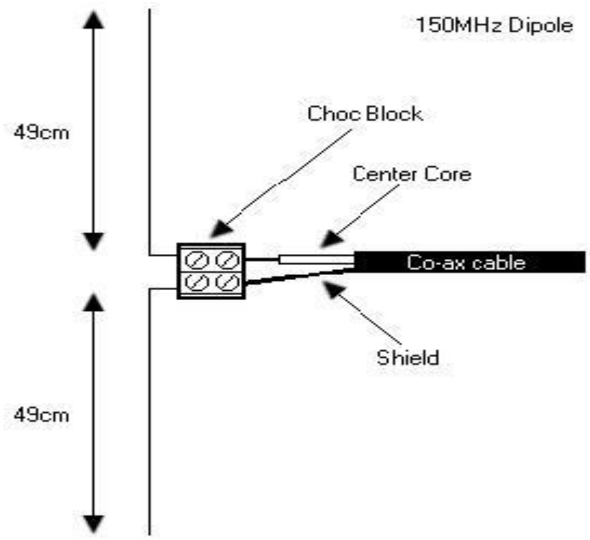


Figure 3.2: Dipole Antenna

Most broadly utilized receiving wires are the half wave dipole radio wires. The full length of the receiving wire is break even with the amount of half wavelength that the radio wire is to create. In [22] states that a normal pick up for dipole radio wire is 2dB and the transfer speed is by and large around 10%.

Loop Antenna: The circle antenna is made of a conductor that's bowed into diverse shapes like square, curved, circular and numerous more. Since they have moo radiation resistance and tall reactance so the impedance of these radio wires are troublesome to coordinate. [24] They are exceptionally much useful as collectors. Rather than dipole antennas which are exceptionally much huge circle antenna can be utilized at moo frequencies. Ambresh et al expressed that the productivity of little circle radio wire isn't great, be that as it may a tall flag to clamor proportion compensates for it [23]. The center of the circle radio wire can be filled with ferrite to upgrade its execution. -2dB to 3dB is the commonplace pick up for circle antenna with a transfer speed of around 10%.

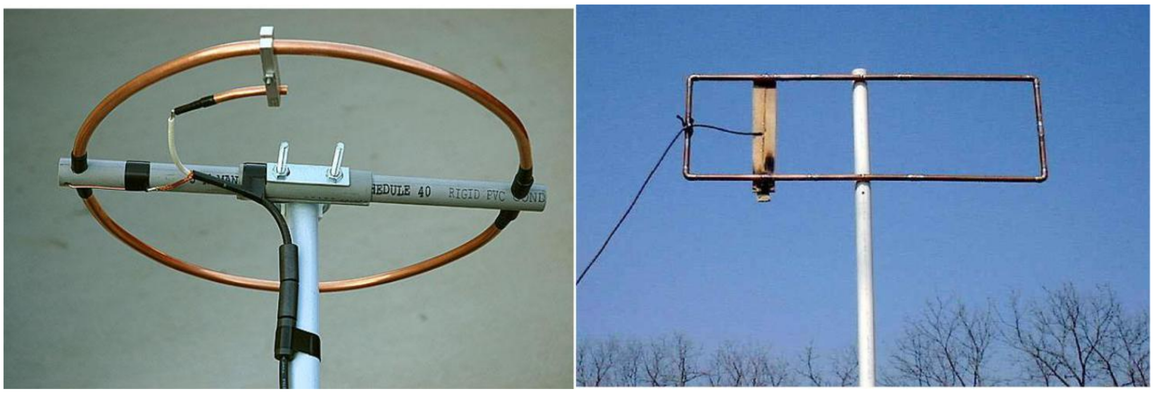


Figure 3.3.(a): Circular Loop Antenna   Figure 3.3.(b): Rectangular Loop Antenna

2. Travelling Wave Antenna

A bunch of receiving wires that employments voyaging wave on a directing structure as the most transmitting instrument is called the voyaging wave receiving wire. The voyaging wave of electromagnetic motions proliferates along its geometric pivot for voyaging wave radio wires. Voyaging wave receiving wires consist of discrete type radiators put with the hub at a specific separate from one another. As voyaging wave receiving wires are non-resounding that's why they have a more extensive transfer speed than resounding radio wires. Yagi Uda, winding, helical etc. are a few common sort of voyaging through radio wires.

Helical Antenna:

Helical radio wires are comprising of a solo conductor injured shape like helical [24]. The helical receiving wire is as a rule placed whereas the nourish line is associated between the ground plane and the foot of helix. Since it is based on voyaging wave so the current and the stage continually change along the helical receiving wire. This sort of receiving wires are circularly polarized. Helical receiving wires working in typical mode are utilized in portable radios and broadcasting antennas. Helical antennas that are working in axial mode used in satellite communication.

Figure 3.4: Helical Antenna

Yagi Uda Antenna: This radio wire was to begin with concocted in Japan named Shintaro Uda. His work which was distributed in Japanese was afterward deciphered into English by Yagi [22]. This sort of antennas is exceptionally much straightforward and simple to build. The Yagi antenna comprise of three components driven component, reflector and executive. Control is connected within the driven component whereas executive components are put at the back of the driven component within the heading of greatest affectability. They for the most part have a tall pick up regularly more noteworthy than 10dB. The Yagi Uda antennas ordinarily work within the HF to UHF groups (3MHz to 3GHz) [24]. As they are directional that's why the obstructions levels have been minimized for getting and transmitting. They have a little transmission capacity.

Figure 3.5: Yagi Uda Antenna

3. Reflector Antenna

For communicating over more prominent separate through transmit and get, reflector radio wires are the commonly utilized antennas for this sort of operation. These are tall pick up antennas that are as a rule required for long separate radio communication, toady communications, tall determination radars, radio space science and numerous more. This sort of receiving wires can effectively accomplish picks up of 30dB for microwave and higher frequencies. A few of the common sorts of reflector radio wires incorporate corner reflector and allegorical reflector.

Parabolic Reflector: This sort of radio wire comprises of an illustrative type metal reflector. There's a little antenna feed before this was at the center. Reflector ordinarily consist of metal surface is bowed like parabola. Amid sending radio recurrence current is provided using cable line for sending to bolster radio wire whereas amid gathering of waves for radio are centered point of bolster receiving wire which changes them into current that voyages through the sending line to the receiver. These receiving wires regularly have exceptionally tall pick up (30-40 dB) and moo polarization with a sensible transfer speed [24].

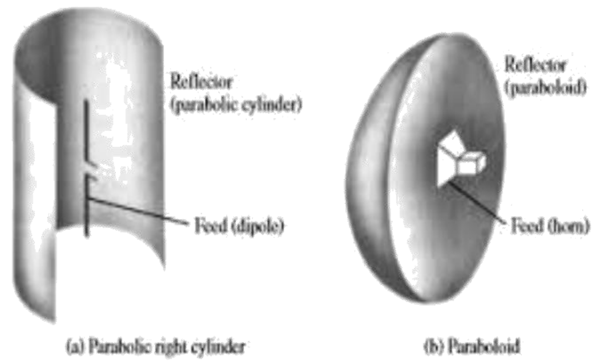


Figure 3.6(a): Parabolic Antenna Figure 3.6(b): Parabolic right cylinder & parabolic

Corner Reflector: For expanding the directivity of a receiving wire in some cases the geometrical shape of the reflectors is being balanced. One such course of action is finished in this way so that reflector of double plane is adjusted in a way to make a corner. These reflector receiving wires for the most part have a direct pick up (10-15 dB) [24]. Corner reflectors have an uncommon include in case the reflector has been used as an inactive target it'll return precisely within the same course because it is gotten because point is 90 degrees. Since for interesting reason numerous vehicles are outlined with least corners for decrease their location by foe radar. Without this it’s generally utilized in UHF tv antennas with P2P communication joins and information joins for remote WANs.

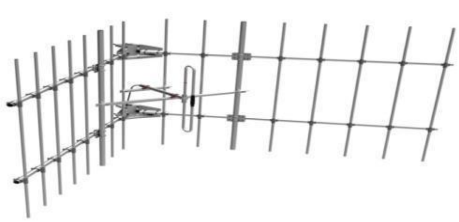


Figure 3.7: Corner reflector Antenna

4. Aperture Antennas

Gap radio wires are basically consisting of metallic dielectric dividers generally with edges. Waveguide utilized it with excitations. Gap receiving wires are more prevalent since of the expanding request for advanced radio wires and use of greater frequencies. These receiving wires are exceptionally valuable for flying machine and shuttle applications. Most common sorts of opening radio wires are horn radio wires and space receiving wires.

Horn Antennas: At UHF (300 MHz-3 GHz) and higher frequencies horn receiving wires are exceptionally much well known. They as a rule have directional radiation design and tall receiving wire pick up which can run up to 25dB in a few cases, whereas in most cases its more often than not from 10-20dB. The pickup of the radio wire frequently increments as the recurrence operation increments [24].

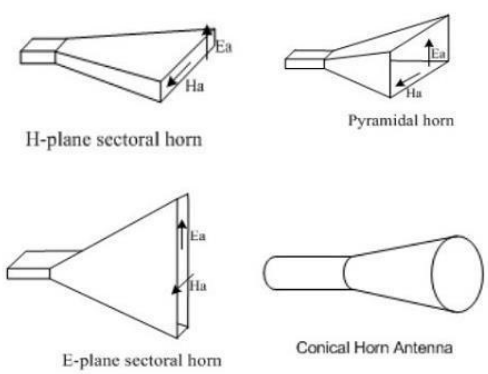


Figure 3.8: Different Type Horn Antennas

Slot Antenna: This type of receiving wires consist of essentially split spaces or surface mount cutting. For the most part utilized 300Hz and 24GHz frequencies. It has generally radiation design with Omni direction. Source of voltage is connected over the brief conclusion of the opening radio wire which actuates field of electric dispersion inside the space of the opening, this is the way to radiation contribution. The polarization of the space receiving wire is straight. The shape, estimate of the openings can be modified to tune execution.

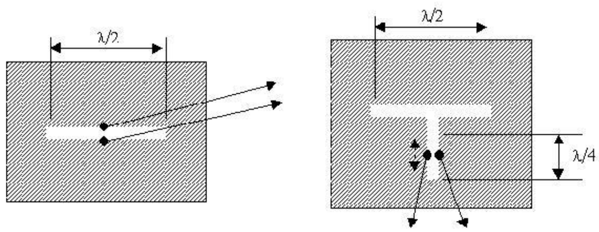


Figure 3.9: Different shapes for the slot

5. Microstrip Antenna

Microstrip receiving wires are one of the foremost well-known and broadly utilized printed radio wires. They are moreover alluded to as fix receiving wire and have moo fetched, low profile is simple to manufacture. Fundamental development of the microstrip fix radio wire incorporates an emanating type of patch best of substrate made of dielectric materials encompasses a plane of ground underneath it. The microstrip receiving wires with great alluring execution have large type of substrate consistent is lesser with superior productivity. The microstrip fix receiving wire has distinctive bolstering strategy. Line microstrip, test of coaxial, are mostly used. Microstrip radio wire patches are in different types rectangular, circular etc. Main impediments of microstrip fix radio wire are their moo effectiveness, moo control, tall Q, destitute polarization, spurious bolster radiation and contract recurrence transmission capacity as talked about by Balanis in [26]. In tall execution aircrafts, spacecraft’s and satellites where estimate,

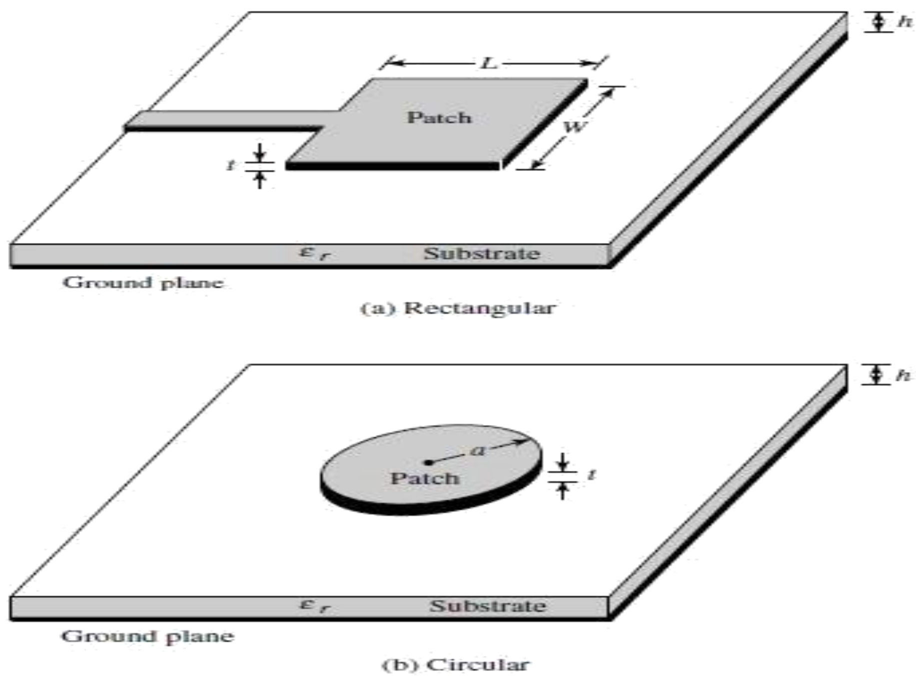


Figure 3.10: Microstrip - Rectangular & Circular patch

3.3 Antenna Parameter:

A radiation design aka a receiving wire design can be portrayed as the variety of the control emanated by a receiving wire as a work of the course absent from the receiving wire. The properties with respect to radiation most of the time comprise of flux thickness, radiation concentrated, field quality, directivity, stage or polarization. As a cruel of a work of directional arranges it is spoken to and more often than not characterized in distant field locale. Within the Shape underneath ready to see a third dimensional version of facilitates for radio wire radiation design.

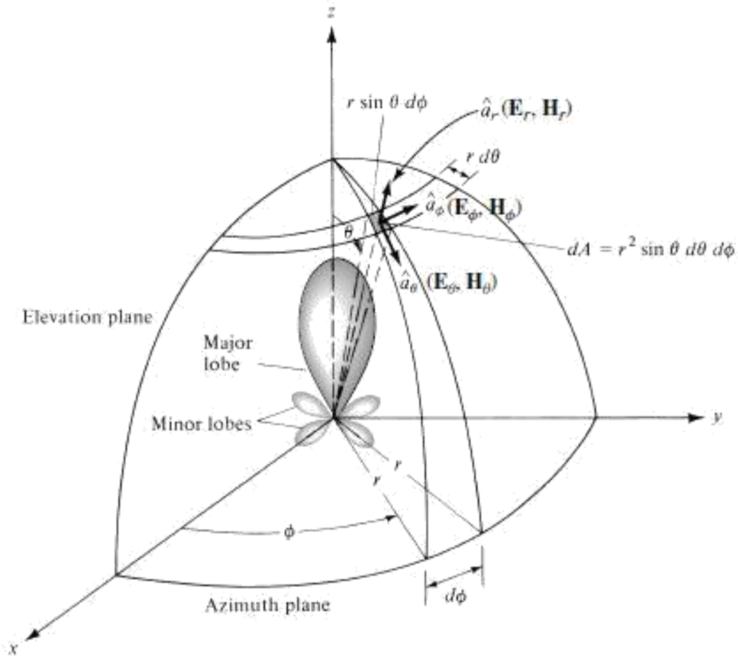


Figure.3.11. Coordinate system for antenna analysis

For speaking to radiation design us for the most part plot them in 2-D is visualized with the shape underneath. Standard round arranges are utilized, where Θ is calculated point off z-axis, and Φ is Calculated for x – axis.

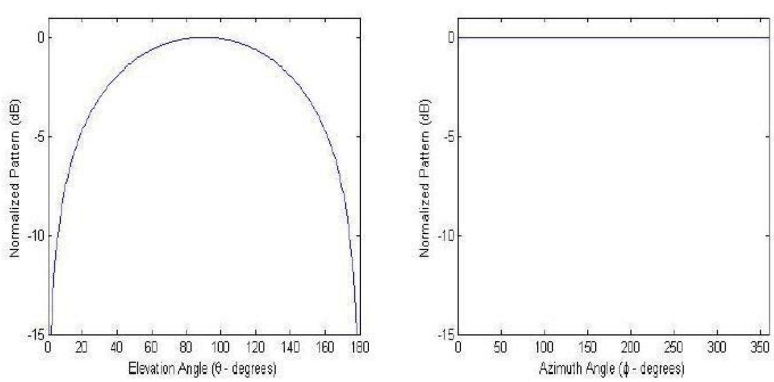


Figure.3.12. Theta & Phi for elevation and azimuth angle respectively

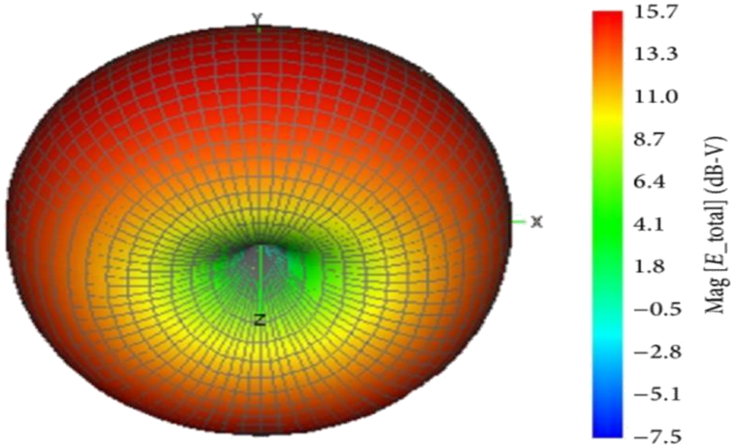


Figure.3.13. Pattern of radiation 3-D view

Basically when it is for the radiation design of antenna we consider two angles control design and field. Field design is for the plot of E-field ad control design square size plot [27]. We ordinarily speak to control designs according to the scale of logarithm because it's comprises indeed design part projections which is talked about underneath.

According to the final critical bit around antenna radiation for the HPBW. The half power beam width is characterized for precise division for the greatness of design diminish by half a hundred percent for crest of most pillar [27,28]. Invalid Beam width alluded for the precise partition from the greatness from the design diminishes to negligible amount absent from the most pillar.

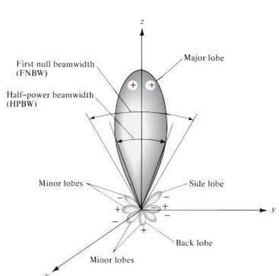


Figure.3.14. Main lobes and side lobes

Antenna Gain

The term antenna pick up called degree for amount of control sending within the heading for top radiation with regard to a source of isotropic. For occurrence in the event that we had a sending receiving wire along dB of 3 pick-up it shows control gotten distant of radio wire [29,30]. Moreover, an accepting receiving wire along with 3dB to a particular course suggests of 3dB more control in case comparison with a less loss receiving wire. Radio wire Pick up can make a relation along with directivity.

Here,

= Antenna Gain

= Efficiency of Radiation

= Directivity

The pick up of antenna is relative to its different aspects. Due to occasion an expansive receiving wires for dish has picks up as tall greater than 40dB in spite of the fact that it's not often regular issue.

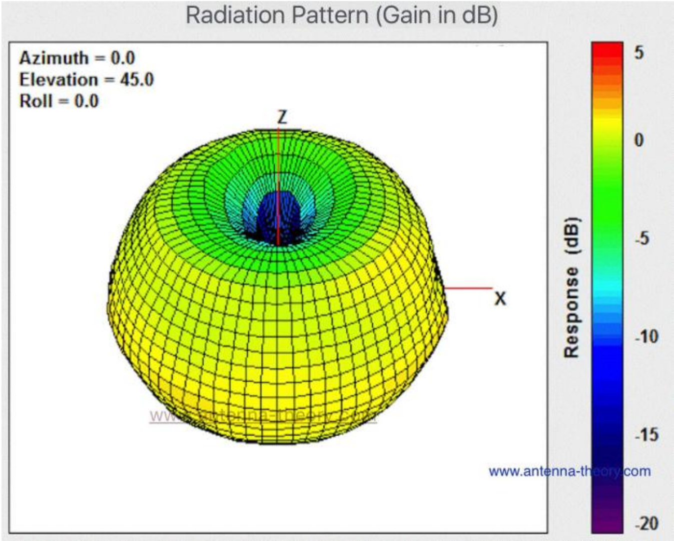


Figure.3.15. Azimuth, elevation radiation

Directivity

Directivity is an important parameter for receiving wire with basically an estimation for pattern of radiation heading. Radio wire directivity characterized proportion for radiation concentrated within heading with receiving wire along with radiation concentrated for the half value of overall system where radiation as usual escalated is rise to the full control emanated by the radio wire separated by 4π [31]. We expect that course of most extreme radiation concentrated is inferred on the off chance that no course is indicated. Expression for this system is as follows

= / = 4 /

We can use maximum intensity radiation direction as follows

= 0 = | / = / = 4 /

Where,

D = directivity without dimension

D0 = directivity maximum without dimension

U = Intensity of radiation

Umax = Intensity of radiation maximum

U0 = Isotropic source intensity of radiation

Prad = power of radiation

For radio wires halfway of directivity radio wire for declared polarization heading alluded for the portion which escalated comparing with partitioned for whole escalated radiation found the middle value of over all directions [32]. In expansion we may characterize the full directivity as the entirety of the halfway directivities for any two orthogonal polarizations. On the off chance that we are managing with circular facilitate framework the whole greatest directivity D0 may be communicated as

$$D_\theta = \frac{4\pi U_\theta}{(P_{\text{rad}})_\theta + (P_{\text{rad}})_\phi}$$

$$D_\phi = \frac{4\pi U_\phi}{(P_{\text{rad}})_\theta + (P_{\text{rad}})_\phi}$$

Uθ = Intensity of radiation θ field

Uφ = Intensity of radiation φ field

(Prad)θ = Power of radiation θ field

(Prad)φ = Power of radiation φ field

Expressions for directivity with maximum range

$$D(\theta, \phi) = 4\pi \frac{F(\theta, \phi)}{\int_0^{2\pi} \int_0^{\pi} F(\theta, \phi) \sin\theta \, d\theta \, d\phi}$$

$$D_0 = 4\pi \frac{F(\theta, \phi)|_{\max}}{\int_0^{2\pi} \int_0^{\pi} F(\theta, \phi) \sin\theta \, d\theta \, d\phi}$$

S Parameter

The important parameter that makes a difference for assess generally execution receiving wire. It's fundamentally characterizes connection of incoming yield harbor framework [33,34]. The occurrence, into harbor framework, unexpectedly title harbor first and second, and control harbor second to one called S12. Essentially, S21 speaks to control send harbor first to second. While, these will be the reflection of control harbor first and second attempting, separately.

Topic of radio wires, The S11 foremost utilized compared parameter to others. It basically implies control which fundamentally make reflection from receiving wire. In this manner, it can too be spoken to utilizing coefficient for reflection, defined as Γ. Misfortune of control which happen for a few irregularities more often than not for bungle among double impedance within line of transmission. Misfortune return is more often than not communicated as follows

$$RL_{\mathrm{dB}} = 10 \log_{10} \frac{P_{\mathrm{i}}}{P_{\mathrm{r}}}$$

Here Pi stands for power and Pr stands for power reflection.

$$\Gamma = \frac{Z_{\mathrm{L}} - Z_{\mathrm{S}}}{Z_{\mathrm{L}} + Z_{\mathrm{S}}}$$

$$RL_{\mathrm{dB}} = -10 \log |\Gamma|^2 = -20 \log |\Gamma|$$

Subsequently, it is conceivable to decide the transfer speed of a radio wire from its S-parameter.

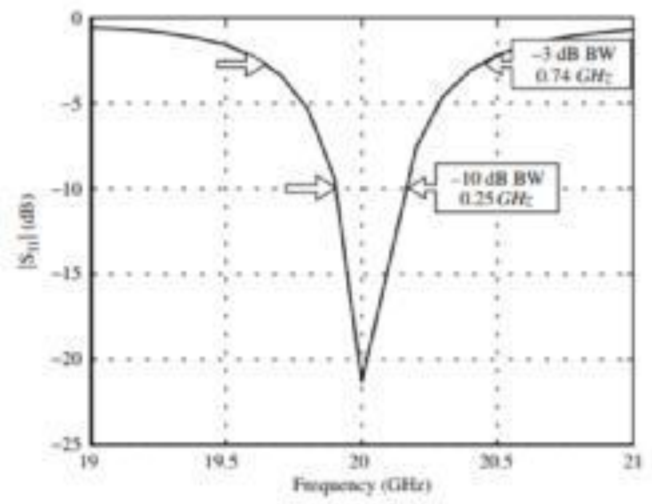


Figure.3.16. Rectangular patch antenna return loss with 20 GHz

Antenna Efficiency

Radio wire proficiency, which is another exceptionally critical parameter for radio wire can be communicated as the radiation effectiveness. It is characterized as the proportion of the control conveyed to the radio wire to the control that's really transmitted by the radio wire. A really tall proficiency demonstrates that most of the control that was occurrence at the antenna's input was effectively emanated. Though a wasteful antenna implies a noteworthy sum of control was misplaced. These misfortunes may happen due to I2R misfortunes (conduction and dielectric).

[24]. The radiation effectiveness of an antenna is given by the condition underneath. It can be communicated as a proportion, rate or indeed in decibels and is recurrence subordinate. Concurring to the complementary property of the radio wire, no matter in case the radio wire is being utilized a recipient or transmitter, its transmitted productivity will stay unaltered.

$$\varepsilon_R = \frac{P_{radiated}}{P_{input}}$$

R = $e_c \cdot e_d$

It is for all intents and purposes outlandish for the antenna productivity to be 100% but dish radio wires, horn antennas, or half-wavelength dipoles have for all intents and purposes no lossy materials around them so they come exceptionally near to it.

Figure.3.17. Different types losses within Antenna

They are follows,

$$e_0 = e_r e_c e_d$$

Where,

e0 = Efficiency summation

er = Efficiency reflection

ec = Efficiency for conduction

ed = Efficiency for dielectric

Bandwidth

One of the center choosing parameter to select the sort of receiving wire for an application is transfer speed. It alludes to the run of recurrence where the radio wire can profitably give or get vitality [35]. One other way to see at is the recurrence extend on either side of the center recurrence inside which the other parameters of the receiving wire such as pick up, radiation productivity, impedance etc. are satisfactory. For broadband and narrowband receiving wires, the transfer speed is indicated as a proportion and rate, individually. These values are vital for deciding which operation the receiving wire is most reasonable for since most of the characteristics are not indeed remotely influenced by the recurrence within the same way, so transfer speed has no other particular characterization.

$$BW = 100 \times \frac{F_H - F_L}{F_C}$$

Here,

FH = Frequency Maximum

FL = Frequency Minimum

It is conceivable to discover the transfer speed of a radio wire from its S-parameter, i.e. return misfortune (dB) versus recurrence plot. Where the return misfortune esteem is the most reduced will be the center recurrence of the receiving wire. Whereas, the extend frequencies where the return misfortune is lower than -10 dB is the transmission capacity. It is conceivable to alter the satisfactory recurrence extend of a narrowband receiving wire in case the specified changes are made either to the genuine measurements of the radio wire or the coupling systems like transformers or both as the recurrence shifts.

Input Impedance

For antenna impedance calculation esteem for voltage partitioned with current radio wire. Radio wire impedance will genuine esteem. A genuine esteem shows that the receiving wire is thunderous. In the event that it is communicated in complex shape, at that point the genuine portion of the impedance will mean the control that's either transmitted or retained though the fanciful portion suggests the power put away within the close areas of the receiving wire i.e. the control which is not emanated. Radio wire impedance which has stack connected is as follows

$$Z_A = R_A + jX_A$$

So the receiving wire associated with other line of transmission gear as it were inside the transfer speed. The esteem of the radio wire is impacted by very a number of variables which incorporate geometry closeness to encompassing stuff. For all these complex geometries, not all radio wires have been explored systematically but instep tentatively.

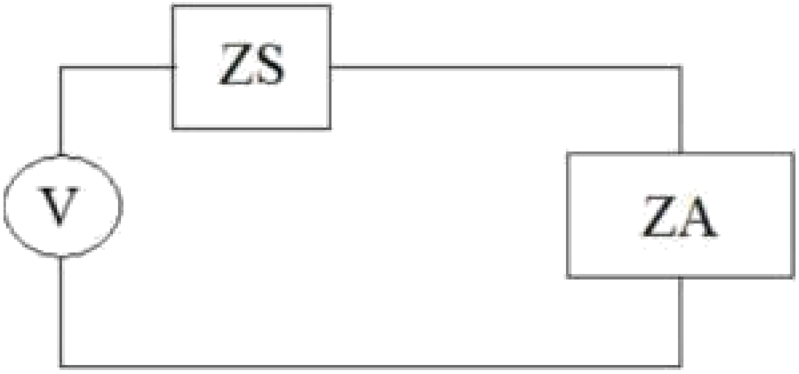


Figure.3.18. Low frequency circuit

Because of minimum recurrence receiving wires, line of transmission disregarded for the length little comparison with wave recurrence. Demonstrate appeared demonstration circuit over, Zs speaks for impedance of source with ZA and impedance of radio wire. Hence, control conveyed as follows.

$$P_A = \frac{V^2 \cdot ZA}{(ZA + ZS)^2}$$

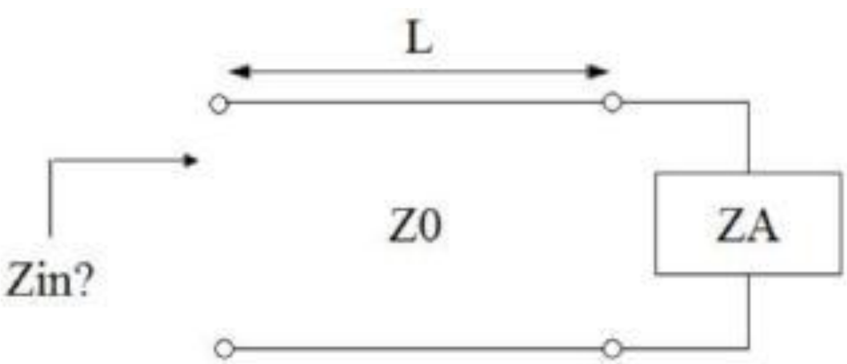


Figure.3.19. Higher frequency circuit

Presently line of transmission creates competitive conveying the control to the receiving wire because it changes the impedance, without legitimately similar with receiving wire. Within demonstrate circuit over, in the event that L stands for line of transmission length and Zo stands for the impedance as follows

$$Z_{in} = Z_0 \frac{ZA + jZ_0 \cdot \tan(\frac{2\pi f}{c} L)}{Z_0 + jZA \cdot \tan(\frac{2\pi f}{c} L)}$$

Chapter: 4: Characteristics of UHF Antenna

4.1 Introduction

Ultra high frequency (UHF) band operates different communication protocol in between 300 MHz to 3 GHz. Frequencies with different radio waves along with band of UHF drop between high repeat or repeat expand microwave. Lesser signal repeat drop along with VHF. Waves of radio with UHF incite fundamentally to find; these are restricted with inclines, gigantic structure in show disdain toward of the reality that sending in between building dividers is powerful adequate because small gathering. These utilized because of sending TV Signals, mobile, divided checking GPS, person organizations radio tallying Wi – Fi, Bluetooth, walkie-talkies, wireless phones etc.

4.2 Characteristics

Waves of radios between the band of UHF move about completely for causing LOS, reflection of ground not at all like inside band of HF there are negligible amount of reflection with ionosphere or wave of ground. Radio waves of UHF are restricted by inclines so cannot move to enter indoor gathering building. Climatic moistness debilitates as quality of the signal related to UHF with large partitions for debilitating getting higher along repeat. TV signals with UHF band for the foremost portion more corrupted by moistness in lesser bunches for TV signals for VHF.

Figure.4.1. UHF Television Antenna

As sending of UHF band is obliged between 30 – 40 miles and regularly smaller partitions from neighborhood domain, this licenses similar repeat channels which are again used by some clients in near places. Open security, exchange person radio organizations with communication. The broadly grasped cellular UMTS with GSM frameworks utilize frequencies with UHF cellular.

Figure.4.2. UHF Reflective array TV Antenna

The brief wavelengths besides allow tall choose up getting wires to be supportively small. Tall choose up radio wires for point-to-point communication joins and UHF tv gathering are as a run the show Yagi, log irregular, corner reflectors, or shrewdly cluster getting wires. At the beat conclusion of the band space accepting wires and illustrative dishes gotten to be down to soil. For lackey communication, helical, and entryway radio wires are utilized since satellites frequently utilize circular polarization which isn't fragile to the relative presentation of the transmitting and getting accepting wires. For television broadcasting specialized vertical radiators that are for the most part alterations of the opening accepting wire or cleverly cluster radio wire are utilized: the opened barrel, diagonal, and board getting wires.

4.3 Uses of UHF Antennas

UHF tv broadcasting fulfilled the ask for additional over-the-air tv channels in urban zones. These days, much of the transmission capacity has been reallocated to reach versatile, trunked radio and flexible phone utilize. UHF channels are still utilized for computerized tv. UHF run is utilized around the world for arrive versatile radio systems for commercial, mechanical, open security, and military purposes. Various person radio organizations utilize frequencies assigned inside the UHF band, in show disdain toward of the reality that adjust frequencies in utilize shift basically between nations. Major broadcast communications providers have sent voice and data cellular frameworks in UHF/VHF run. This licenses versatile phones and flexible computing contraptions to be related to the open traded phone orchestrate and open Web [36,37]. UHF radars are said to be compelling at taking after stealth warriors, in case not stealth planes[38].

Depending on the recurrence run the employments of the UHF radio wire has been isolated into numerous portion. For the run of 300 – 420 MHz it is utilize for Meteorology and government two-way. For 420 – 450 MHz it for Government radiolocation and 70cm ham radio band. For 450 – 470 MHz it is utilized for UHF Trade Band, GMRS, FRS, open security. For 470 – 512 MHz it is for TV channels 14-20. For 512 – 698 MHz it is utilized for TV channels 21-51, channel 34 is some of the time utilized for radar, channel 37 is utilized for radio space science. For 698 – 806 MHz it is utilized for already utilized for TV channels 52-69. For 806 – 824 MHz it is utilized for Pagers, already utilized for TV channels 70-72. For 824 – 849 MHz it is utilized for Terminal (versatile phone), already utilized for AMPS, and already utilized for TV channels 73-77. For 849 – 869 MHz it is utilized in Open security 2-way (fire, police, rescue vehicle), already utilized for TV channels 77-80. For 869 – 894 MHz it is utilized for Base station, already utilized for AMPS, already utilized for TV channels 80-83. For 902 – 928 MHz run it is utilized for ISM band, cordless phones and stereo, RFID, datalinks, 33cm ham radio band. For 928 – 960 MHz it is for blended studio-transmitter joins, versatile 2-way, and paging. For 1240 – 1300 MHz it is utilized for 23cm ham radio band. For 1850 – 1910 MHz it is for PCS. For 1920 – 1930 MHz it is for DECT cordless phones. For 1930 – 1990 MHz it is utilized for PCS. For 2300 – 2310 MHz it is utilized for 13cm ham radio band – lower section. For 2310 – 2360 MHz it is utilized for Disciple radio (Sirius and XM). For 2390 – 2450 MHz extend it is for 13cm ham radio band – upper fragment. Finally, for 2400 – 2483.5 MHz it is utilized for ISM, IEEE 802.11, 802.11b, 802.11g Remote LAN, IEEE 802.15.4.

Chapter 5: Methodology

5.1 Microstrip Patch Antenna

Microstrip Antennas, as well commonly implied to as settle radio wires have earned allocate of utilize inside the microwave region direct, viably construct PCB. It has directly finished up a set up sort of radio wire especially charming when radiators of single profile need these. As these facilitated wonderfully with the PCB development which are simple with less amount of budget need to construct components and clusters. These can be successfully balanced to non planner as well as planner surface and solid before associated to resolute plane. The system are as well flexible for reverberating repeat, plan when particular system are chosen.

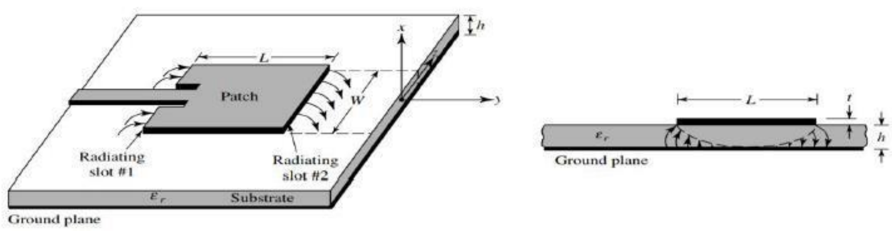


Figure.5.1. A simple microstrip patch antenna

5.2 Applications

Because it can be seen some time recently, microstrip radio wires do have a few drawbacks. But their points of interest incredibly outperform the restrictions. Essentially, it was military frameworks that broadly utilized the application of these receiving wires in executions extending from rockets, rockets and aircrafts to satellites. In any case, by and by their uses are developing increasingly particularly within the commercial segment as a result of their moo fetched and creation innovation [39,40]. Over time, due to advance of inquire about and discoveries and made strides utilization they can conceivably supplant ordinary receiving wires in most application. A few conspicuous employments of microstrip antennas are recorded underneath

- Antennas with complex structure
- Services for broadcast
- Radar
- Radio application
- Control mechanism
- Technology related to defense
- System of navigation with satellite
- Application of mobile
- Radiator system
- Remote sensing application

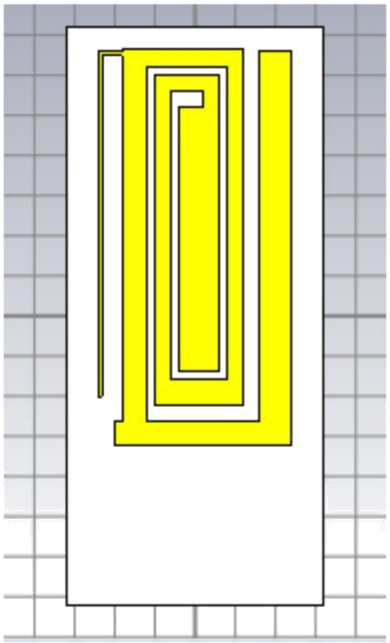
5.3 Antenna Design

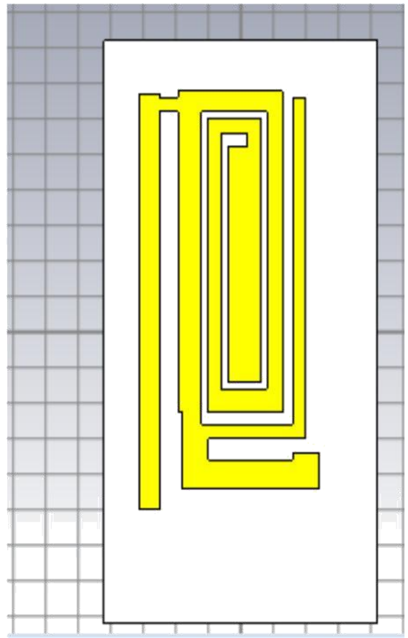
For designing the UHF antenna which will be used in nano satellite operations we have go through in a structured way to fulfill our desired configurations. First of all, talking about the configuration we have selected the type of our design as microstrip patch antenna. As we are working on UHF band so we have selected the frequency range around 437 MHz for our design.

For designing procedure, we have used a software named CST Microwave Studio. In this software we have to input the requirements regarding to our model for achieving the desired design. Firstly, we have to create a new template in the software then needs to select the antenna type. We have selected patch as planner which include patch, slot etc. after that we have to select the minimum and maximum frequency range. After that we need to input the ground and substrate values in the component sun section. Then we set the values regarding coaxial probe at the last stage.

At first we have designed the total antenna system in centimeter unit. We found the desired values for the frequency range around 437 MHz on that design. As nano satellite antenna needs to be smaller in size so we need to convert the design in millimeter unit. That's why we have applied trial and error base approach to achieve the desired value in mm unit.

At the very first design of mm unit we have found the frequency range around 885 MHz which was far behind of our actual design. So we have changes different parameters like ground pattern, patch design, patch width, substrate etc. One of the major changes we have done was moving the feed point from bottom to the center. After all these changes we have found the value around 522 MHz

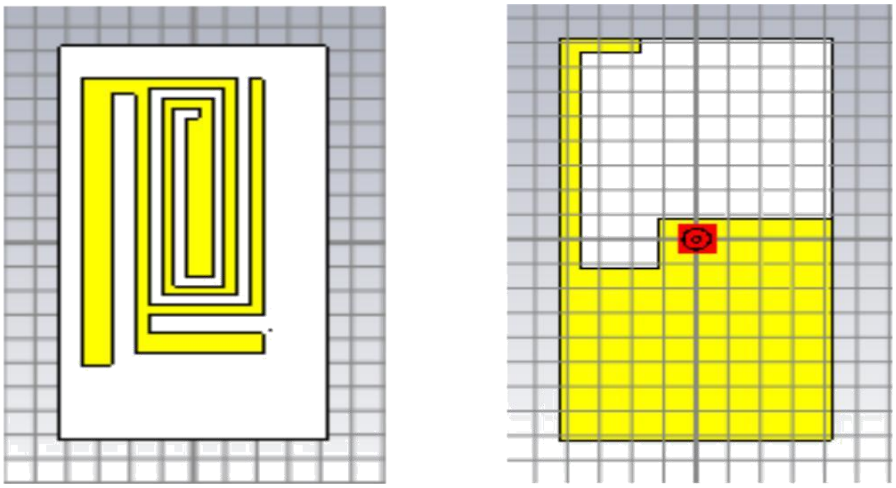




(a) (b)

Figure.5.2. Microstrip Patch antenna design (a) For 855 MHz (b) For 522 MHz

As our main goal is to find the frequency 437 MHz so we have again edited our design and make several changes like making the edge of the patch design smoother, increasing distance between the patch lines, changing shape of the ground etc. we have also changes the feeding point from bottom to the center point. Feeding technique is also changes to coaxial probe feed from line feeding technique. In the coaxial probe we have selected the outer conductor as copper, dielectric material as Teflon and inner conductor as copper. The impedance was 50ohm in that case.



(a) (b)

Figure.5.3. Microstrip patch antenna (a) For 437 MHz (b) Ground pattern

5.4 Simulation

(a) Centimeter Unit: 437 MHz

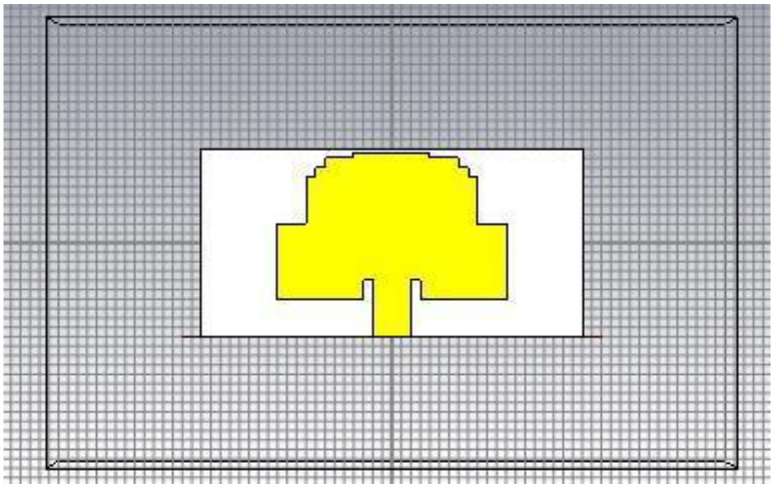


Figure.5.4. Microstrip patch antenna in centimeter unit for 437 MHz

The above figure number 5.4 is the patch design for the centimeter unit antenna design. Though we have achieved desired frequency in this design but the size of the design is not perfect for nano satellite.

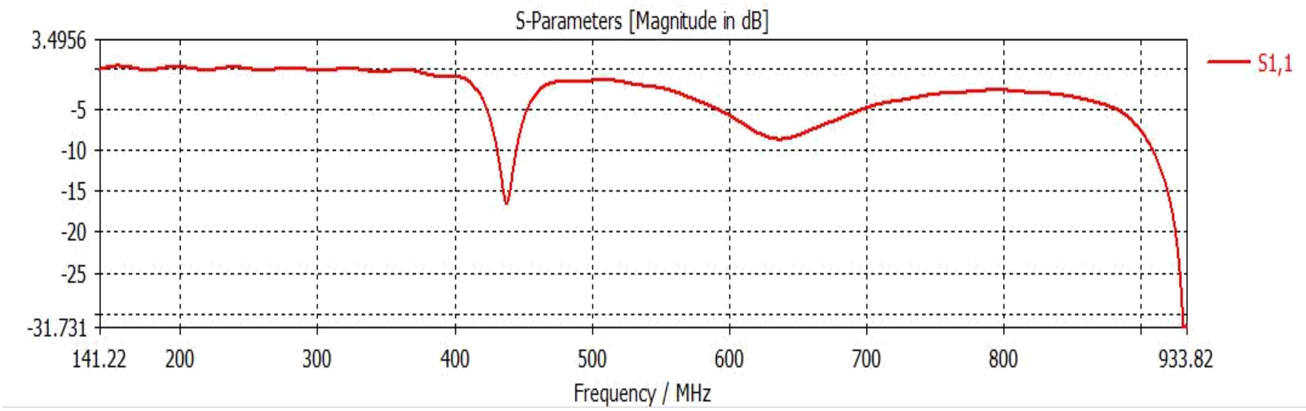


Figure.5.5. S Parameter for microstrip antenna at 437 MHz

From our observation we can see that the designed microstrip antenna has a return loss of around -15 dB at the 437 MHz level. Which shows that a good condition and declare a perfect gain for the design.

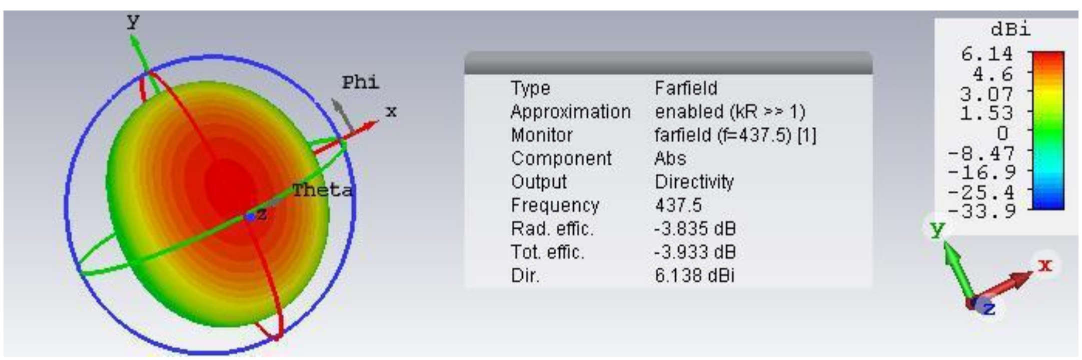


Figure.5.6. 3D farfield directivity pattern of microstrip antenna

In this design the directivity is noted 6.14 dB. We also can visualize the situation using this figure. The exact frequency is also shown in this 3D model which is 437.5 MHz. the position of phi and theta angle is also shown in the model. From there we can get idea about the working angles of this model.

(b) Millimeter Unit: 885 MHz

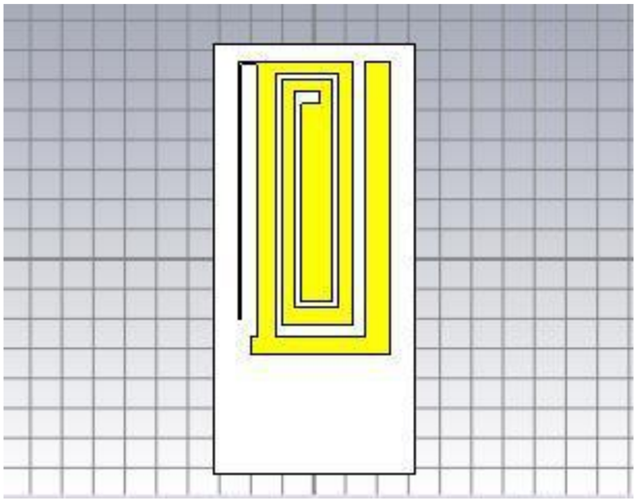


Figure.5.7. Microstrip patch antenna in millimeter unit for 885 MHz

The above figure number 5.7 shows the patch sequence for the first millimeter unit design of ours. In this patch we have reduce the size of the antenna from the previous version of centimeter unit.

Parameter	Dimension in centimeter
Substrate Width	42
Substrate Length	82
Substrate Height	1.4
Patch Width	25
Patch Length	50
Ground Width	42
Ground Length	40

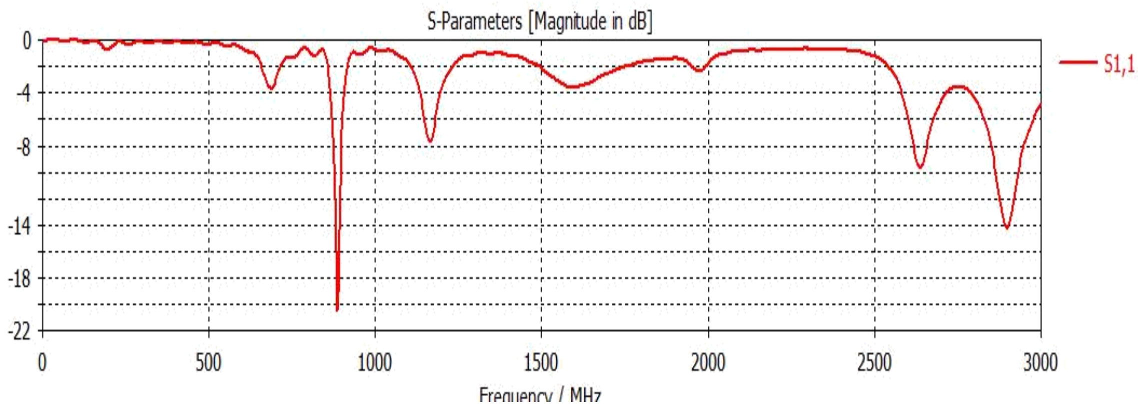


Figure.5.8. S Parameter for microstrip antenna at 885 MHz

From our observation we can see that the above designed microstrip antenna has a return loss of around -20 dB at the 885 MHz level. As we have designed this model in millimeter unit so the desired frequency is not achieved in this model due to some design related works. From the graph we can get idea about the working frequency range for this model also

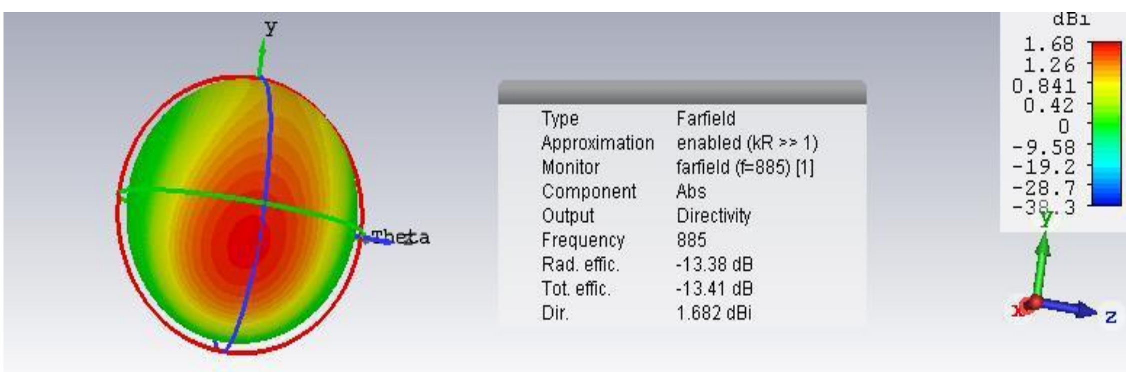


Figure.5.9. 3D farfield directivity pattern of microstrip antenna

In this design the directivity is noted 1.68 dB. We also can visualize the situation using this figure. The exact frequency is also shown in this 3D model which is 885 MHz. the position of phi and theta angle is also shown in the model. From there we can get idea about the working angles of this model.

(c) Millimeter Unit: 522 MHz

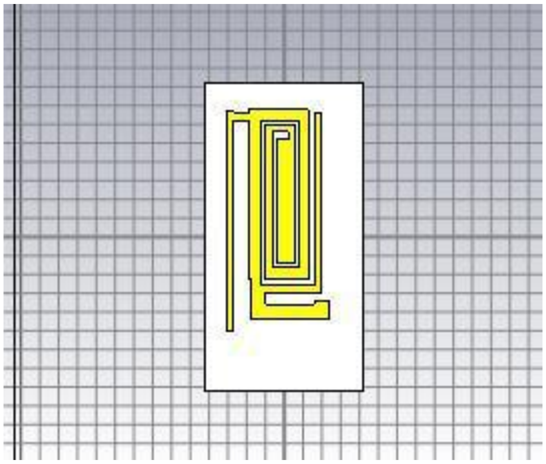


Figure.5.10. Microstrip patch antenna in millimeter unit for 522 MHz

The figure number 5.10 is the patch pattern model for the 2nd version of millimeter unite design of ours. In this model we have applied slightly thinner patch lines to achieve the desired frequency. Though we have successfully reduce the size of that antenna but cannot achieve the desired frequency for the ground pattern design related works

Parameter	Dimension in centimeter
Substrate Width	42
Substrate Length	82
Substrate Height	1.4
Patch Width	30
Patch Length	60
Ground Width	42
Ground Length	82

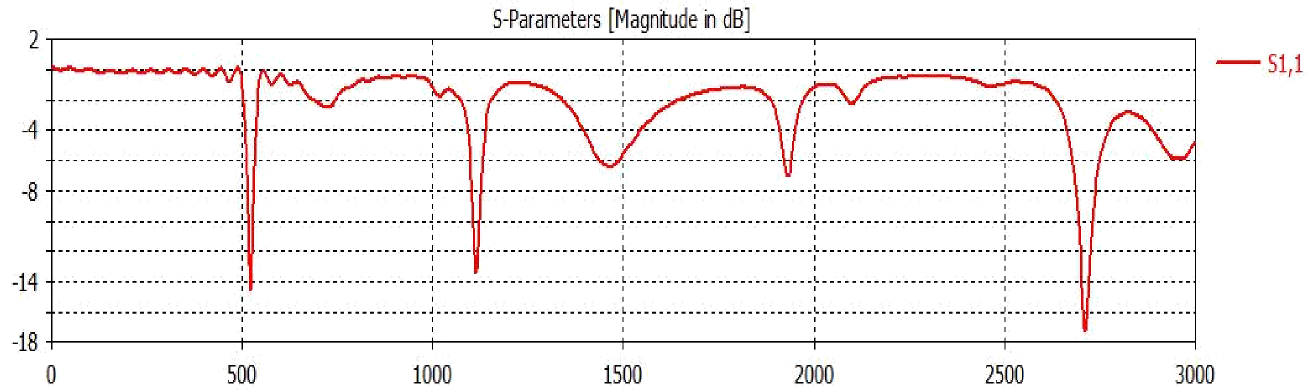


Figure.5.11. S Parameter for microstrip antenna at 522 MHz

From our observation we can see that the following microstrip antenna has a return loss of around -14.5 dB at the 522 MHz level. As in this figure number 5.11 shows that the operating frequency range for the model. This design is gradually improving to achieve the desired frequency range for UHF band.

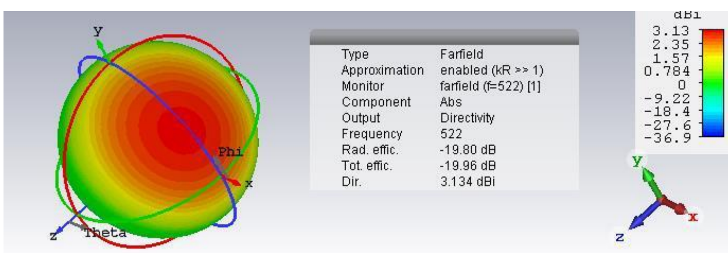


Figure.5.12. 3D farfield directivity pattern of microstrip antenna

In this design the directivity is noted 3.13 dB. We also can visualize the situation using this figure. The exact frequency is also shown in this 3D model which is 522 MHz. the position of phi and theta angle is also shown in the model. From there we can get idea about the working angles of this model.

(d) Millimeter Unit: 437 MHz

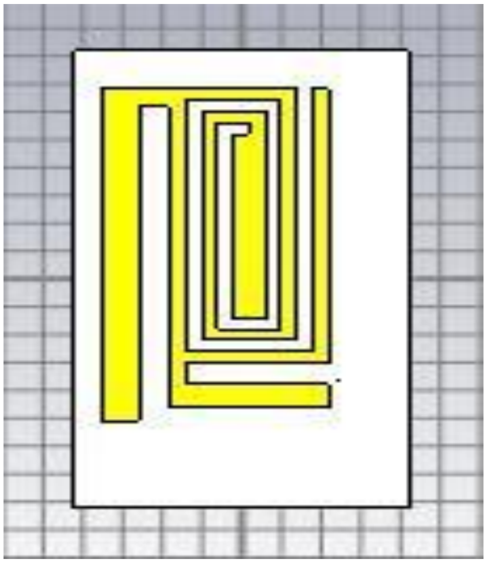


Figure.5.13. Microstrip patch antenna in millimeter unit for 437 MHz

This above figure number 5.13 is the final patch pattern design for the desired frequency range. In this version we have increases the distance between lines of the patch and also make thinner line from the previous version. For those changes based on trial and error method we have achieved our desired frequency range in this version.

Parameter	Dimension in centimeter
Substrate Width	42
Substrate Length	82
Substrate Height	1.4
Patch Width	30

Patch Length	60
Ground Width	42
Ground Length	82

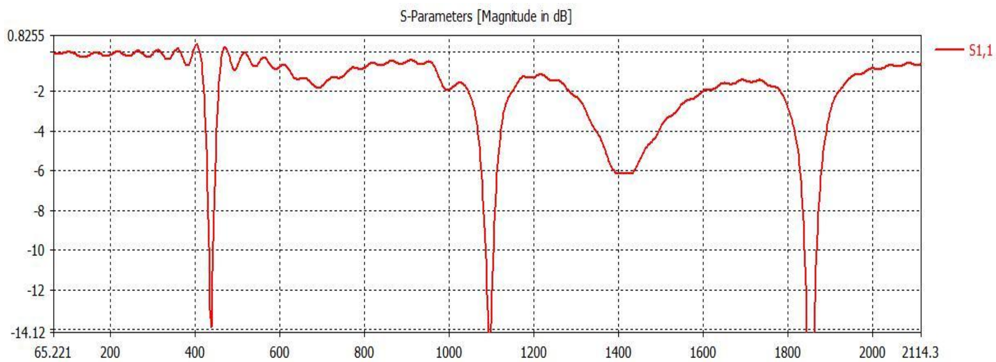


Figure.5.14. S Parameter for microstrip antenna at 437 MHz

From our observation of the above figure we can see that the graph of microstrip antenna has a return loss of around -14 dB at the 437 MHz level. As we have fix all the issues related to ground and patch pattern design and applied new designs in this version that’s why the desired frequency range is achieved. The graph also shows the frequency range between 435 - 440 MHz which indicates that we have successfully achieved our goal.

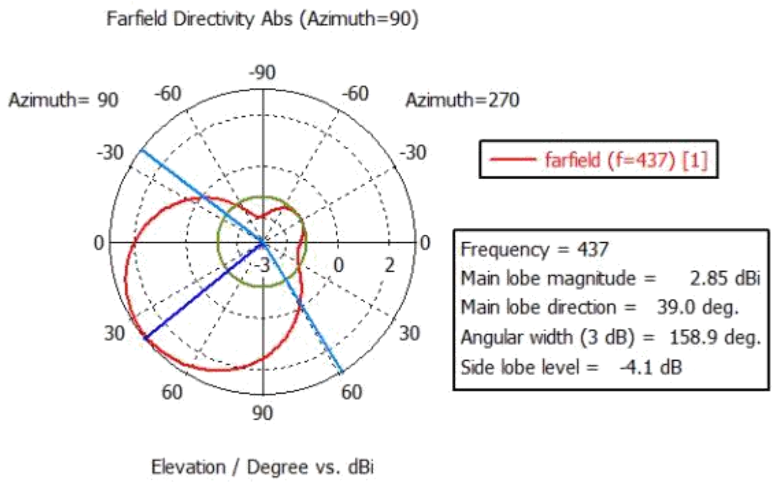


Figure.5.15. Polar plot of microstrip antenna

From the above figure number 5.15 which is the polar plot of our current version of antenna we can observe that the main lobe has a magnitude of around 2.85 dBi. And the side lobe level is considerably good as it attains a value of -4.1 dB. We can also get about the main lobe direction for this model which is 39 degree. The angle of azimuth is also shown in this figure which is 90 degree. We also can get idea about the angular width of this model which include 158.9 degree angle.

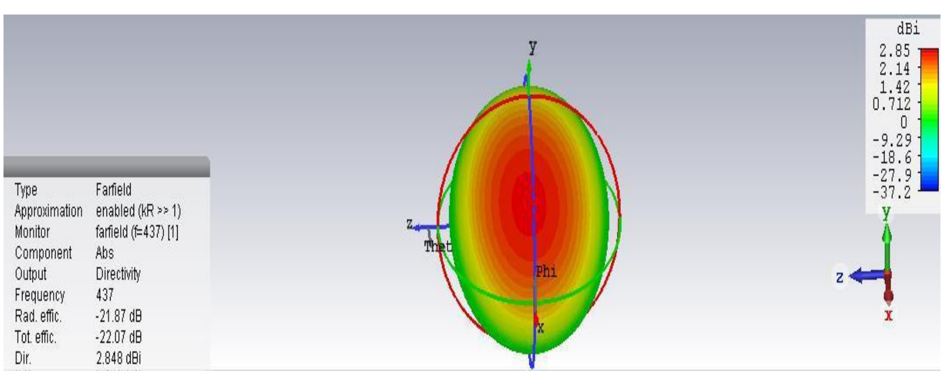


Figure.5.16. 3D farfield directivity pattern of microstrip antenna

From the above figure number 5.16 which shows the 3D version of our final version of design we were able to yield a directivity of 2.85 db. It is considered to be a very good directive radiation pattern when compared to others. We also can visualize the situation using this figure. The exact frequency is also shown in this 3D model which is 437 MHz. the position of phi and theta angle is also shown in the model. From there we can get idea about the working angles of this model.

5.5 Antenna Performance Analysis

After achieving the desired frequency now we can analyze the performance of that model. For that we need regarding values of the design. The values are as follows

Parameter	Dimension in mm
L	72
W	32
S1	2.47
S2	0.905
L1	44.195
L4	2.53
L5	25.5
L6	9.152
L7	11.245
L8	2.64

L9	1.371

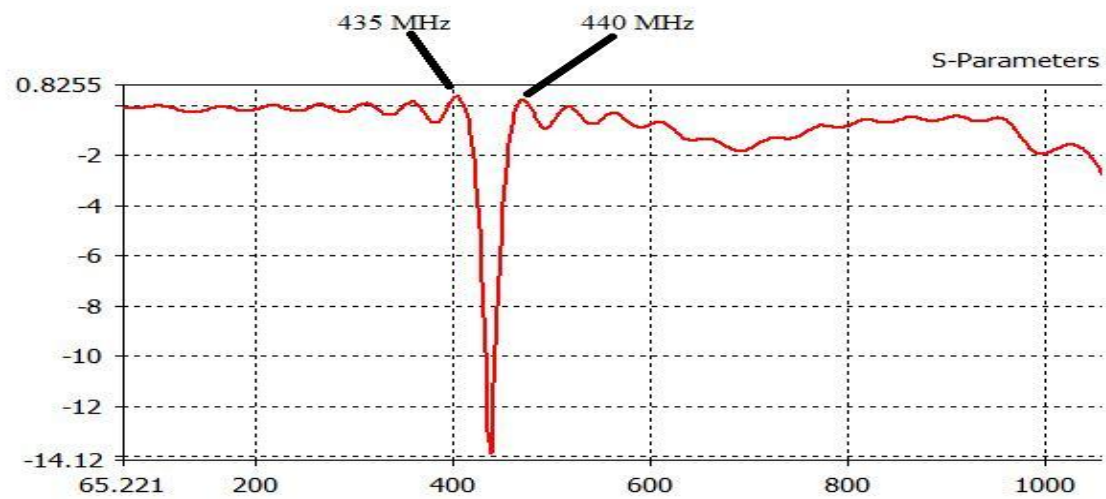


Figure.5.17. Simulated reflection coefficient of the UHF antenna

This above figure shows the zoom version of our S parameter graph for the desired version of ours which is 437 MHz. If we look at the frequency range then we can see that it is between 435 – 440 MHz which shows that the performance of this design will be perfect as for better performance it needs 437 MHz operational frequency.

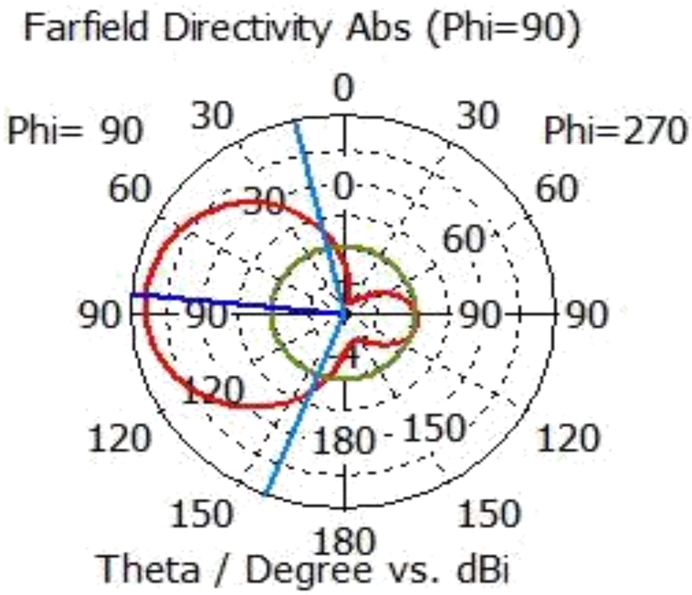


Figure.5.18. 2D simulated radiation pattern of the antenna

From the above figures we can get an idea about the proposed design. For example, the frequency range of the proposed design is 437 – 440 MHz means the desired frequency 437 is in between them. The return loss is less than -14dB. We can also get information about the radiation pattern which is directional. The total summary of the proposed antenna design is given below

Parameter	Specification
Operating Frequency	435 – 440 MHz
Frequency Band (-10 dB)	10 MHz
Dimension	82mm X 42mm X 1.52mm
Thickness	10 mm
Substrate Material	FR4 (lossy)

Connector	50ohm coaxial probe feed
Return Loss	-14dB
Radiation Pattern	Directional

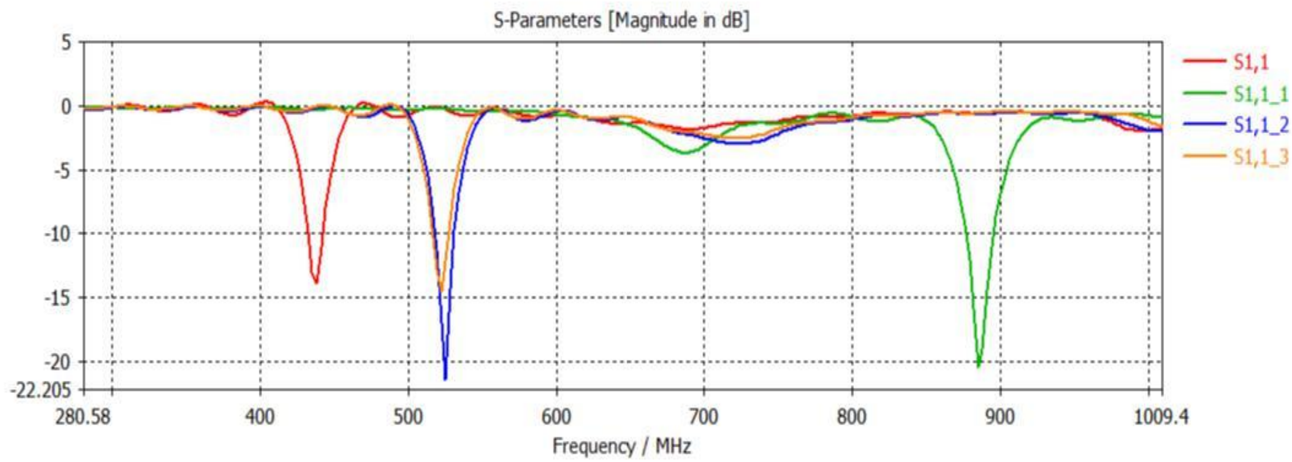


Figure.5.19. Comparison Graph for 437, 522, 885 MHz

The above figure number 5.19 is the combination of the S parameter graphs of three different designs of ours. From this figure we can easily visualize the changes that we have made for achieving our desired frequency. The red graph, the blue graph, the green graph is designated for 437 MHz, 522 MHz, 885 MHz frequencies respectively. We can also compare the dB range of these graphs and find the efficient design from this figure.

Chapter 6: Conclusion and Future Development Scopes

In this modern era of modern era of satellite technology nano satellites are being popular all over the world for their focused mission goal and cost effectiveness. Developing countries and many universities now can taste the flavor of satellite technology with the help of nano satellites. As satellite related research has been increased in university levels so in this thesis paper we have also approached a UHF microstrip patch antenna for nano satellite related operations. After a couple of trial and error based effort we have successfully designed the antenna with desired values. The design consists of different parameters like frequency range 435 – 440 MHz, band frequency with a directional radiation pattern. From the various types of simulation, we have selected the final version of our design. As we are now designing in software and simulate the design virtually so in future we want to fabricate the design and measure all the parameters by real life experiment. We also want to compare the fabricated versions results with the simulated versions one and improve the design to fulfill all the requirements for nano satellite operations. As in our university there are several research going on regarding nano satellite and a complete cube satellite will be manufactured in the university in near future so we really looking forward to fabricate our antenna design into that nano satellite and want to continue the research regarding antennas related to satellites technology.

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