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3 Dimensional Spherical Micro strip Antenna with Duel Band and High Bandwidth

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Abstract—***This thesis involves the design of the 3-dimensional spherical micro strip antenna. It's been employed in order to obtain huge band width of 16.7 Giga Herts's, 21.2 Giga Herts's. The spherical patch antenna is capable of working in micro wave frequencies. A new design of 3 dimensional micro strip antenna is introduced for making the scope and refinements for implementations of Microwaveapplications with two different bandwidths falling in 'Ku, K' bands of microwave frequencies. This Design is capable of operating at 10 GHz, 48.1GHz, and 68.1GHz.This antenna finds huge scope in meeting furtherchallenges of maintaining microwave frequency Terrestrial air links and is also capable of meeting the high bandwidth requirement of future.***

Index terms --- 3 dimensional micro strip antenna, patch antenna, multi band, microwave frequency, Ku Band, K Band, and Terrestrial air Link.

I. INTRODUCTION

Patch antennas usually used in modern applications the miniaturization and high gain characteristics of the antennas are the characteristics of these antennas that made them to be used permissively in various applications. There are many new evolving techniques that were being used in order to have a high gain antenna although achieving high bandwidth is a hard deal. To answer these issues certain innovative techniques of 3 Dimensional patches is been used. We knew that best advantage of the micro strip antennas is that they can be accommodated in minute space mostly on a fabricated micro strip. Achieving the multiple bands is possible using the micro strip antennas but the overwhelming issues are the side lobes. [1] Although the reduction of the side lobe is possible and can also be made to achieve multiple bands. A spherical patch antenna is the one with more design complexities, even we can design it. The advantage of using a spherical radiator is its uniform structure. A spherical patch is capable of producing a high directivity even though it has side lobes. In this thesis we have used a spherical micro strip antenna[2] as shown in the figure 1A.

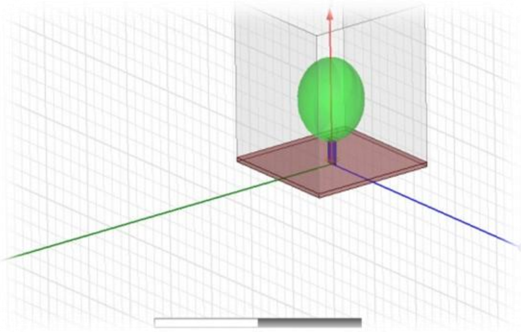

Figure 1A: Design Preview.

Spherical Micro Strip Antenna.The E Field component of the Spherical antenna can be obtained by using the below formulae.[3]

$$E(x,\theta,\emptyset) = \frac{e^{-jkx}}{4\pi x}\,u(\theta,\emptyset)$$

The magnitude of the equation is independent of the spectral angles $\theta,\emptyset$, but they determine the direction of the unit vector of $u(\theta,\emptyset)$.The maximum value of the directive gain of an antenna is defined to be as the Directivity.Directive gain is represented as $D(\theta,\emptyset)$, and compares the radiation intensity (power per unit solid angle) $u(\theta,\emptyset)$ that an antenna creates in a particular direction against the average value over all directions: [4]

$$D(\theta,\emptyset) = \frac{u(\theta,\emptyset)}{P_{total}\,/4\pi}$$

Where $u(\theta,\emptyset)$ is the radiation intensity, which is the power density per unit solid angle, and P total is the total radiated power (TRP). As in equation shown below. [2] In telecommunications, return loss is due to the loss of power in the signal returned by a discontinuity in a transmission line or optical fibre.

$$TPR = P_{total} = \int_{\emptyset=0}^{\emptyset=2\pi} \int_{\theta=0}^{\theta=2\pi} Usin\theta$$

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 decibels (dB); [5]

$$RL(db) = 10log_{10} \frac{p_i}{p_r}$$

Where *RL* (dB) is the return loss in dB, P_i is the incident power and P_r is the reflected power.

II. DESIGN CONSIDERATIONS

This spherical patch antenna design comprises of ground, substrate and a patch sections. There is a lumped port feed employed in order to excite the spherical radiator patch. The excited radiator produces the radiation spectrum with a very high bands and also capable of producing two different micro wave frequency bands of 16.7GHz and 21.2GHz which fall under the category of Ku and K Bands of micro wave frequencies. The below figure 1B shows the three segments and the individual thickness of the patch, Substrate and Ground which are 10MM, 2.5MM, 0.5MM Respectively.

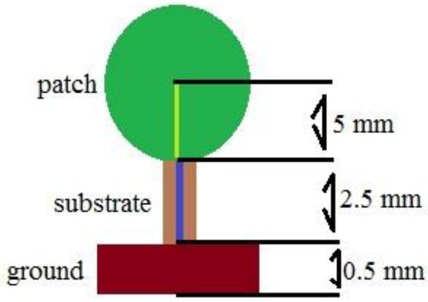

Figure 1B: Design Dimensions.

In order to provide dual band operation the antenna can be operated in the operating frequencies of 10GHz and 48.1GHZ, 64.1GHz and the operating bandwidths[6] can be 16.7GHz and 21.2GHz respectively. The gain of the antenna is high when it is operated with the operating frequency of 10GHz. But when we operate the antenna with the operating frequency of 64.1GHz the gain of the antenna is observed to be comparatively low when compared to gain obtained with the operating frequency is 10GHz. This is because of the couple of side bands formation, although the band width is pretty high.The feeding point is at the centre of the antenna. These balanced feeding lines with identical length ensure that the two radiating elements have the same phase [7] which leads to constructive directional radiation. This characteristic is very attractive in modern communication systems.

III. RESULTS

To verify the design, a prototype of the proposed antenna has been simulated and various parameters are measured. The dimensions of the antenna are given in Figure 1B. The figure 1C shows the plot of the radiation pattern of the antenna with rect(S(1,1)) related to the return loss parameter.

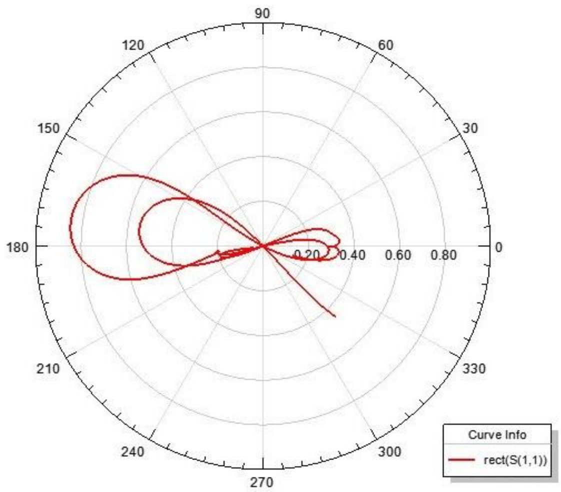

Figure 1C : Radiation pattern.

In the above result we can find that two broad side bands and three minor lobes the largest side band is the one which is being produced when the antenna is been operated in the operating frequency of 10GHz and one minor lobe is also produced. When the antenna is operated at a operating frequency of 64.1GHz then we are having the major lobe with fewer gain and a couple of minor lobes, which there by helps us in justifying that the antenna is capable of operating in two operating frequencies although there is fewer losses due to formation of minor side bands, there by achieving the fact that the antenna is a duel band type.In the Figure 1D, It can be vivedly observed that the antenna is producing a couple of operational band widths of Ku and K bands of micro wave frequncies.

mark	X	Y
m1	10.0000	-13.6634
m2	48.1000	-13.0200
m3	64.1000	-15.1654
m4	89.0000	-10.9248
m5	44.1000	-9.9868
m6	65.3000	-9.8084
m7	7.1000	-9.9383
m8	23.8000	-10.0269

Figure 1D : Freqiences and Returnloss obatained form the simulation of the Radiator.

The above marks in the table represents various frequencies on the polt of return loss versus frequency. The m1 to m8 are the marks that resembels the frequencies and the corresponding returnloss values. In the above table we can see two values X and Y which represents the frequncy in GHz and the return loss in Db's correspondingly related to the marked points in the figure 1E.

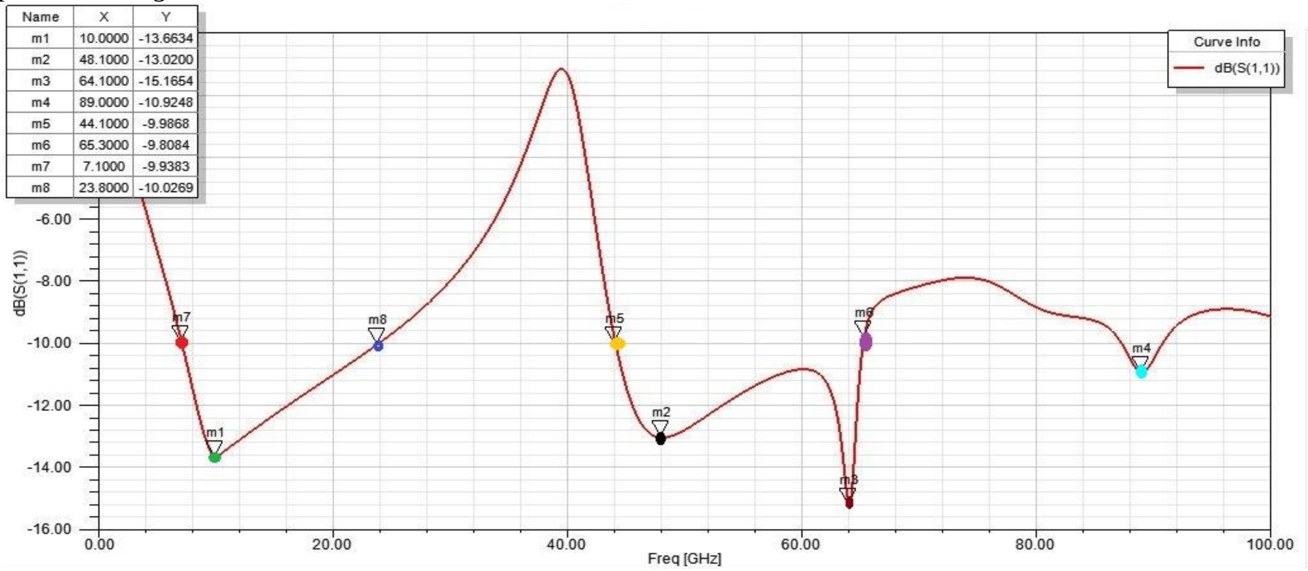

Figure 1E: Rectangular plot of returnloss versus frequency.

In the figure 1E you can observe the return loss of the spherical radiator to be of -13.6634Db at 10 GHz and -13.02Db at 48.1GHz, -15.1654Db at 64.1GHz. This conveys us that the antenna can be operated at all those operating frequencies in order to radiate and receive the electromagnetic radiation. The operating frequencies of the spherical micro strip antenna are shown in figure 1F.

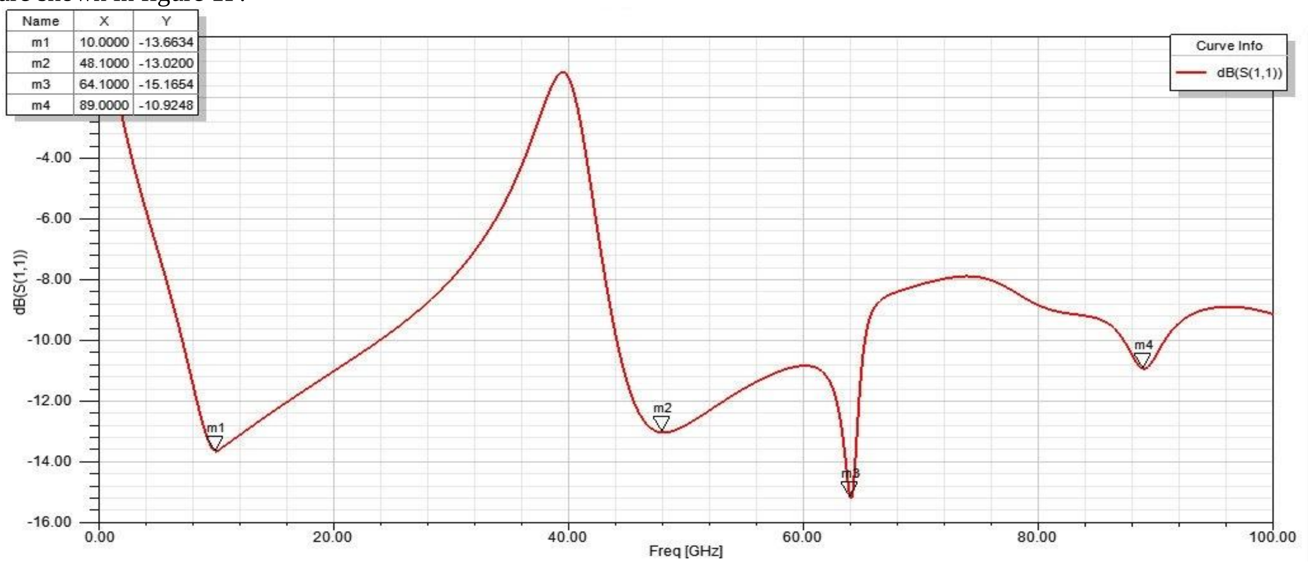

Figure 1F: Rectangular plot of return loss versus frequency with markers representing operating frequencies of the antenna.

VSWR is a measure of amount of power thatis delivered to an antenna. This does not mean that the antenna radiates all the power it receives. Thus, VSWR measures the potential of the antenna to radiate. A low VSWR means the antenna is well-matched, but does not necessarily mean the power delivered is also radiated. Figure 1G illustrates the VSWR of the Radiator at different frequencies. The following are the VSWR values of the designed antenna at different frequencies.

VSWR	1.5234	1.8197	1.4360	14.7370
Frequency in (GHz)	10.000	89.600	64.200	39.6000

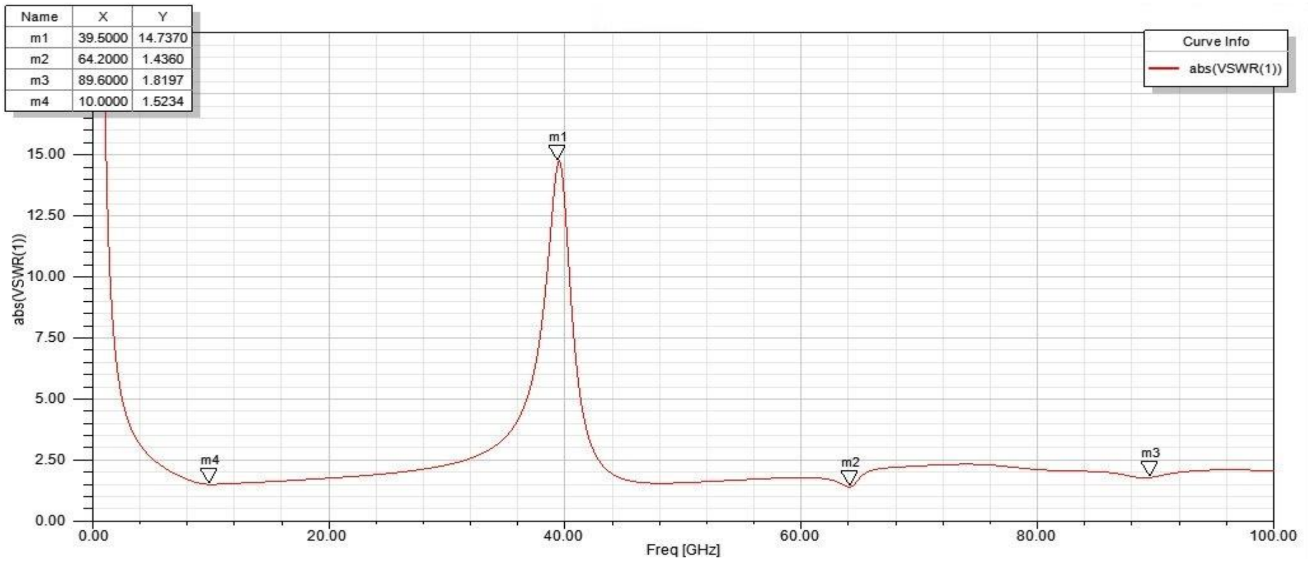

Figure 1G: Rectangular plot of Voltage Standing Wave Ratio (VSWR) Versus Frequency Characteristics of the Antenna.

IV. CONCLUSION

A new technique of using a 3 dimensional Spherical Micro strip antenna has been proposed. The duel bands nature of the antenna helps us in operating the antenna at two different band widths and three different frequencies. The antenna has an advantage of structural simplicity due to a novel use of centred lumped-fed structure for the spherical radiating element. It finds a variety of applications in the terrestrial air link creation and there by finds applications in wireless communications, Radar as well as in Robotics

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REFERENCES

[1] TNE083 Antenna Theory 2012
[2] Wiley: Antenna Theory: Analysis and Design, 3rd Edition - Constantine A. Balanis
[3] L.J. Ippolito, Jr., Radio wave Propagation in Satellite Communications (Van No strand Reinhold, New York, 1986).
[4] The ARRL Antenna Book: The Ultimate Reference for Amateur Radio Antennas, Transmission Lines and Propagation (Arrl Antenna Book): American Radio Relay League,
[5] J.E. Allnutt, Satellite-to-Ground Radio wave Propagation (Peter Peregrinus, London, UK, 1989).
[6] IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 52, NO. 8, AUGUST 2004
[7] T. Y. Yun and K. Chang, “A phased-array antenna using a multi-line phase shifter controlled by a piezoelectric transducer,” in IEEE Int. Microwave Symp. Dig., vol. 2, Boston, MA, 2000, pp. 831–833.