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Design of Ionofree Micro Strip Quad Helix Antenna for Global Positioning System

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Abstract

This letter introduces the compact design of triple-band circularly polarized quadrifilar helix antennas (QHAs) possessing the characteristics of wide beam, high gain at the low elevation, and high stability of the phase center. The available triple-band operation is achieved through the incorporation of a UHF-band QHA and an L/S-band QHA, which are assembled in a "piggyback" fashion. The UHF-band QHA is fed by a compact microstrip feed network. The quad filler helix antenna will furnish circular polarization. The concept is enforced GPS receivers for L1/L2 applications. This will scale down ionosphere delays or refractions. L1/L2 designates it maneuvers at two frequencies to concurrently know the time and place of the particular object. One of the major problems with conventional quad filler helix antenna is hard to operate at multifrequencies.Several technologies have been depicted that would have some limitations and advantages with respective time and performance.

Keywords: Micro strip Quad helix antenna, GPS, Ionosphere refraction.

I. INTRODUCTION

As the antenna of satellite or ground base station, wide beam, circular polarization antennas have been widely applied to spaces communication such as conical spiral antenna, bifilar helices antenna, microstrip antenna, quadrafilar helix antenna. The quadrifilar helix antenna (QHA) was invented by C.C. Kilgus in 1968. Helical antenna [1],[2] is broadband VHF and UHF antenna to provide circular polarization characteristics.

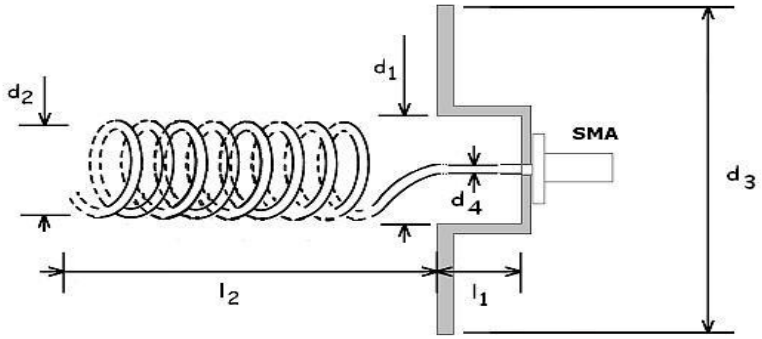

Figure 1: Helical antenna

Coaxial line is coincident with the helix axis and the feed wire lies in the plane through helix axis. A helical antenna may radiate in many modes, but prominent modes of radiations are two i.e. normal and axial mode of radiation. It permits you to record or create locations from places on the earth and help you navigate to and from those places. The main deviation between micro strip antenna and helix antenna [7], [10] is its more sensitive in the direction along axis whereas helical is sensitive along the axis. By placing 4 helical antennas and design a single antenna is called "Quard filler Helix antenna [11], [12]. Here helical wire as a radiator and fabrication of monopolies which furnishes high performance. It is used for wireless communications. If thoughtfulness of antenna is bent, then the wavelength is decreased. QHF also applicable for half duplex communication because it furnishes positive gain. It lies of 4 antennas conducting and these are offered primary resonant frequency. The first two antennas out of four which furnishes primary resonant frequency and remaining two provide secondary resonant frequency.

QHF maneuvers in different modes of axial, normal or a combination of both. To attain axial mode, the axial length of each antenna is quietly larger than the wavelength in which antenna is to operate and it furnishes a high gain radiation pattern so it says it is high direction. If it is operating in the normal mode helix is fed at the top and arms are of resonant length of 1/4 λ, 1/2 λ. To attain pattern of satellite communication it furnishes quasi-hemispherical radiation pattern. In QHF by honoring above modes of operation, it is limited by power transfer thoughtfulness. This total concept will depend on the voltage standing wave ratio.

The QHA [17] is mere and solution ate to the problem of non geosynchronous satellite research and it is very mere to design particularly for GPS applications. Its provide good horizon overhead direction. Mainly QHA [17]lies of 4 helical antennas [19] which have equal amplitude and phase of 0, 90,180,270 degrees. Over a long reign, these antennas transmit and receives polarized waves. The shape depends on pitch angle, diameter, and shape. These 4 antennas have a separate and different types of phase feeding systems. Phase quadrature that generates separate feeding network. Another alternative approach is a balance approach system with separate 90 degrees

pattern. It permits low microwave bands which are L bands and X-bands. One to one type of helix antenna[16] major deviation is back lobe radiation.

The antenna is exciting from the feeding point of ground plane. Below figure lies of Patch Antenna [23] which is more preferable for GPS applications. It first starts with the ground plane, above ground plane owning a dielectric substrate on the below surface. By thoughtfulness of width and length rations the micro strip antenna or Patch Antenna [23] is located. That is shown in dark in the figure. Below the micro strip antenna owning a measure of thickness. The directivity of Patch Antenna [23] is approximately 5-7 dB. The fields are linearly polarized in a horizontal manner[9]. Half wave long patch maneuvers in fundamental mode. By thoughtfulness of electric field is 0 in the center of Patch Antenna [23] and maximum at one side of the patch and the minimum at the other ended of patch antenna. The phase of the RF signal will varyfrom taking the minima and maxima thoughtfulness with respect to micro strip antenna. It is often applied theory of TM10 mode.

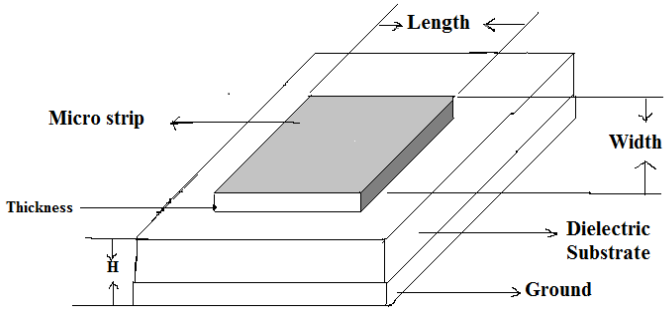

Figure 2: Patch antenna

Placing the micro strip or patch on a dielectric substrate above the ground plane. A good antenna furnishes better efficiency, large bandwidth and better radiation, which it is desirable by a thick dielectric substrate with a low dielectric constant. The micro strip antennas used in 10-30 GHz (microwave frequency). Because the size of micro strip antenna is directly tied with wavelength. This antenna generally used at microwave frequencies, these are also called patch antenna. It lies of a metallic patch with relative permittivity and permeability. The advantage is low profile, substrate is thin. If this is like, thin it is flexible to bent conform to bend it a curved surface. An important advantage of this antenna uses 4 helical antenna [19]s using the top and ridding of the disadvantage of bottom-fed antenna. Micro strip antenna length L = $\lambda/2\sqrt{\mathcal{E}}r$

$$\text{Frequency of micro strip antenna} = c/2L\sqrt{\mathcal{E}}r = 1/2L\sqrt{\mathcal{E}}r\mathcal{E}o\mu o. \quad (1)$$

The microwave antenna furnishes narrow band and wide beam. A thicker substrate will increase the radiation power and the scale downconductor loss and improve

bandwidth.The shape of micro strip antenna such as rectangular, square, triangular and circulated.

Table 1: Conventional QHA without cross dipole

	Without cross dipole	Cross dipole as director	Cross dipole as reflector
R	11	11	11
Laz	52	52	52
p	138	138	138
L	-	50	70
H	-	15	15
85 degrees	0.14	-2.40	1.14
0 degrees	3.18	5.65	0.14

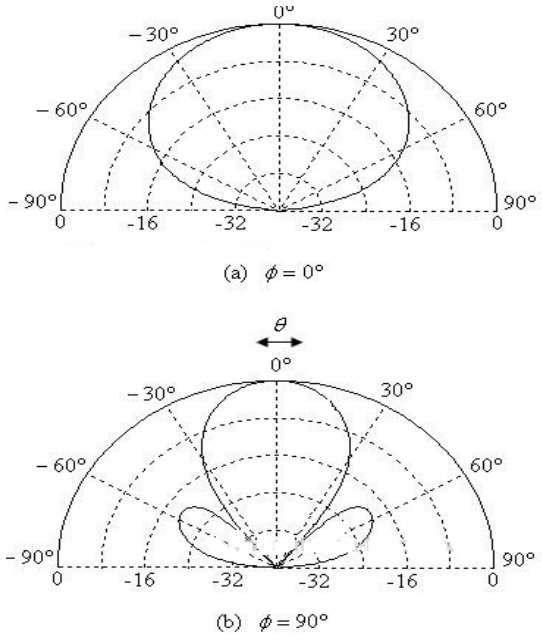

Figure 3: Micro strip Patch antenna Radiation pattern

$$E_{\Theta} = \frac{\sin\left(\frac{kwsin\Theta sin\Phi}{2}\right)}{kwsin\Theta sin\Phi/2}\cos\left(\frac{kLcos\Phi}{2sin\Theta cos\Phi}/2\right) \quad (2)$$

$$E_{\Phi} = \frac{\sin\left(\frac{kwsin\Theta sin\Phi}{2}\right)}{kwsin\Theta sin\Phi/2}\cos\left(\frac{kLcos\Phi \sin\Phi}{2sin\Theta cos\Phi}/2\right) \quad (3)$$

The wave frequency is refracted by ionized layer should depend upon the angle where the wave enters due to deviation in density.QHA [17] utilizes a resonant structure. The first resonance occurs when a filer length is near a quarter wavelength at the center of the cylindrical structure length of helical and radius lengths are common. While calculating bandwidth of the antenna diameter plays a major role. QHA [17] series is a omnidirectional and these are rugged all weather model, uses alloying. The compact size of omni permits transmitting, receiving, monitoring, handling, shipping. Without the requisite of multiple frequencies QHA [16] furnishes communication between ground to air applications. According to technology of antenna theory by using circular polarization which minimizes the outcome of multipath interference.These commercial grade antenna plays a great performance as compared to other products. If thoughtfulness of Patch Antenna [22] and helical antenna [19] both will not be the same, application wise it is somewhat different. Small deviations between helical and the patch is in terms of aperture. At the operating frequencies: VSWR<1.5, 5^0 elevation above Gain>-1.5dBi, HPBWE >155°, 10^0 elevation above AR < 5dBi. The actual antenna is simulated by Ansoft HFSS software based on the finite element method. Reasonably good agreements between the simulation and measured results are obtained.

II. DESIGN PROCEDURE

A typical structure of the four arms helical antenna is shown in Fig.1. The Antenna is composed of four helical arms. The length of each helical arm is a quarter wavelength multiplying an integer(Mλ/4,M is an integer).Each helical arm has equal feeding current magnitude, and the feeding current phase is respective 0°, 90°, 180°, 270°, having 90° phase difference successively. This kind of rotary feed is better for antenna circular polarization axis ratio. Feed network function is to meet the requirements of equal power allocation and realize phase shift.

In GPS system the Electromagnetic waves are travelling in the ionosphere layer. When the signals are travelling in this that will pretend by the radiation of solar means the free electrons which is produced by X-rays and UV rays recombined with Electromagnetic signals [5]. Then the velocity of EM waves scale down due to the reduction of electron density. The delay will increase due to the signal refraction in ionosphere layer [4].For GPS application, we cannot conclude that whether the Patch Antenna [22] is better or helical is better? According to a survey of this project no one is better between two. But sincerely can say helix is better for GPS applications. Alternative can conclude is micro strip antenna or Patch Antenna [22]. GPS owning a high gain towards the sky and gradually decrease towards the horizon. This is the best advantage if by taking thoughtfulness with unidirectional.

The reason patch is more advantage than helical means it furnishes maximum gain towards the sky such that it is also very suits for GPS application. By thoughtfulness of isolation scenario, it is the coupling between two antennas. GPS is placed as long as placed by other antennas.Multipath occurs when the wave is emitted by the transmitter of a different line of sight path. This is called as signal fading. As shown in below figure when the signal is travelling towards the upper signal and lower signal

by moving the signal isotropic delay is calculated using isotropic refraction. Finally by taking the above assumptions the delay will be calculated.

To Resolve

Now let us consider L1/L2 technique with two bands of frequencies. By thoughtfulness of first band

$$D_{L1} = f_{L1}^2/f_{L1}^2\text{-}f_{L2}^2\,(P_{L1}\text{-}P_{L2}) \qquad (4)$$

Let's move to second band

$$D_{L2} = f_{L2}^2/f_{L2}^2\text{-}f_{L1}^2\,(P_{L2}\text{-}P_{L1}) \qquad (5)$$

From these equations by calculating the phase by subtracting those two equations can observe or attain better accuracy and position of any object. In fig 3.0 by honoring the ionosphere delay are decreasing with thoughtfulness of upper and lower layers. From transmitting side the refracted rays are called missing rays.

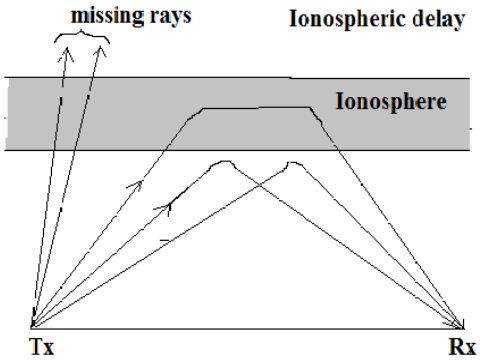

Figure 4. Ionosphere Refraction

QFH furnishes circular polarization and reception completely which we need polar orbiting satellites and a 2m antenna will receive horizontal vertical and clockwise from all directions. The usual cross provide for satellite furnishes circular polarization. Quadrature of circular polarization is only for theoretical applications[4], but not in practice the QHA [16] was in normal configuration operating in space mode. The Two current distributions are identical except in terrestrial mode. In fig 5.0 by honoring the current distribution process of a helical antenna [2], [19]owning with two types of modes, one is space mode and another one is terrestrial mode.

Straight line represents the terrestrial mode and dotted line points to the space mode. In between these two modes owninga geometryQHA [16]. In space mode the top and bottom sections it furnishes 90 degrees of circular polarization. In terrestrial 8 overlap helix sections will be formed in the current distribution process. This furnishes 180 degrees of circular polarization. The final upshot will become by subtracting the polarizations of space and terrestrial by canceling the radiation pattern upshot will provide 90 degrees.

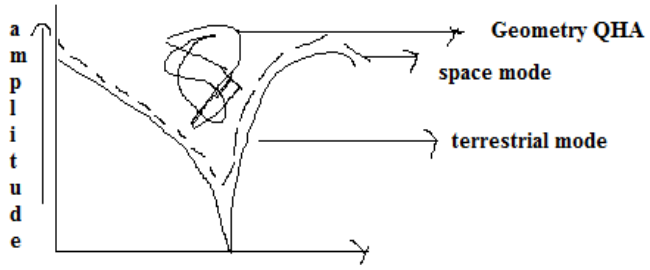

Figure 5: Current distributions

III. ANALYSIS AND UPSHOTS

The analysis of Propagation delay is proportional to the frequency of f1 of first band and f2 of the second band. Analyze the upshot of reducing the ionospheric delay of using two frequency bands as shown in fig 3

Table 2: Final Upshot

R	11.02
Laz	49
P	120
L	63.99
H	19.43

Four helical lines are manufactured with iron wires and coiled on the cardboard. The crossed dipoles and reflectors used for satellite reception to only provide circular polarization directly upwards when the strength is high. Upshot show that in QHA [21] reducing the size of the antenna which causes input impedance is going to be decreases. Mutual coupling between helix is increasing. By decreasing input impedance radiation efficiency decreases. In order to increase the input impedance proposed folded inverted-F antenna. By splitting the patch into equal parts to exciting the circular polarization.And vary one of the phase angle by 180 degrees.

IV. SIMULATION AND MEASURED RESULT

Table 3 is the proposed optimal antenna parameters which effect on the performances of the antenna.

Table 3. Antenna Parameter

Parameter	**D (mm)**	**Lo (mm)**	**K**	**N**
Value	**18.3**	**35**	**2**	**2**

The simulation and measured results of VSWR is shown in Fig.6. VSWR is less than 1.4 in frequence band. The simulation results agree well with the measured results.

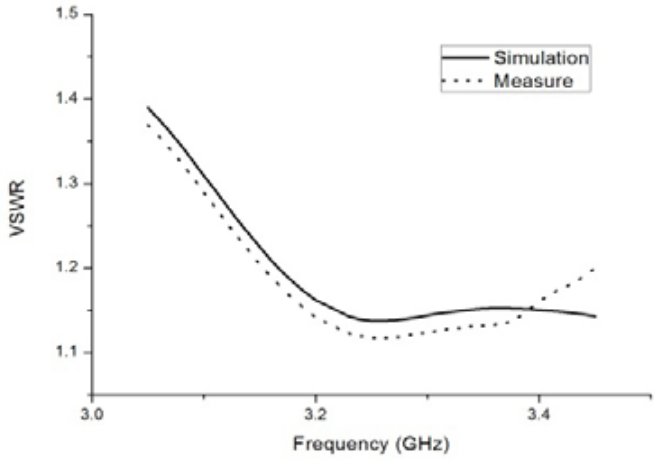

Figure 6. Simulation and Measured Results of VSWR

The measured result of antenna axis ratio is shown in Fig.7. The results show that as the working frequency increases, the axial ratio becomes smaller. In the entire frequency band, when θ is between – 90°and + 90°,the axial ratio is less than 5dB.

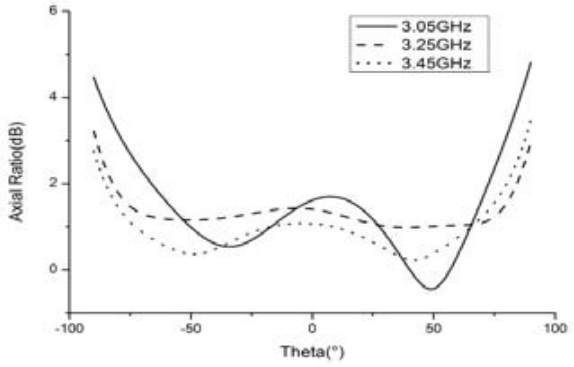

Figure 7. Measured result of axis ratio

V. CONCLUSION

By thoughtfulness of micro strip technology the area postulated to place antenna has scaled down and it often furnishes the wide range of radiation and more bandwidth. The concept is enforced for GPS receivers for L1/L2 applications. This scale down ionosphere delays. L1/L2 designatesitsmaneuvers on two frequencies to concurrently know the time and place of a particular object. Overcome the problem with conventional quad filler helix antenna is hard to operate at multifrequencies. Proved with it several technologies have been depicted that would have some limitations and advantages with respective time and performance.

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