



DESIGN OF 4X4 HELICAL ARRAY ANTENNA USED FOR SATELLITE COMMUNICATION

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Hari Chandana B, Harika D, Neelima K and R Nagendra

Assistant Professors, Department of ECE, Sree Vidyanikethan Engineering College, Tirupati

¹harichandana996@gmail.com, ²Harikadondapati408@gmail.com, ³neelumtech17@gmail.com, ⁴rallanaga@gmail.com

ABSTRACT

A 16- element coiled antenna is introduced and studied. during this array antenna, every antenna contains twelve flip helices. This coiled antenna array antenna operates at a frequency of twelve GHz which might be utilized for applications having higher information measure and gain. so as to present equal quantity of power to every and each antenna a feed network with binary company feed is used. Here Array antenna is meant and simulated victimization ANSYS HFSS. Obtained results shows the benefits of bigger potency, radial asymmetry. Comparison was done between the coiled array antenna and dish supported satellite communication functions.

Keywords: Helical antenna, 4x4 Helical array antenna, Binary tree corporate feed network, Circular polarization.

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INTRODUCTION

Helical antenna is one in which every of the antenna consisting of 1 or a lot of conducting wires that square measure wound within the kind of a helix [1][2][3]. A coiling antenna fabricated from one coiling wire, the foremost common kind, is termed mono fiber. In most of the cases, directional coiling antennas square measure mounted over a ground plane, whereas position coiling antennas might not be. The feed line is connected between the bottom plane and also the bottom of the helix. coiling antennas is operated in 2 principal modes: traditional or axial. within the axial mode coiling antenna, the diameter and pitch of the helix square measure adore a wavelength. The antenna functions as a transmitting aerial divergent a beam at the ends of the helix, on the antenna's axis. It radiates circularly polarized radio waves. These waves square measure used for satellite communication [4][5][12][13]. Axial mode operation was discovered by man of science John D. Kraus. satellite TV systems during which the top users United Nations agency receives the signals directly from the fixed satellites square measure known as Direct Broadcast Satellite systems [6][7][8][15]. In Broadcast Satellite systems we

tend to use parabolic dish antennas permanently signal reception as a result of their higher gain and directionality particularly within the higher frequency regions of the spectrum. The projected coiling array antenna can operate at a frequency of 12GHz for capturing the satellite TV signals [9][10][11][16][17] in to a twelve-flip single coiling antenna was designed in axial mode. so, we tend to affected from single coiling antenna to 4x4 coiling array antenna to extend the number of energy radiated by several folds and to reduce the beam width, a 4x4 helical array antenna was designed by using the ANSYS HFSS software.

DESIGN OF HELICAL ARRAY ANTENNA

Initially one voluted antenna must be designed, for the look of the 4x4 voluted array antenna. The theoretical style parameters were calculated, then some parameters were accustomed style the antenna in ANSYS HFSS. Since Axial mode voluted antenna emits circularly polarized radio signals and additionally, the radiation is on the axis of the antenna we've got chosen it over traditional mode[14]. The antenna is intended and therefore the simulation is performed exploitation the ANSYS



HFSS computer code. to ensure optimum size and most potency, the amount of turns N was twelve. Since we have a tendency to area unit exploitation the frequency of 12GHz, the corresponding wavelength would be

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$$\lambda = \frac{c}{f_o} = \frac{3 \times 10^8}{12 \times 10^9} = 0.025m = 2.5cm$$

After the completion of single spiral antenna array arranging 16 element antenna in array we achieve 4x4 spiral array antenna and Double tree commercial feed network was incorporated to insure the distribution of equal quantities of power to each antenna. For 4x4 spiral array antenna FR4 library paste substrate with a relative permittivity of 4.4 and a consistence of 1.6 mm. The distance between the antennas was 1.5λ which ensures proper insulation to help co-polarization and cross polarization. Therefore, the confines of the proposed 4x4 spiral array antenna was $13.75 \text{ cm} \times 13.75 \text{ cm} \times 0.16 \text{ cm}$

SIMULATION AND EXPERIMENTAL RESULTS

After the completion of designing antenna based on below given tabular parameters. start the simulation of helical array antenna by using HFSS ANSYS software.

Table 1: Design Parameters for Antenna

NAME	DIMENSION (mm)	NAME	DIMENSION (mm)
dW	0.141	Ro	0.09675
dH	0.796	Lf	0.7075
N	12	hp	0.03525
s	0.625	dp	0.0575
Ri	0.0289	λ	2.5

4x4 Helical Array Antenna

The 4x4 coiled array antenna consists of sixteen single coiled antennas that square measure placed equal distance from one another. Spacing between the antennas influences the gain and radial asymmetry. This style of the antenna array uses constant values of single antenna. The feed consists of micro-strip lines of varied widths running from the antenna to the facility offer. The

radiation electric resistance of the antenna are going to be are going to be the electric resistance at the region wherever the input power applied is 50Ω . Therefore, this 140Ω must be reduced to a worth a worth or otherwise there'll be power losses thanks to electric resistance mismatching.

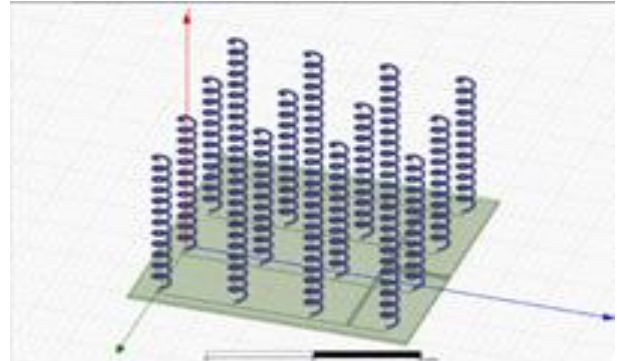


Fig 1: 4X4 helical Array Antenna

3D View of Radiation Pattern.

The gain is measured in the broadside direction i.e., along the Z-axis as 13.3 dB at the 12 GHz frequency as shown. The radiation is along broadside i.e., maximum along the z – axis.

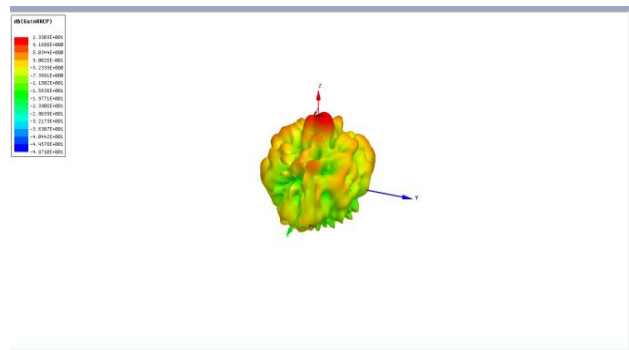


Fig 2: 3D view of radiation pattern of helical antenna array

2D View of Radiation Pattern

The maximum gain in this array antenna is 13.3 dB which is used in Satellite Communication. There is a improvement over single patch antenna. The maximum directivity in this array antenna is 13.3 dB.



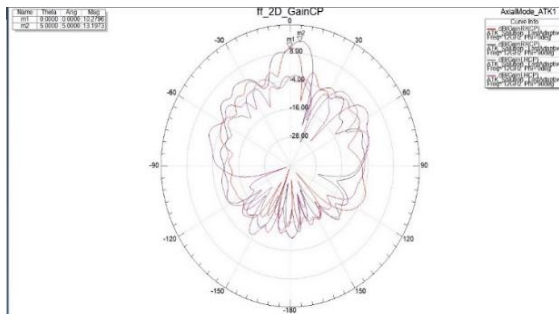


Fig 3: 2D view of radiation pattern of helical antenna array

Plot of Return loss

The Return loss of Helical array antenna is -7dB.

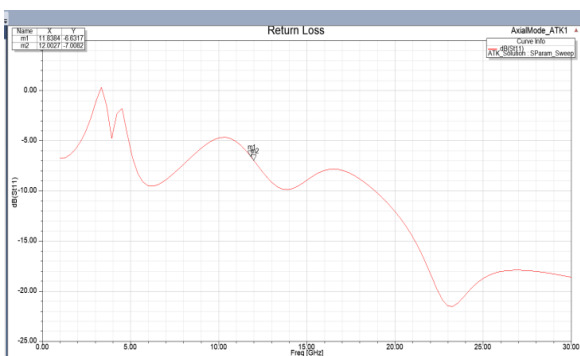


Fig 4: Return Loss of helical antenna array

Comparison between Dish and Array Antenna

Table 2: Shows comparison of 4X4 helical array antenna with Dish Antenna.

Parameter	4X4 helical array antenna	Dish Antenna
Gain	13.3dB	15dB
return loss	-7dB	-7.5dB

CONCLUSION

By designing a 4X4 helical array antenna, combined variation in gain, directivity has been proposed, its experimental and synthesized results are presented in this paper. Obtained data has very good acknowledgement with synthesized data. The maximum gain in this array antenna is 13.3 dB at 12GHz which is used in Satellite Communication.

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