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Designing of axial mode ferrite helical Antenna for automobile Application

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Abstract:- In helical antenna mostly Metal wires are used. These are generally used as the radiator of helical antenna. helical antenna results like - Gain can be determined by the helical coil number namely the longer helical wire is the higher gain of antenna. However when the number of turns is too large the improvement of result is weak and the fabrication of antenna becomes very complicated.Axial-mode ferrite helical antenna will be employed to improve Bandwidth. To provide reliable communication. Simulation and optimizing of helix antenna will be done by electromagnetic software-Computer Simulation Technique (CST)MWS. Optimized results of return loss, gain, efficiency, etc. It can be improvise by proposed design of Helical antenna.

Keywords:- Axial mode, helical Antenna,(CST)MSW,ferrite Rod

I. INTRODUCTION

Antenna is the simple metallic structure. It is designed for radiating and receiving electromagnetic energy. An antenna acts as a transitional structure between the guiding device (waveguide, transmission line) and the free space.

Helical Antenna

A helical antenna is an antenna consisting of a conducting wire wound in the form of a helix. In most cases, helical antennas are mounted over a ground plane. The feed line is connected between the bottom of the helix and the ground plane. Helical antennas can operate in two principal modes: Normal mode and axial mode. The most popular travelling wave antenna is a helical antenna (helix) that produces radiation along the axis of the helix in axial-mode and normal mode. The basic geometry of the helix antenna is shown in Fig 1.

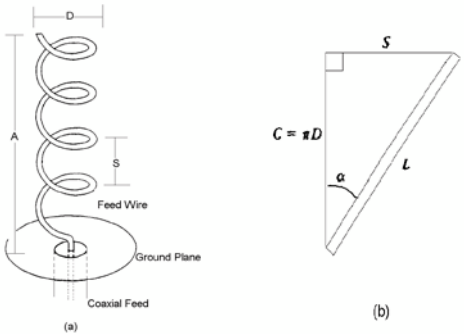

Fig. 1 (a) Geometry of Helical Antenna (b) Unrolled turn of helical antenna [6]

For a helical antenna with dimensions much smaller than wavelength, the current may be assumed to be of uniform magnitude and with a constant phase along the helix [6]. The maximum radiation occurs in the plane perpendicular to the helix axis. This mode of operation is referred to as the "normal mode" [6]. When the circumference of a helix is of the order of one wavelength, it radiates with the maximum power density in the direction of its axis. This radiation mode is referred to as "axial mode" [6]. In circular polarization, this mode is found to operate over a wide range of frequencies [6]. When the circumference (C) and pitch angle (α) are in the range of "$3/4\ \lambda<c<4/3\ \lambda$" and "$12^0 < \alpha<15^0$", the radiation characteristics of the axial-mode helix remain relatively constant [6].

Ferrite

A **ferrite** is a type of ceramic compound composed of iron oxide combined chemically with one or more additional metallic elements. A ferrite can be divided in two types: hard ferrite and soft ferrite. Hard ferrite have high field intensity, they are difficult to demagnetize. They are used to make magnets, for devices such as refrigerator magnets, loudspeakers and small electric motors. Soft ferrite have low field intensity. They are used in the electronics industry to make ferrite cores for inductors and transformers

II. GEOMETRY OF AXIAL MODE HELICAL ANTENNA

Geometrical Parameters

The geometry of a conventional helix is shown in Fig.1 (a).
The parameters that describe a helix are summarized below. D = diameter of helix
S = spacing between turns
N = number of turns
C = circumference of helix =π D A = total axial length = NS
α= pitch angle

If one turn of the helix is unrolled, as shown in Fig. 1(b) the relationships between S, C, and the length of wire per turn L, are obtained as:

S = L sin= C tan (1) S = L sinα = C tanα Eq. (1)

L= $(S^2 + C^2)1/2$

$(S^2 + \Pi^2 D\text{^}2)1/$ 2 Eq. (2)

III. PARAMETERS FOR OPTIMUM PERFORMANCE OF AXIAL MODE HELIX

TABLE 1. PARAMETER OF AXIAL MODE HELICAL ANTENNA

S. No	Parameter	Optimum range
1	Circumference	3/4 λ<c<4/3 λ
2	Pitch angle	$12^0 < \alpha < 15^0$
3	Number of turns	3<N<15
4	Wired diameter	Negligible effect
5	Ground plane diameter	At least 1/2 λ

Fig.2 shows the front view geometry and the structure designed on CST Microwave Studio software of axial mode ferrite helical antenna with at 1.5GHz.

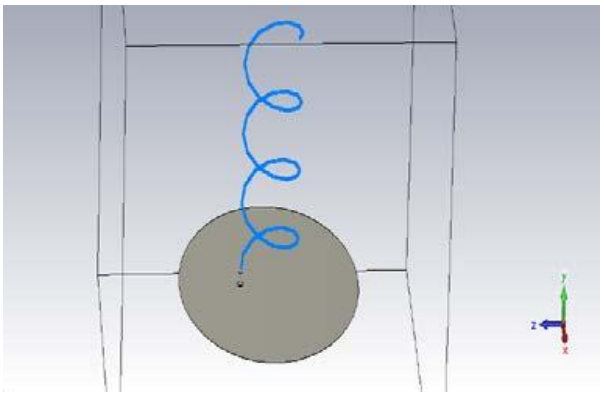

Fig. 2 design of helical antenna

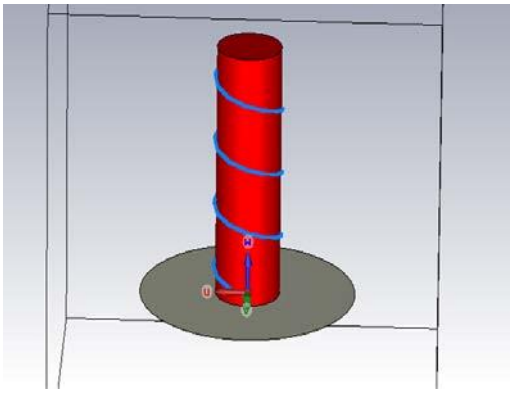

Fig.3 design of helical antenna with ferrite

Table II. Parameter of helical antenna and helical antenna with ferrite

S. No	Parameter	Optimum range
1	Centre frequency	1.5GHZ
2	Diameter of the ground plane	19.98
3	Diameter of the helix	6.36
4	Number of helix turns	3.6
5	Pitch angle of the helix	13^0
6	Wire diameter	0.3
7	helix height	16.61
8	Ferrite Core diameter	3.1
9	Ferrite Core height	16.61

IV. SIMULATION RESULTS

Result-1 Axial mode helical antenna

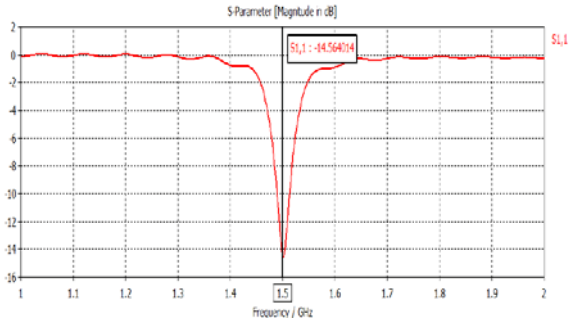

Fig. 4 Return loss graph at (1.5GHZ)

In above result shows that the return loss of axial mode helical antenna. Return loss is -14.56db at center frequency 1.5GHZ

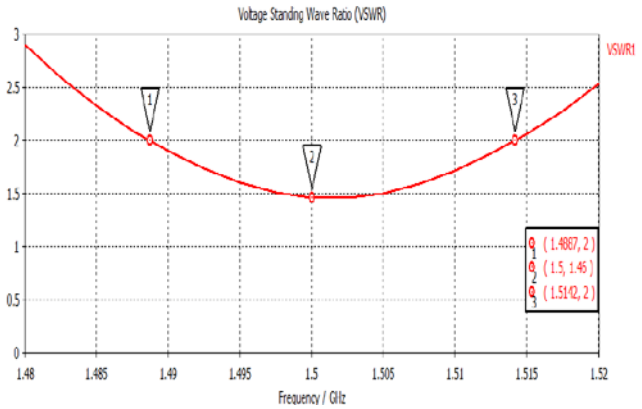

Fig. 5 VSWR graph at (1.5GHZ)

In above result shows the VSWR of axial mode helical antenna. VSWR is 1.46 at center frequency 1.5GHZ

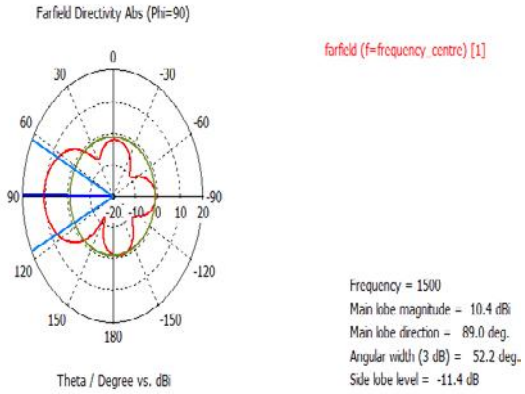

Fig. 6 Directivity at 1.5GHZ

In above result shows that the Directivity of axial mode helical antenna. Directivity is 10.4dbi at center frequency 1.5GHZ

Result-2 axial mode helical antenna with ferrite

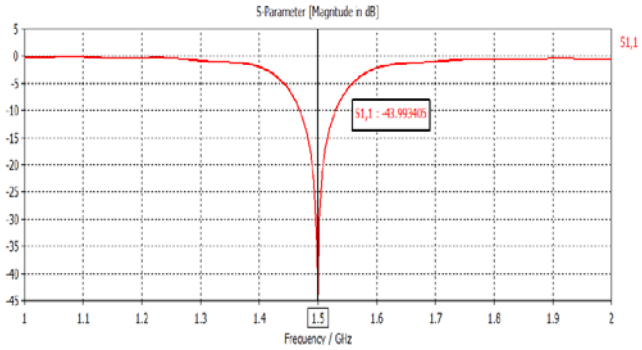

Fig. 7 Return loss graph at (1.5GHZ)

In above result shows that the return loss of axial mode ferrite helical antenna. Return loss is -43.99db at center frequency 1.5GHZ

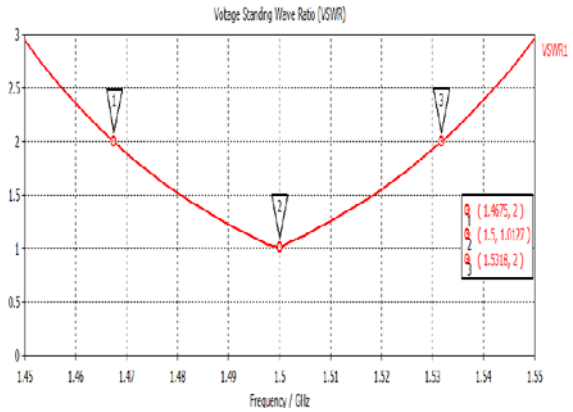

Fig.8 VSWR graph at (1.5GHZ)

In above result shows that the VSWR of axial mode ferrite helical antenna. VSWR is 1.0127 at center frequency 1.5GHZ

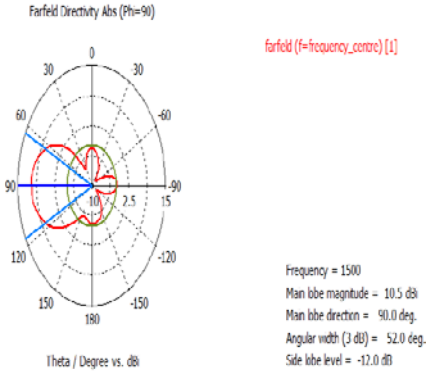

Fig. 9 Directivity at 1.5GHZ

In above result shows that the Directivity of axial mode ferrite helical antenna. Directivity is 10.5dbi at center frequency 1.5GHZ

V. SUMMARY

Table III. Result Analysis

Parameter	Helix Antenna	Ferrite Core Helix Antenna
Resonant Frequency	1500 GHz	1500 GHz
Return Loss	-14.56	-43.99
Bandwidth	30 MHz	70 MHz
VSWR	1.46	1.0127
Gain	8.787 db	8.807 db
Directivity	10.4 dbi	10.5 dbi
Efficiency	84.49 %	83.87 %

VI. CONCLUSION

This Work Present design of Designing of axial mode ferrite helical antenna for automobile application at 1.5GHz by using CST(MWS) software for simulation purpose. The proposed Axial mode Helical Antenna with ferrite core bandwidth is increase. It improves bandwidth and provide reliable communication.

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