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WIDEBAND STRIP-HELICAL ANTENNA: A REVIEW PAPER

Hamsa S
Faculty of Engineering and Technology
Jain (Deemed-to-be University), Ramnagar District, Karnataka – 562112
Email Id- s.hamsa@jainuniversity.ac.in

Abstract

Numerically and experimentally, a wideband strip-helical antenna with 1.1 turns has been analysed. The forward moving current on the strip helix at about one turn smoothly decays to the minimum value at the open end of the helix by replacing the conventional wire helix with a wide metallic strip. Thus, with 50-ohm impedance matching, the strip helix will excite a wideband circular polarisation (CP) wave. The proposed antenna is printed with a substrate relative permittivity of εr = 2.2 and a thickness of h = 0.5 mm on a hollow-cylinder. To excite the strip-helical antenna without any additional impedance matching portion, a 50 Ω coaxial cable is directly linked. In order to have a directional radiation pattern, the ground plane is positioned below the antenna. A prototype 1.1-turn strip-helical antenna is being tested to demonstrate this process. The test shows that the proposed antenna can achieve a 46 percent overlapping bandwidth with a height of 0.52λ0, where λ0 is the wavelength in free space at the centre frequency of operation.

Keywords: *Axial Ratio (AR), Circular Polarisation (CP), Helical Antenna, Magnetic Field.*

I. INTRODUCTION

Conventional axial-mode helical antennas are one of excellent candidates for achieving circular polarizations in wireless communications due to their advantages such as high gain and wide axial ratio (AR) bandwidth. However, the large profile limits their applications in wireless terminals. Some low-profile wire helical antennas have been proposed to tackle this disadvantage[1].

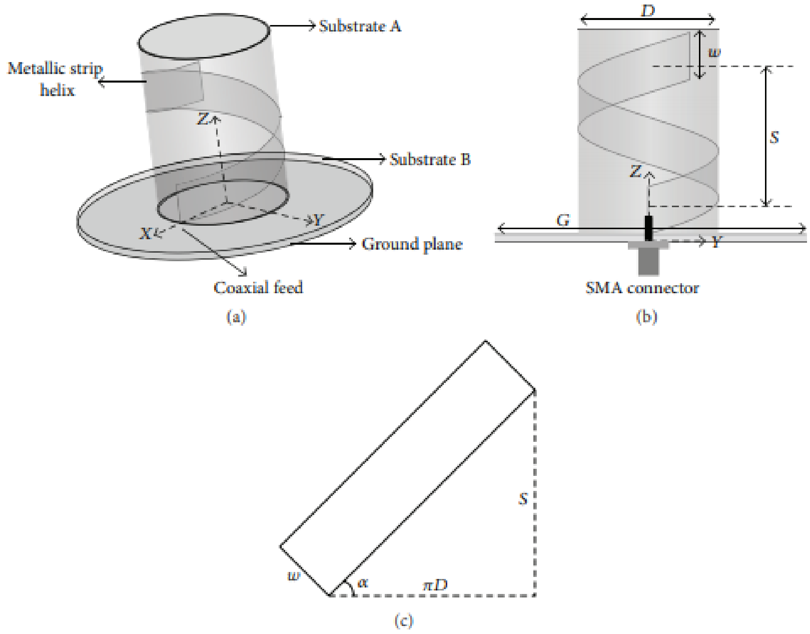

Fig. 1 Strip-helical antenna. (a) 3D view. (b) Side view. (c) Unrolled strip helix of one turn[2].

Since the electric and magnetic field vectors are always related according to Maxwell's equation, it is enough to specify the polarization of one of them. And commonly it is specified by the electric field. Polarization should be defined in its transmitting mode with reference to IEEE norms[3]. The polarization plane is the plane containing the electric and magnetic field vectors and it is ever perpendicular to the plane of propagation. The contour drawn by the tip of the electric field vector describes the wave polarization[4]. Figure 1 shows Strip-helical antenna. (a) 3D view. (b) Side view. (c) Unrolled strip helix of one turn. Figure 2 shows current densities on the centre of the strip along the helix at three C/λ ratios. Figure 3 shows axial ratio against frequency of the strip-helical antennas with different turn.

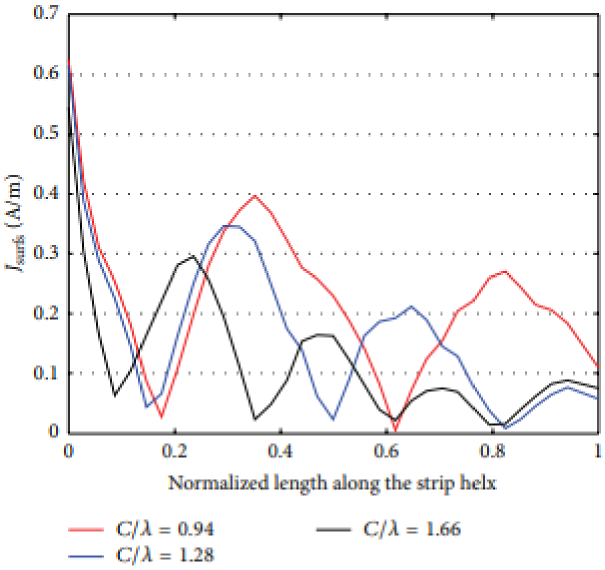

Fig. 2 Current densities on the centre of the strip along the helix at three C/λ ratios[2].

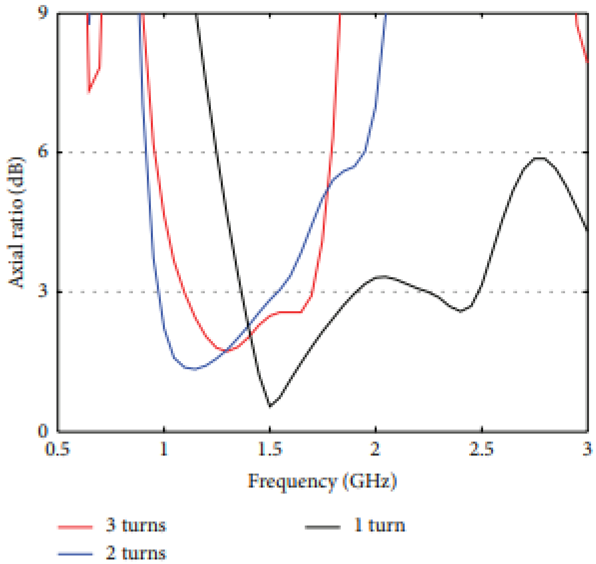

Fig. 3 Axial ratio against frequency of the strip-helical antennas with different turn numbers[2].

The width W of the antenna is calculated by using the following equation.

$$w = \frac{c}{2\, f_r \sqrt{\frac{(\varepsilon_r + 1)}{2}}}$$

Where

f_r denotes the resonant frequency, and

r represents substrate dielectric constant

The effective dielectric constant (ε_{reff}) of antenna is derived by applying the given equations[5].

$$\varepsilon_{reff} = \frac{(\varepsilon_r + 1)}{2} + \frac{(\varepsilon_r - 1)}{2}\sqrt{\left(1 + 12\frac{h}{W}\right)}$$

Where h denotes the height of the antenna and W denotes the width.

The length of the antenna may be measured by applying the following equation.

$$L = \frac{c}{2\, f_r \sqrt{\varepsilon_{reff}}}$$

The antenna length extension is calculated by applying the equation below[6].

$$\Delta L = 0.412\, h\, \frac{\left(\varepsilon_{reff} + 0.3\right)\left(\frac{W}{h} + 0.246\right)}{\left(\varepsilon_{reff} - 0.258\right)\left(\frac{W}{h} + 0.8\right)}$$

Here W represents the width and h denotes the height.

The real length (L_{eff}) of the antenna can be calculated by using the following formula.

$$L_{eff} = L + 2\Delta L$$

II. LITERATURE REVIEW

A survey was performed on the circular polarisation planar helical antenna by Chen et al. To achieve wideband end-fire radiation of circular polarisation while retaining a very low profile, a planar helical antenna is given. Using printed strips with straight-edge connections, the helix is created by plating through holes. The currents flowing on the helix strips and along via-holes lead, respectively, to the horizontal and vertical polarizations. In addition, to weaken the strong amplitude of the horizontal electric field produced by the one on the strips, the current on the ground plane is used. Thus, it is possible to obtain good circular polarisation. In addition, to extend the axial ratio (AR) bandwidth as well as to boost the end-fire radiation pattern, a tapered helix and conducting side-walls are used[7].

III. DISCUSSION AND CONCLUSION

It introduces and tests a wideband strip-helical antenna for circular polarization. The reflected current at the open end can be greatly decreased over a broad frequency spectrum by using the proposed strip helix with 1.1 turns. An overlapping bandwidth of 46 percent was obtained, where S11 is below-10 dB, AR is lower than 3 dB, and the gain is stable at 7.5±0.5 db. The proposed strip-helical antenna has much better impedance characteristics compared to the conventional wire helical antenna and needs less turns to achieve a broad AR bandwidth. It produces and tests a prototype of the proposed antenna. Generally speaking, a strong agreement exists between the effects simulated and calculated. Due to its wide bandwidth and ease of manufacturing, the proposed antenna has a possible application in high data rate wireless communication systems.

IV. REFERENCES

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