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APPLICATIONS OF TRIANGULAR MICROSTRIP PATCH ANTENNAS: A STATE OF THE ART SURVEY

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Abstract

The triangular geometry of the microstrip patch is one of the most common shapes having a wide range of applications ranging from circuit elements to modern wireless antennas. Recent survey of open literature shows interesting development of this patch as novel circuit elements and antennas. In this paper, a very comprehensive review of the applications and investigations on triangular microstrip patch (TMP) has been presented. The world of the antennas involves the understanding of the antennas' sense, function, parameter, and form. It is possible to describe an antenna as an electromechanical system capable of transmitting or receiving electromagnetic waves. This survey article provides a detailed analysis on the triangular microstrip patch antenna for wireless communication in order to reduce the overall size off the antenna.

Keywords: *Ground Plane; Microstrip Antenna; Microstrip Patch Antennas; Microstrip Feed Line; Triangular Antennas; Substrate.*

I. INTRODUCTION

The world of the antennas requires the comprehension of the meaning, feature, parameter, and shape of the antennas. An antenna can be defined as an electromechanical device which can transmit or receive electromagnetic waves [1]. In other words, a set of elevated conductors may be said to be an antenna that pairs or matches free space with the transmitter or receiver. A transmitter-connected transmitting antenna drives electromagnetic waves into free space and then travels in space at the speed of light. Similarly, a transmitting antenna connected to a radio receiver receives or intercepts a portion of electromagnetic space-based waves. The structure of a triangular microstrip patch antenna is shown in Figure 1 [2].

Fig. 1: Shows the Structure of a triangular microstrip patch antenna[3].

Microstrip Line Feed is the most basic feeding technique used. In this, a Microstrip line with impedance 50 Ohms is attached with the patch, and the port is connected at the other end of the additional Microstrip line introduced[4]. This additional Microstrip line acts as a feeding point to the rectangular Microstrip patch antennas. Figure 2 shows the Coax-fed TMP with an air gap between the substrate and the ground plane [5].

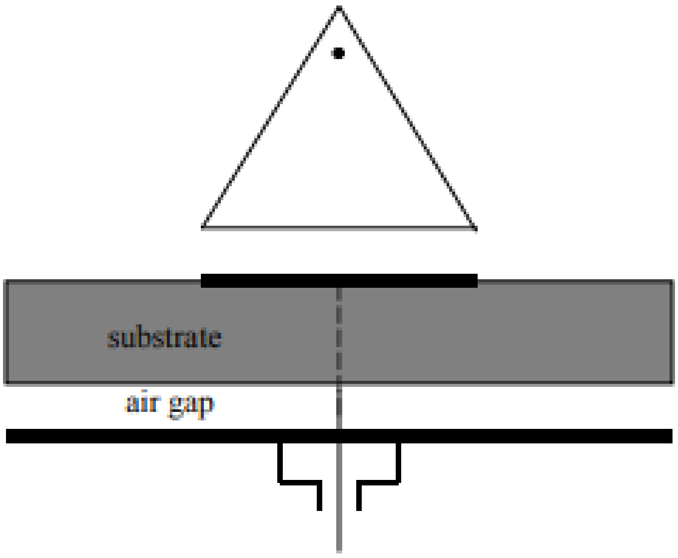

Fig. 2: Illustrates the Coax-fed TMP with an air gap between the substrate and the ground plane[3].

Microstrip Inset Feed is the advancement of the previously introduced Microstrip feed line. In this feeding technique, a feed point is measured somewhere on the surface of the rectangular patch where the impedance of the patch matches with the impedance of Microstrip feed line that is 50 ohms. Figure 3 illustrates the Microstrip inset fed patch antenna design [6].

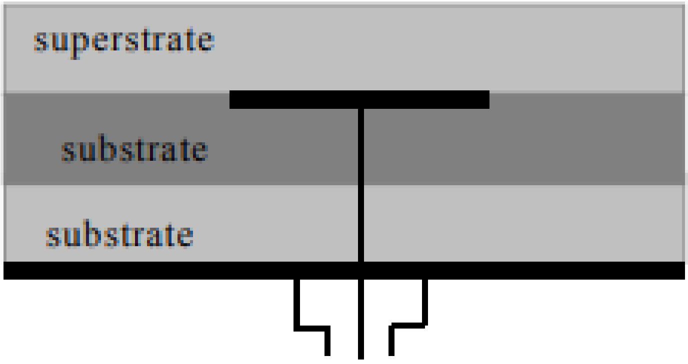

Fig. 3: Illustrates the TMP Antenna in Multi-layered Media[3].

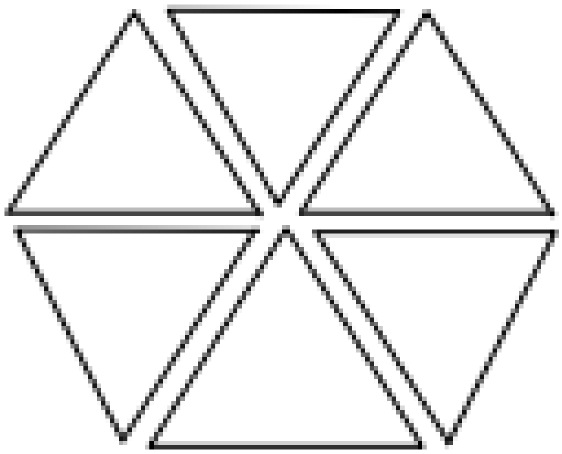

Fig. 4: Illustrates the Array configuration utilizing the six (6) element TMP[3].

The width W of the DRA antenna can be determined by utilizing 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 DRA antenna is derived by using the following equations.

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

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.

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

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 research by Kumar et al was conducted on the circularly polarised microstrip patch antenna. For mobile communication and GPS applications, a triple-frequency single-feed S-shaped circularly polarised microstrip antenna with a minimal frequency ratio has been proposed. In the centre of a square patch of 84.5 to 84.5 mm2 for multi-band service, an S-shaped slot is eliminated. The suggested antenna geometry consists of a single microstrip line with an aperture-coupled feeding structure. The simulation results show that the proposed antenna can be used with an acceptable return loss of -34.34 dB, -18.23 dB and -24.75 dB for multiband antennas at 1.193 GHz, 1.454 GHz and 1.615 GHz, respectively [7].

III. DISCUSSION AND CONCLUSION

In the restricted range, a brief analysis of triangular microstrip patch (TMP) research has been presented. The analysis reveals that the application of TMP differs from elements of the circuit to radiators of broadband. In order to address the inherent limitation of narrow bandwidth, many approaches are seen. There is recorded as much as 99 percent SWR<2 bandwidth. The implementation of TMP is commonly demonstrated in modern wireless systems covering the UMTS, ISM and PCS bands. For array designs, the conformal shape and geometry makes it an appealing feature to be used. The first research dates back to 1977 on TMP. Initial reports indicate that, due to its high Q value, the TMP was considered to be a narrow band structure. The early studies therefore demonstrate possible applications of the TMP as oscillators, filters and circulators. Almost simultaneously, theoretical and experimental investigation of equilateral TMP as disc resonator, filter and circulator was reported by Helszajn and James [5].

IV. REFERENCES

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