Institute of technology,

Nirma University

ANTENNA & WAVE PROPOGATION (EC-602)

Sessional Assignment Report

CIRCULAR MICROSTRIP ANTENAA

By

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Submitted to

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1) Introduction:

Microstrip antenna are utilized in correspondence frameworks because of straightforwardness in structure, similarity, low assembling cost, and adaptable as far as thunderous recurrence, polarization, example and impedance at the specific fix shape and model. The exhibition of the recieving wire is influenced by the fix geometry, substrate properties and feed strategies [3]. In a roundabout microstrip radio wire, the mode is bolstered by the hover shape on a substrate with tallness is little contrasted with frequency ($h << \lambda$). Alluding to the components of the roundabout fix, just a single degree opportunity to control the span, an of the fix. This would not change the request for the modes however the outright estimation of the thunderous frequency[1]. Fundamentally a round microstrip recieving wire must be broke down by means of the hole model and full-wave investigation.

The pit model additionally gives the technique that the standardized fields inside the dielectric substrate can be discovered all the more precisely and it doesn't emanate any power [4]. Because of the bordering fields between the fix and the ground plane, the viable components of the reception apparatus are more prominent than the genuine measurements.

Fringing effect was bigger because of the way that a portion of the waves travel in the substrate and some noticeable all around [1]. In this paper, the feed line utilized was straightforwardly associated with the edge of the microstrip fix. Such taking care of method gives coordinate impedance between fix and the feed. This coordinating circuit was very ignificant so as to guarantee the most extreme force can be moved to the microstrip recieving wire and in this way expanding the general exhibition.

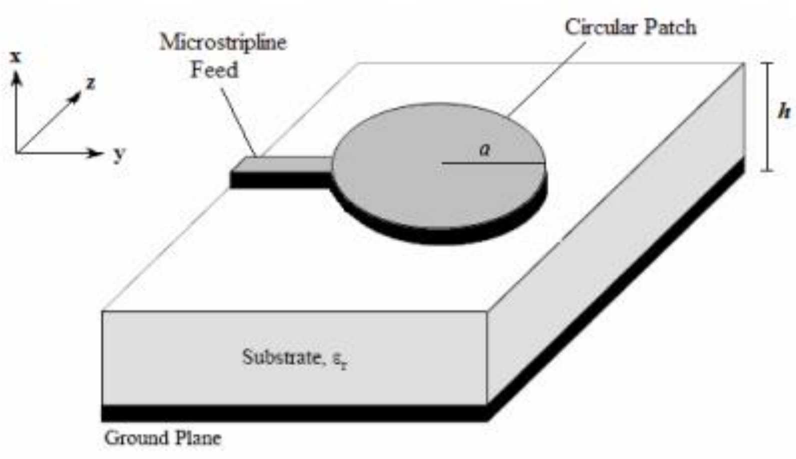

Figure 1 Circular Microstrip Antenna

2)DESIGN :

CMPA design radius of patch is only parameter to control the resonant frequency. Radius of patch, can be determined by the following-

$$\text{Circular patch radius a} = \frac{F}{\left\{1 + \frac{2h}{\pi\varepsilon_r}\left[\ln\left(\frac{\pi F}{2h}\right) + 1.7726\right]\right\}^{\frac{1}{2}}} \qquad (1)$$

$$\text{Where} \qquad F = \frac{9.791\times 10^9}{f_r\sqrt{\varepsilon_r}} \qquad (2)$$

εr -Dielectric constant of substrate

h- Height of substrate

a- Radius of the patch

fr - Resonant frequency

Effective radius of patch (aeff): Because of fringing fields, electrically the patch dimensions look like more than physical dimensions of patch. The effective radius of the patch (aeff) can be determined by

Aeff= a(1+q)^.5 where a is radius of patch.

3)PERFORMANCE PARAMETERS[3]:

Conformal antenna, when all is said in done, have a few points of interest over organizer microstrip antenna, for example, wide rakish inclusion and controlled addition. The primary downside of microstrip recieving wires is their tight data transmission which brings about high affectability to any recurrence change and diminishes the proficiency of their general execution.

In this chapter, we present the impact of bend of an acclimated circular microstrip antenna on the successful dielectric steady, reverberation recurrence, input impedance, voltage standing wave proportion (VSWR), return loss (S11), quality factor, and transfer speed of such radio wire. Moreover, the numerical conditions for these parameters as elements of ebb and flow for round and hollow surface are additionally announced in this section.

First, we obtained dielectric constant er for different curvatures

$$E_\theta = E_0 \frac{e^{-jk_0 r}}{\pi r} \sum_{n=-\infty}^{\infty} e^{jn\emptyset} j^{n+1} f_n\left(-k_0 \cos\theta\right), \qquad (3)$$

$$E_\emptyset = -E_0 \frac{\omega\mu\epsilon e^{-jk_0 r}}{\mu_0 \pi r} \sum_{n=-\infty}^{\infty} e^{jn\emptyset} j^{n+1} g_n\left(-k_0 \cos\theta\right),$$

$$f_n = \frac{j\omega\varepsilon_0 \int_{-\infty}^{\infty} M(n,p)\, e^{-jn\emptyset} e^{-jpz} dz}{\left(k_0^2 - n^2\right) H_p^2 \left(a\sqrt{k_0^2 - n^2}\right)},$$

$$g_n = \frac{\int_{-\infty}^{\infty} M(n,p)\, e^{-jn\emptyset} e^{-jpz} dz}{\left(\sqrt{k_0^2 - n^2}\right) H_p'^2 \left(a\sqrt{k_0^2 - n^2}\right)} \times \left(\frac{np}{a\left(k_0^2 - n^2\right)} - 1\right).$$

Input impedance as function of effective dielectric constant and position of feeding is defined as

$$Z_{\text{in}} = j\omega\mu h \sum_n \sum_m \frac{1}{k_0^2 - k^2} \frac{R\varepsilon_{r\text{eff}}}{2a_{\text{eff}}^3} \times \cos^2\left(\frac{\pi}{a_{\text{eff}}} z_0\right) \times \sin c\left(\frac{\pi}{2a_{\text{eff}}} z_0\right) \sin c\left(\frac{R\pi}{2a_{\text{eff}}^2} \emptyset_0\right).$$

The total quality factor depends on the conduction quality factor , dielectric loss quality factor , and radiation quality factor as given in

$$\frac{1}{Q_t} = \frac{1}{Q_{\text{rad}}} + \frac{1}{Q_c} + \frac{1}{Q_d},$$

$$Q_c = h\sqrt{\pi f \mu \sigma},$$

$$Q_d = \frac{1}{\tan\delta},$$

$$Q_{\text{rad}} = \frac{2\omega\varepsilon_r}{hG_t} K,$$

The bandwidth BW is given by-

$$\mathrm{BW} = \frac{f_0}{Q_t}$$

Return loss is also given by-

$$S_{11} = -20 \log \left[\frac{\mathrm{VSWR} - 1}{\mathrm{VSWR} + 1} \right].$$

4) MODES[4]:

Microstrip patch antenna offers reconfigurable radiation attributes if attractive parameter for controlling radiation example can be found[1].It is seen that the mode is as energized relies upon the radius of the fix and excitation strategy.

In this section, the probe position impacts on effectiveness of mode excitation, radiation example and invalid guiding has been contemplated. The radiation designs for various blends of the mode have been acquired here. It has been seen that the radiation design has two nulls which can be controlled freely and is required in numerous applications, for example, hostile to sticking recieving wires. The radiation design reconfiguration is accomplished by energizing the predominant TM11 mode alongside the higher request TM21 and TM31 modes.

This multimode microstrip patch antenna contains three concentric circular patches which are shown in fig 2.

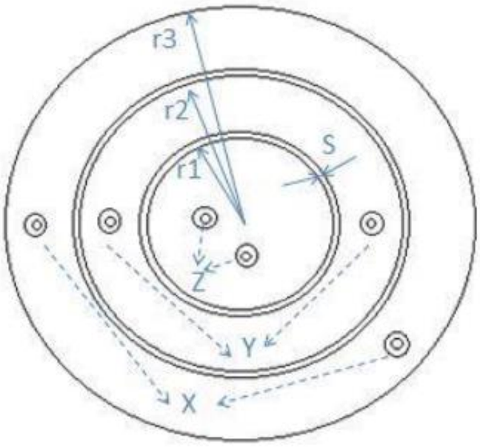

Figure 2 Geometry of antenna [4]

This multimode microstrip antenna apparatus contains three concentric round patches which are appeared in fig1 (I). Plan conditions for the calculation of sweep of the round fix which bolsters various modes are referenced in [6]. Rogers RT duroid substrate (tan δ=0.004, εr=2.20), thickness=0.7478mm. Cuts between round fix is s=0.5mm for segregation between the modes. Cuts with s=0.8mm and 1.5mm were additionally contemplated, however they were giving poor impedance coordinating. The fix radii are 11.35mm, 16.9mm, 24mm. The range of the ground plane 'r' is 85mm.

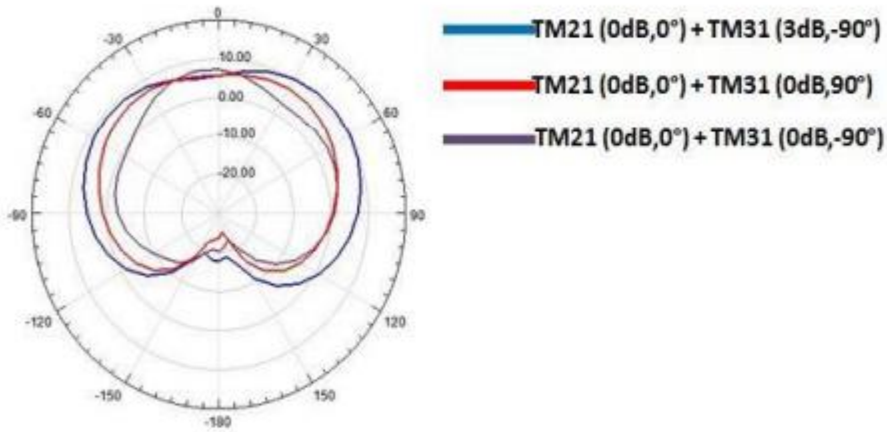

Figure 3 Radiation Pattern for TM21 and TM31 modes

The prevailing TM11 mode is energized by coaxial feed situated at the middle fix. The TM21 mode is energized by two coaxial tests at 180° direction situated from the outset ring. The other higher mode TM31 is energized by three coaxial tests at 120° direction situated at the subsequent ring. The size of the ground plane is shifted with sweep from λ to 3.5 λ with 0.25 λ step size. For TM11 mode, the augmentation in the size of ground plan shows 1.0 dB decline in increase because of the coupling impact with higher modes. In TM21 and TM31 modes there is increment in gain from 1 to 2 dB subsequently, the size of ground plan was advanced to accomplish better addition just as immaculateness of higher modes.

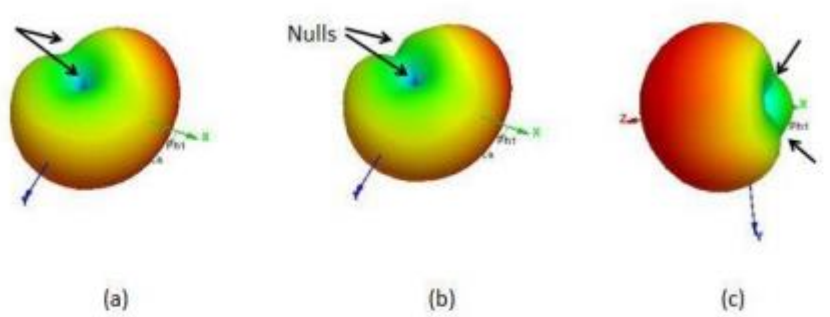

Figure 4 Null locations forTM11(0dB,0 °) + TM21(0dB,-90°) + TM31(0dB,0°), TM11(3dB,0°) + TM21(0dB,-90°) + TM31(0dB,0°)and TM11(3dB,0°) + TM21(0dB,90°) + TM31(0dB,90°).

5) CONCLUSION:

In this paper, the probe position effects on efficiency of mode excitation, radiation pattern and null steering has been studied. The multimode (TM11, TM21, TM31) microstrip patch antenna was observed. Moreover we looked at performance parameters of the circular microstrip antenna and it's design parameters.

6) REFERENCES:

1. Gade, M.S.L. & Prasad, G. & Gantala, Anilkumar & Anjaneyulu, P. & Shaik, Hasane. (2017). Design of circular microstrip patch

antenna and its simulation results. Journal of Advanced Research in Dynamical and Control Systems. 9. 230-239.

2. http://ijarcst.com/doc/vol4issue2/ver2/sonu.pdf
3. https://ieeexplore.ieee.org/document/8770711
4. B. Kim, B. Pan, S. Nikolaou, Y. Kim, J. Papapolymerou and M. M. Tentzeris, "A Novel Single-Feed Circular Microstrip Antenna With Reconfigurable Polarization Capability," in IEEE Transactions on Antennas and Propagation, vol. 56, no. 3, pp. 630-638, March 2008, doi: 10.1109/TAP.2008.916894.