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Micro Strip Patch Antenna and Its Uses

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Abstract: Micro strip patch antenna has made great progress in the past few years. The basic geometry of a MSPA consist of a metallic patched printed on a grounded substrate. This review presents an overview of the design techniques for micro strip patch antennas. Antennas are available in different shape and signal strength. Micro strip patch antennas have become the favorite of antenna designer. This study discusses some of the principal techniques of micro strip patch antennas. The paper ends with some results and conclusions.

Key words: Micro strip patch antenna (MSPA), Bandwidth, Probe feed, R F signal, Field zone, Gain.

Introduction:

Antenna:

An antenna is a device used to transform an RF signal, traveling on a conductor, into an electromagnetic wave in free space. Most antennas are resonant devices, which operate efficiently over a relatively narrow frequency band. An antenna is characterized by its center frequency, gain, bandwidth, polarization, radiation pattern and impedance. Two conditions are required for the maximum performance of antenna:

a) Resonance: The resonance will occur at the center frequency when the impedance of the antenna is strictly resistive.

b) Matching: A proper matching of the antenna to the feed point implies that both the impedances are equal. When there is a impedance matching, all the energy delivered by the feed point is converted to electromagnetic field.

Return Loss:

Return loss is another way to express the impedance mismatch.

Bandwidth:

The bandwidth of an antenna refers to the range of frequencies over which the antenna can operate correctly. The bandwidth can also be described in terms of percentage of the center frequency of the band.

$$B_{\omega} = 100 \times (F_H - F_L) / F_C$$

where FH is the highest frequency in the band, FL is the lowest frequency in the band and FC is the center frequency in the band.

Gain and Directivity:

The directivity D and the gain G are probably the most important parameters of an antenna. The directivity of an antenna is equal to the ratio of the maximum power density max (watts/m2) to its average value over a sphere as observed in the far field of an antenna. Thus

$D = \frac{P(\theta,\phi)_{max}}{P(\theta,\phi)_{av}}$ The directivity is dimensionless ratio, D   1.

Field Zone (antenna):

The fields around an antenna may be divided into two principle regions, one near the antenna called the near field zone and one at a large distance called far field zone. The boundary between the two may be arbitrary taken to be at a radius

$$R = \frac{2L^2}{\lambda}$$

where maximum dimension of the antenna and   wavelength.

Radiation Pattern

The radiation or antenna pattern describes the relative strength of the radiated field in various directions from the antenna at a constant distance.

Micro strip Patch antenna:

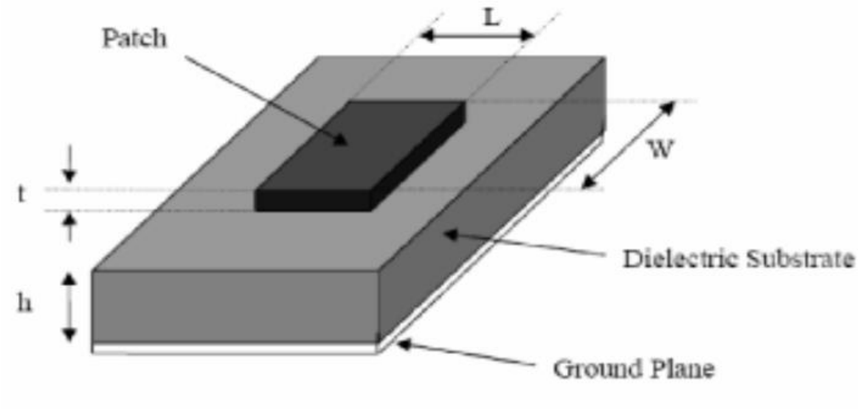

Fig. 1: *Construction of a basic patch antenna*

Micro strip patch antennas (transmission line model):

According to this model, most of the electric field lines reside in the substrate and parts of some lines in air as shown in Fig. 2.

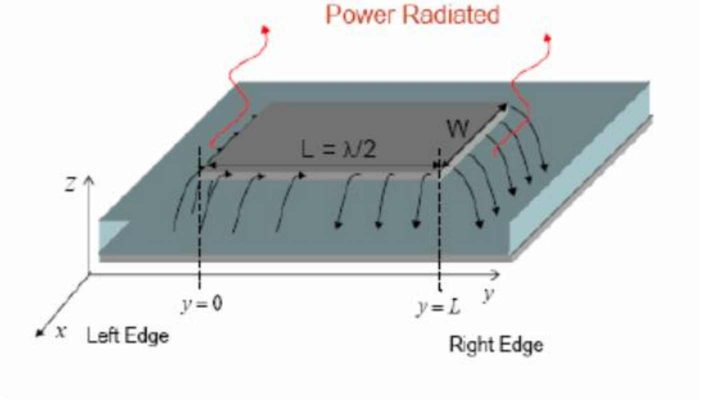

Fig. 2: *Power radiation from patch antenna*

Fields around the periphery of the patch are not confined in the dielectric substrate but also spread in the air. So the effective dielectric (εreff) constant is slightly less than εr. The expression for εreff is given by

$$\epsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + \frac{10h}{w}\right]^{-1/2}$$

Where,

εreff = Effective dielectric constant
εr = Dielectric constant of substrate
h = Height of dielectric substrate
w = width of the patch

Probe Feed:

The coaxial feed or probe feed is a very common feeding technique for Micro strip patch antenna. For the coaxial field at a distance x from the center, the input impedance of the rectangular patch at resonance can be approximately calculated as

$R_{in} = R_e \sin^2\left(\frac{\pi x}{L}\right)$ for $0 \angle x \angle L/2$.

where, $R_e = \frac{1}{2(G_r + G_m)}$ and G_r = slot conductance , G_m = mutual conductance

In this study, we have designed a micro strip patch antenna with center frequency 1.28 GHz using edge feeding. For edge feeding

$$Z_{10} = \sqrt{Z_0 R_L}$$

HFSS:

We have used High Frequency Structure Simulator, HFSS (Trial Version). HFSS is a high-performance full-wave electromagnetic (EM) field simulator for arbitrary 3D volumetric passive device modeling.

Design parameters of Patch Antenna (Specifications):

Material: FR4 (High frequency laminate) with dielectric constant (εr=4.39)
Height (h):1.56 mm
Center frequency (f): 1.28 GHz
After calculating, for 1.28 GHz, length (L)=53.50 mm and width (W)= 71.55 mm

Result:

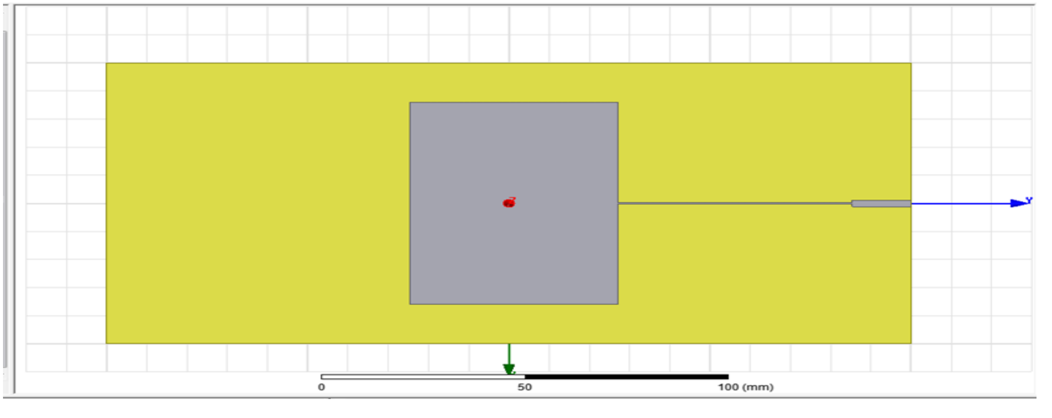

Fig. 3: *Schematic diagram of the designed patch antenna*

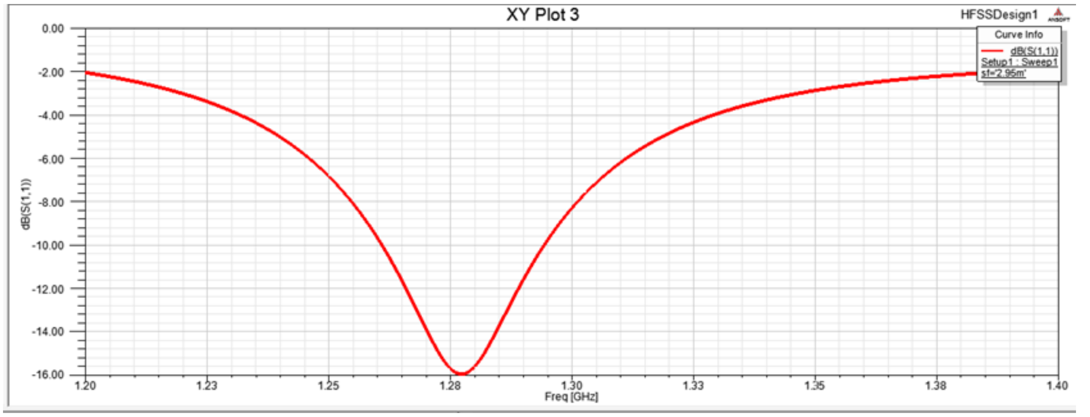

Fig. 4: *S11 characteristics of the designed patch antenna*

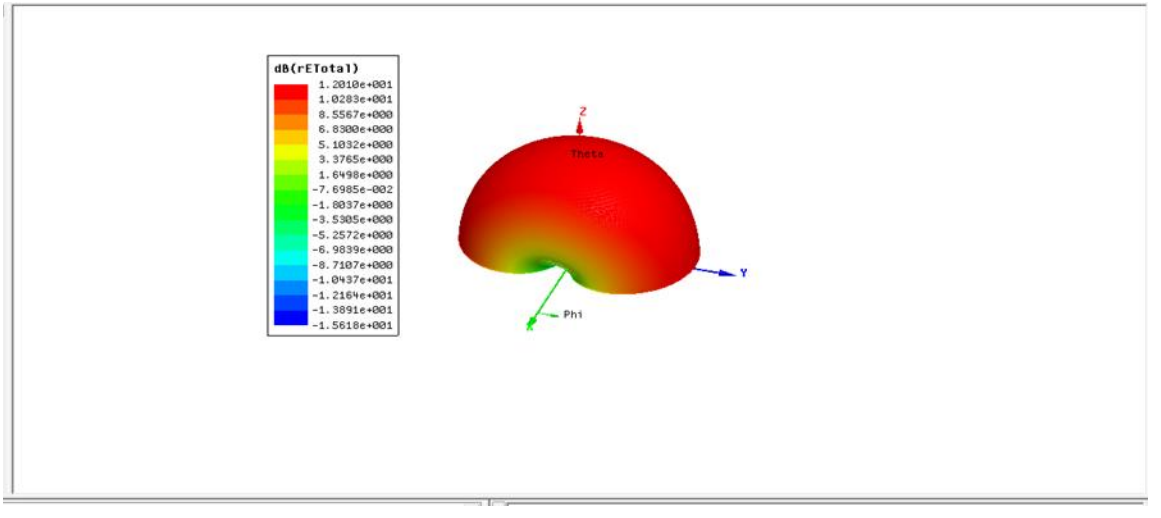

Fig. 5: *Radiation pattern of the designed patch antenna*

Conclusion:

In this study we have used edge feed for antenna excitation. So in this case we have used quarter wave matching for antenna in at the edge. From the results of different graph it is showing that the antenna is properly matched with our desired frequency. Microwave imaging to detect cancer is a promising method and there are many works in this area. MSPA are still considered under developing and also replaced traditional antennas.

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