COMPARISON OF T-SHAPED MICROSTRIP ANTENNA AND U-SHAPED MICROSTRIP ANTENNA

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Abstract: In this paper a comprehensive parametric study has been carried out to understand the effects of U patch antenna and T-patch antennas to optimize the performance of the final design. The theoretical simulations are performed using SONNET software. The results are obtained for U-shaped antennas and T-patch antenna to compare the simulation results.

Key-words: Microstrip antenna, U-patch antenna, T-patch antenna, VSWR.

1 Introduction
In telecommunication, there are several types of microstrip antennas (also known as printed antennas) the most common of which is the microstrip patch antenna or patch antenna. A patch antenna is a narrowband, wide-beam antenna fabricated by etching the antenna element pattern in metal trace bonded to an insulating dielectric substrate with a continuous metal layer bonded to the opposite side of the substrate which forms a ground plane. Common microstrip antenna radiator shapes are square, rectangular, circular and elliptical, but any continuous shape is possible. Some patch antennas eschew a dielectric substrate and suspend a metal patch in air above a ground plane using dielectric spacers; the resulting structure is less robust but provides better bandwidth. Because such antennas have a very low profile, are mechanically rugged and can be conformable, they are often mounted on the exterior of aircraft and spacecraft, or are incorporated into mobile radio communications devices.

Microstrip antennas are also relatively inexpensive to manufacture and design because of the simple 2-dimensional physical geometry. They are usually employed at UHF and higher frequencies because the size of the antenna is directly tied to the wavelength at the resonance frequency. A single patch antenna provides a maximum directive gain of around 6-9 dBi. It is relatively easy to print an array of patches on a single (large) substrate using lithographic techniques. Patch arrays can provide much higher gains than a single patch at little additional cost; matching and phase adjustment can be performed with printed microstrip feed structures, again in the same operations that form the radiating patches. The ability to create high gain arrays in a low-profile antenna is one reason that patch arrays are common on airplanes and in other military applications.

2 U-Patch Antenna
Antenna has been investigated for many years as the demand in emerging technology applications developed simultaneously. Many techniques have been proposed in various ways to suit the desired character. In telecommunication, there are several types of microstrip antennas (also known as a printed antennas) the most common of which is the microstrip patch antenna or patch antenna. A patch antenna is a narrowband, wide-beam antenna fabricated by etching the antenna element pattern in metal trace bonded to an insulating dielectric substrate with a continuous metal layer bonded to the opposite side of the substrate which forms a ground plane. Common microstrip antenna radiator shapes are square, rectangular, circular and elliptical, but any continuous shape is possible. Some patch antennas eschew a dielectric substrate and suspend a metal patch in air above a ground plane using dielectric spacers the resulting structure is less robust but provides better bandwidth. The bandwidth is an important specification of antennas should be satisfied not only for the VSWR, but also at least for the radiation pattern and polarization.
property. From experience in engineering development, a wide bandwidth is usually restricted by a radiation pattern. Because such antennas have a very low profile, are mechanically rugged and can be conformable; they are often mounted on the exterior of aircraft and spacecraft, or are incorporated into mobile radio communications devices.

![Fig: 1 Geometry of the Antenna element](image)

### 3 T-Patch Antenna

Figure 2 shows the geometry of the proposed antenna. In the Figure 1, all of the multi-layers thickness $d_1$, $d_2$ and $d_3$ has 1.5mm, the relative permittivity in each layers. In order to have a high relative permittivity because it makes the size of the feeding patch with coaxial line this is possible with the smallest. Also, in order to expand the bandwidth of multilane the region 2 planned to have an air layer [3] and to raise the radiation efficiency of the antenna the region 3 select the low dielectric constant. Therefore, the multilayer structure consists of three substrate plates separated by air gaps. Here, the air gaps ensure the necessary volume necessary to achieve the required bandwidth. Two stacked square patches have been printed on the top and bottom substrates. The two patches are coupled electromagnetically which is a well know bandwidth enhancement technique [4]. Specially, the method will be able to change minutely a central frequency of the multi-band and a bandwidth, control the distance between the feeding patch and the parasitic patch.

![Figure 2. Multi-band microstrip patch antenna of (a) Structure of layers and (b) geometry of the Antenna element](image)

### 3.1 Design Calculation Formula

#### 3.1.1 U-Patch Antenna

The conventional rectangular patch antenna was designed as the basic structure using Micro strip patch antenna using sonnet software. This antenna was designed at which is compatible with indoor wireless applications. The two arms of the antenna were calculated based on the equations as follows.

Approximate lengths of the two arms

$$L_1 = L - \delta L$$

$$L_2 = L - 2\delta L$$  \[1\]

Approximate widths of the two arms;

$$W_1 = \frac{W}{4}$$

$$W_2 = W_1 - \delta W$$  \[2\]

The operating frequency $f_r$,

Thickness of the dielectric medium,

$$h \leq 0.3 \times \frac{c}{2 \times \Pi \times f_r \times \sqrt{\varepsilon_r}}$$  \[3\]

Thickness of the grounded material alumina,
\[ h \leq 0.3 \times \frac{c}{2 \times \Pi \times f_r \times \sqrt{\varepsilon_r}} \] \hspace{1cm} \text{------------- (4)}

Width of metallic patch,
\[ W = \left( \frac{c}{2 \times f_r} \right) \times \left[ \frac{\varepsilon_r + 1}{2} \right] \] \hspace{1cm} \text{------------- (5)}

Length of metallic patch, \( L \)
\[ L = \frac{c}{2 \times f_r \times \sqrt{\varepsilon_{\text{eff}}}} - 2\Delta l \] \hspace{1cm} \text{------------- (6)}

Where,
\[ \Delta l = 0.412 \times h \times \left[ \left( \frac{\varepsilon_{\text{eff}} + 0.03}{\varepsilon_{\text{eff}} - 0.258} \right) \times \left( W + 0.264h \right) \right] \]
\[ \varepsilon_{\text{eff}} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2} \times \left( 1 + \left( \frac{12 \times h}{W} \right) \right) \] \hspace{1cm} \text{------------- (7)}

### 3.1.2 T-Patch Antenna

We use the slot antenna fed to obtain the wide bandwidth by T-shaped microstrip antenna since this type antenna can achieve a good impedance match over a wide frequency range thorough the simple feed structure and also easily be implemented. To suppress harmonics, the U-shaped conductor line (\( WU \times LD \)) connected with ground plane in the rectangular slot are applied. This conductor line and the gap (\( WD \)) act as the L-C resonator for filtering out the second and third harmonic frequencies. Since the length and width of the U-shaped conductor line are the critical parameters for suppressing the harmonics, we try to carefully adjust WU, WD,

### 4 Parametric Study

We have compared the rectangular patch antenna and T-patch antenna for the dielectric constant and also for the same length. From this we can see that the VSWR is very less for the T-patch antenna when compare to the U-patch antenna. Hence forth the matching is perfect antenna when compare to U-patch antenna

### 5 Simulation Results

In this we have compared the T-patch antenna and U-patch antenna and the VSWR and magnitude response is show below
6 Conclusion
From the simulated results, we can say that T shaped patch antenna geometry provides wide bandwidth and also the VSWR is very less when compare to the U-patch antenna for the dielectric constant 2.2

References:


