# Design of Multi-band Microstrip Antenna for wireless Applications

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***Abstract —*** *Modern wireless communication system often requires the antenna to work at several frequencies simultaneously. Multiband microstrip antenna has attracted much attention in modern wireless communication. Several types of structures such as slot loading, T-type slot, H-slot antenna, different types of monopole antenna. Different types of stub loading can also produce multiple resonant frequencies. A novel pentagonal structure patch has been introduced in this paper obtained from the rectangular microstrip antenna (RMPA). Multiband operation can be achieved using the modified structure. The good agreement of VSWR, gain and radiation efficiency at these resonant frequencies makes the antenna more practical and efficient.*

***Key words —Multiband, stub loading, RMPA,VSWR.***

## 1 INTRODUCTION

Modern wireless communication requires good performance systems so as it should be capable of performing and handling different operations on its own. Rapid increase in demand of bandwidth for transmission of video and voice simultaneously poses a challenge to system designers to configure and design such a system that should be capable of handling all the requirements of users. For good and efficient communication system, antenna plays a major role. It is used for wirelessly transfer and reception of messages. So, antennas of good characteristics are always in demand.

The present 3G and 4G technologies requires larger data rates with high speed, quality of transmission, and accuracy. MIMO systems are very much suitable for the present and emerging communication systems like Wi-Fi, 3G and 4G, etc. Patch antennas are very much compatible with MIMO systems because they are easier to fabricate and are inexpensive, low in weight, planar or conformal layout, and are able to be integrated with electronic or signal processing circuitry. Patch antennas can be designed in any desired shape like ring, circular, triangular etc. Flexibility in patch antenna design makes it preferable for many modern wireless communication applications.

Multiband microstrip antenna has attracted much attention in modern wireless communication.

## 2.METHODOLOGY & DESIGN CONSTRAINS

Initially the antenna which giving a multiple band operation characteristics have to be designed according to the transmission line model of Microstrip Patch Antenna design concept. The multi-band operation is always limited due to the size of ground plane that being used as it acting as a reflectors to a fringing fields for radiating waves from a radiating elements (patch). The witdh and length of a ground plane is conversely considered as a full size that of substrate giving a multiband operation from a patch.

In this future work, a modified shaped patch antenna system is proposed yielding better results in terms of return loss, impedance bandwidth for multiband antenna. The designed antenna will resonate at triband or multiband at specified regions (bands) of frequencies with VSWR $\leq 2$, with an improved impedance bandwidth.

### *2.1 ANTENNA DESIGN*

Even though the microstrip patch antennas have some advantages like low cost, light weight, simple implementation process and conformability.It suffers from its narrow bandwidth. Hence, the present work mainly focuses on the improvement of impedance bandwidth for multiband applications. The impedance bandwidth of the patch antennas can be improved by using various techniques like introducing parasitic elements, increasing the thickness of substrate and modifying the shape of the antenna and by introducing slots on the patch.

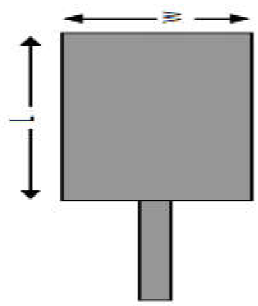

**Fig. 1** Single Patch Antenna Model

The design equations and detailed calculations for antenna parameters are documented below:

**Width of the Patch (*W*):** The width of the Microstrip patch antenna is given by –

$$W = \frac{c}{2fr \times \sqrt{\frac{\varepsilon r+1}{2}}}$$

**Effective dielectric constant ($\mathcal{E}r_{eff}$):**

$$\mathcal{E}reff = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2\sqrt{\left(1+\frac{12h}{W}\right)}}$$

**Effective length ($L_{eff}$):**

$$Leff = \frac{c}{2fr\sqrt{\mathcal{E}reff}}$$

**The length extension ($\Delta L$):**

$$\frac{\Delta L}{h} = 0.412\left(\frac{(\mathcal{E}reff+0.3)\left(\frac{W}{h}+0.264\right)}{(\mathcal{E}reff-0.258)\left(\frac{W}{h}+0.8\right)}\right)$$

**Length of patch** (L)**:** The length of the Microstrip patch antenna is given by **-**

$$L = Leff - 2\Delta L$$

**Substrate dimensions ($L_g$ and $W_g$):** To calculate the length and width of a substrate (ground plane) following equations are given as:

$$Lg = L + 6h \text{ and } Wg = W + 6h$$

The antenna can be modeled in any type of high frequency simulating software like CST Microwave Studio, HFSS or CAD FEKO and the results can be illustrated for a single patch antenna design.

### *2.3 CADFEKO (6.1)*

The name FEKO is an abbreviation derived from the Germanphrase **FE** ldberechnungbei **K**örpernmitbeliebiger Oberfläche(Field computations involving bodies of arbitrary shape.) As the name suggests, FEKO can be used for various types of electromagnetic field analyses involving objects of arbitrary shapes.

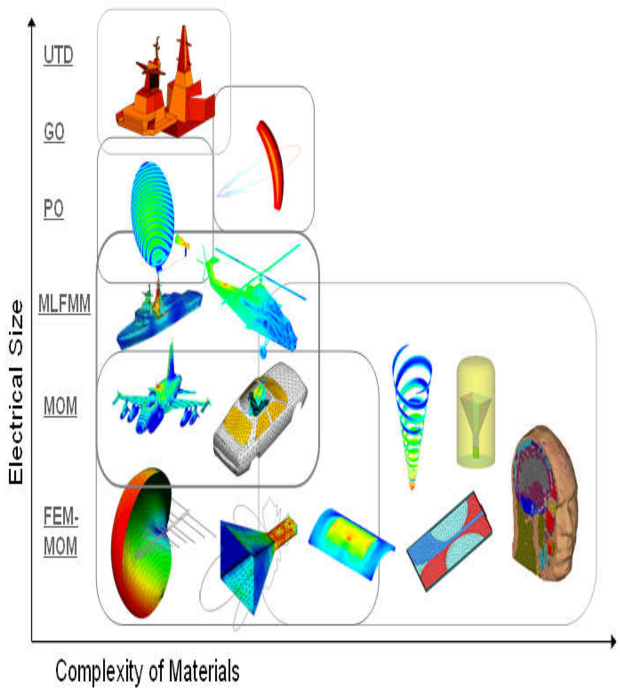


**Fig. 2** Illustration of the numerical analysis techniques in FEKO

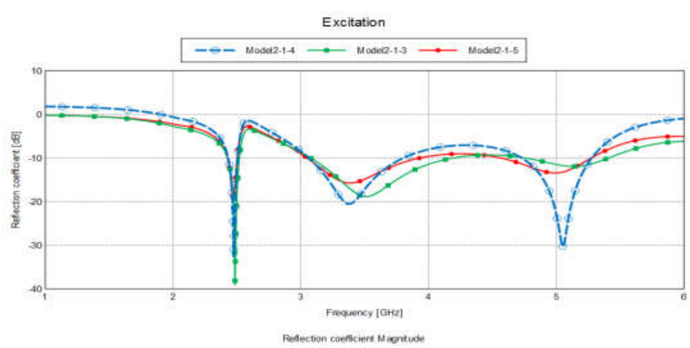


**Fig. 3** Reflection Coefficient vs Frequency Graph

Required Margin: $\leq$ -10dB

Obtained/Simulated Value: 32dB Peak, 19dB Peak, & 14dB Peak

Bandwidth obtained: 2.40 to 4.471 GHz (Bluetooth Band), 3.5 GHz (Wi-fi), & 4.7 to 5.2 GHz (C Band)

## CONCLUSION

To minimize the potential interferences between the multiband system and the narrowband systems, a compact micro strip-fed planar antenna is designed for multiband application having frequency 2.40 to 4.471 GHz (Bluetooth), 3.5 GHz (Wi-Fi), & 4.7 to 5.2 GHz (C Band). The Stable radiation patterns and constant gain in the proposed band of multiband antenna are obtained.

The simulation results of the proposed antenna show a good settlement in term of the VSWR, antenna gain and radiation patterns. Accordingly, the proposed antenna is expected to be a good candidate in various multiband environments having Bluetooth, Wi-Max and C-Band of advanced communication system.

## REFERENCES

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