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Design and Analysis of Slotted Micro Strip Antenna for Wireless Communication

Sandhya Konatham
Department of Computer science
University of Bridgeport
skonatha@my.bridgeport.edu

Tarik Eltaieb
Department of Computer science
University of Bridgeport
teltaeib@my.bridgeport.edu

***Abstract*—Antennas, which send and receive the electromagnetic waves through space play a vital role in wireless communications. It is the basic element used to establish a wireless link between communicating devices. In today's communication industry, antennas are most important due to their several attractive features like small size, low bandwidth etc. and are used widely over the past decade. A micro strip patch antenna with a small aperture is presented in this project. The area of proposed antenna is 26x26mm^2.Here a small rectangular slot of size 6 x 2 mm^2 is created at the center. The bandwidth of proposed antenna by using coaxial feeding is 38.2%. The technique used for improvement of bandwidth is shorting pin. Shorting pin is created either along X-axis or Y-axis. It is created at any position with probe height. The feeding technique used is coaxial The obtained feeding. The coaxial feeding is given at position (x_0,y_0)=(2.7mm,0.5mm).Return loss plot, Radiation Pattern and VSWR plots were observed. The proposed antenna resonates at 5.25 GHz with improved bandwidth of 53.2%. This frequency meets the specifications of wireless applications like Wi-Fi, Wi-MAX. Hence this project mainly emphasizes on bandwidth improvement of patch antennas.[1]**

INTRODUCTION:

There are different feeding techniques for feeding microstrip antennas. The feed line to patch antennas is based on power transfer mechanism. In this experiment we are building micro strip antenna using rectangular slotted strip with effective feeding techniques. The feeding techniques are co-axial feeding and strip line feeding. The simulation is done using Ansoft's HFSS for studying about the band width and radiation pattern. Co-axial feeding can improve the bandwidth. The 34.99% of impedance bandwidth is obtained with respect to center frequency 4.0GHz.

Specifications of Slotted Rectangular Patch

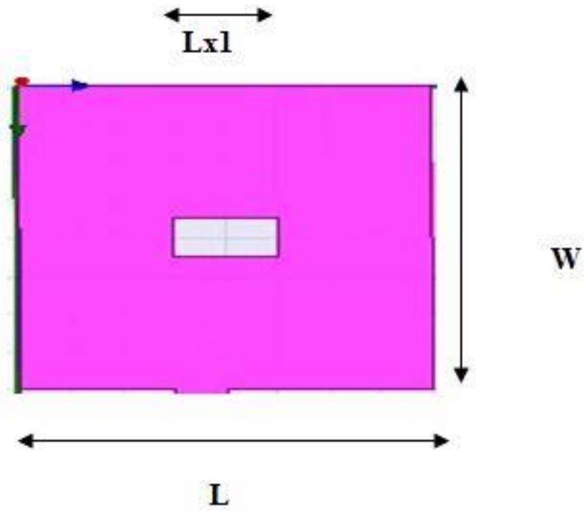


Fig.1 Geometry of Rectangular slot Antenna(top view)

The important diameters for construction of rectangular slotted patch are:

The length and width of two sides are selected such that 80mm each and the resonating frequency is 6.06 GHz .The selection of dielectric constant reduces the size of the antenna. Therefore the dielectric constant is 2.2 and the height of the dielectric substrate is 2mm.the name of the substrate is RT Duroid 5880 and the width of the slot is taken as 10mm.[2]

Results of rectangular-slotted patch antenna with micro strip line feeding:

It is a strip which is connected to the patch as an extension of the patch. This is easy and simple to match by controlling the insert position. As the thickness of substrate increase, the surface wave and radiation of spurious feed increases which limit the bandwidth[3].

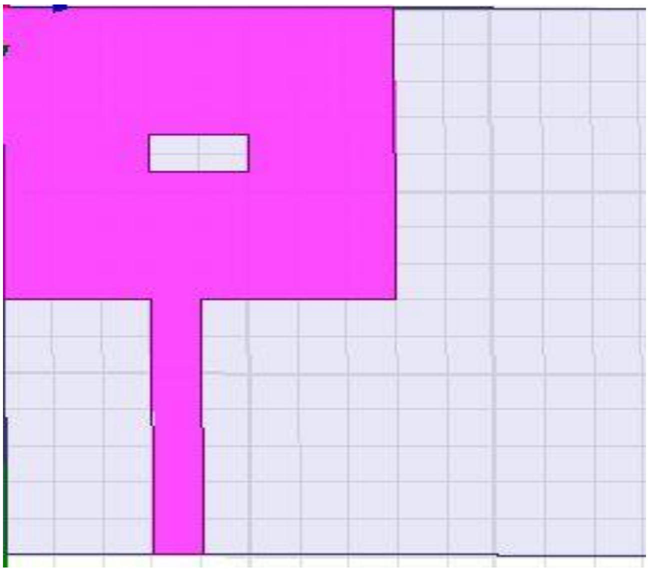


Fig.1.0 3D Geometry of Rectangular Slot Antenna (Top view)

The feed perpendicular to rectangular slot is micro strip feed. By various resonant modes that are generated between slotted ground plane and micro strip feeding very wide bandwidth is achieved for the proposed antenna.[4]

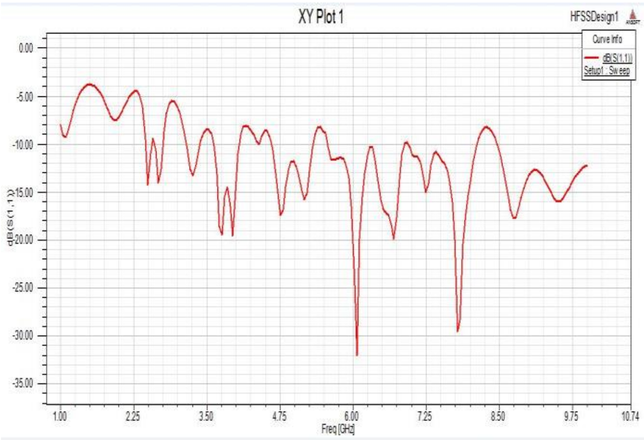


Fig1.1 Return Loss curve for strip line feed

The return loss curve for the Rectangular slot antenna by using Microstrip line feeding is shown in Fig1.1. The operating frequency of the above antenna is chosen at 6.06 GHz. From this we got the return loss of -32.00dB between 5.56GHz and 6.87 GHz band of frequencies at center frequency 6.06 GHz.The radiation pattern for the Rectangular slot Antenna with the Microstrip line feed is shown in Fig.1.2.

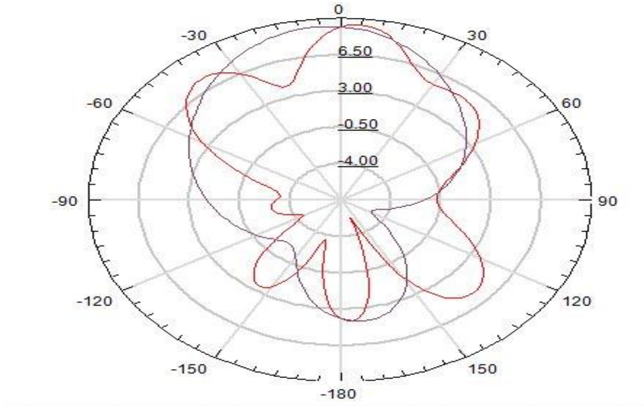


Fig.1.2 Radiation pattern for strip line feed

Simulation Results for Slotted Rectangular Patch with Probe Feed

In co-axial feed, one conductor is attached to radiation patch of the antenna and the other is connected to the ground plane. This method is easy to fabricate, less spurious radiation and easy to match.

The same rectangular Microstrip slot antenna is fed by a co-axial probe feed to improve the bandwidth and the feed can be placed at any desired position inside the patch.The design parameters of the patch are same similar to that of rectangular slot antenna with a Microstrip line feed. The outer cylinder (coax) is of radius 2mm and height -5mm. The inner cylinder (co-axial probe) is of radius 1mm. The probe is of 1mm radius and height 1.5. The design of the co-axial probe feed is shown in the Fig1.3[1, 5]

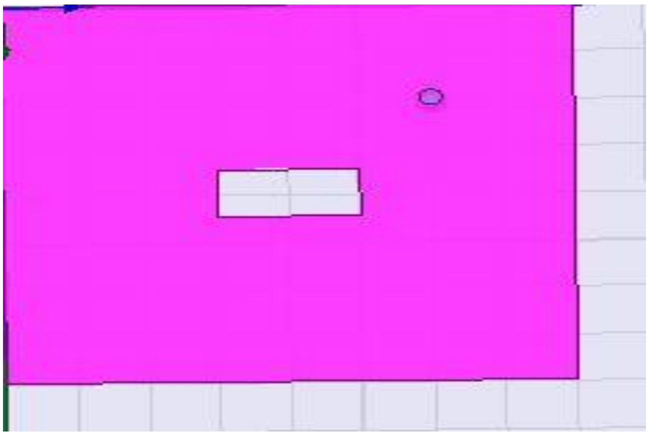


Fig1.3Rectangular Slot Antenna with Probe Feed

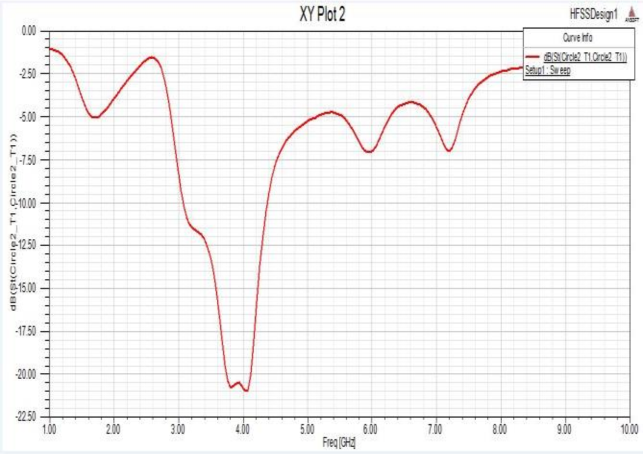


Fig1.4Return Loss Curve for Probe Feed

The fig 1.4 shows the return losses curve of square patch antenna using co-axial feeding. The operating frequency of the developed antenna is chosen at 4.0 GHz.The radiation pattern for the Rectangular slot Antenna with the probe feed is shown in Fig.1.5.

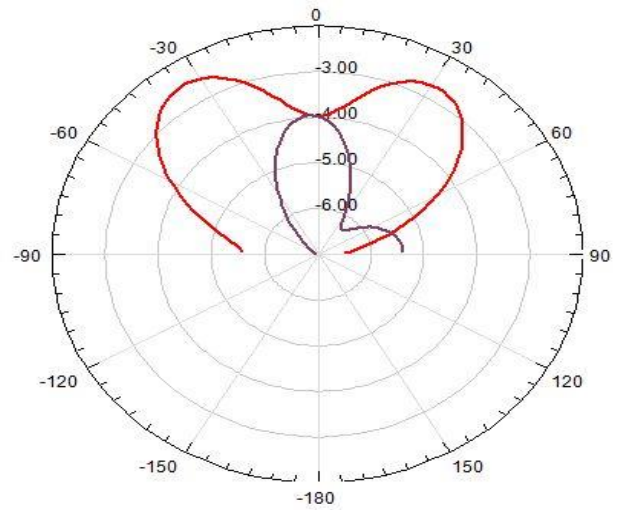


Fig1.5 Radiation Pattern for Probe Feed

From the above results, it is observed that the co-axial probe feed technique is easy to implement. So, probe feeding is used.

2.Design Specifications

The structure of the proposed antenna is shown in the Fig.2.1. For best performance, the thickness of the dielectric substrate should be low because it provides large bandwidth and better radiation. The thickness of the substrate is 6.4mm with permittivity as 2.2. The area of proposed antenna is 6.4mm and dimensions of the substrate is 100*90*6.4mm^3. Here a small rectangular slot of size 6 x 2 mm^2 is created at the center to improve the bandwidth. The below table consists of dimension of the proposed antenna.[5]

Table 2.1 Dimensions of Proposed Antenna in mm

Parameter	L1	L2	L3	L4	H1	H2	H5
Units(mm)	6	3	14	26	4.5	9	3

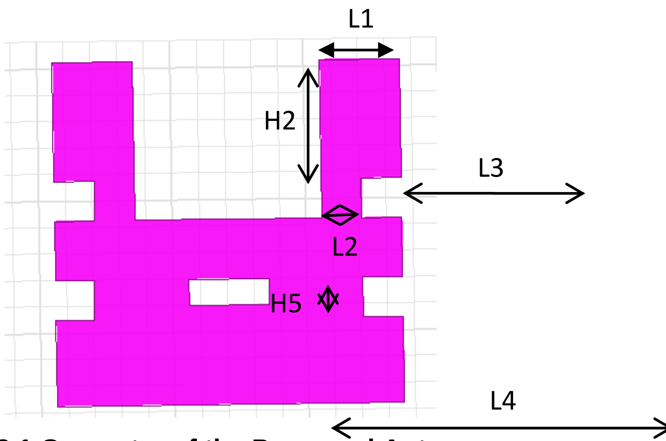


Fig.2.1 Geometry of the Proposed Antenna

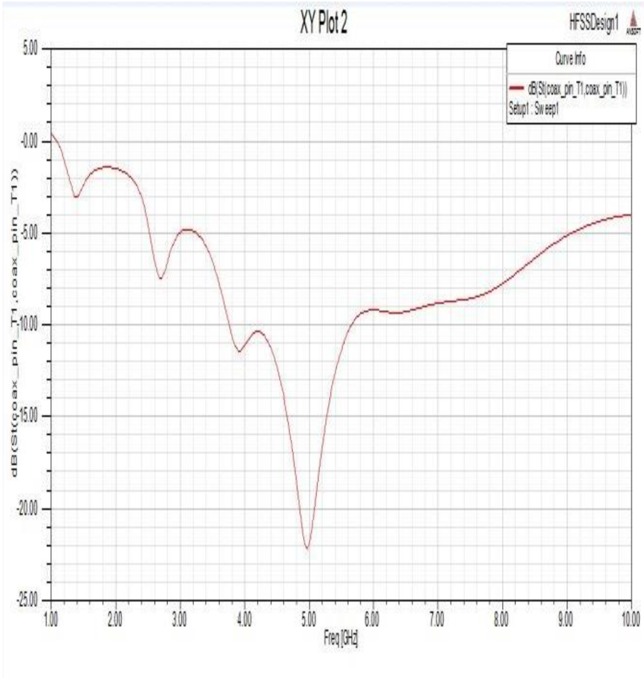


Fig 2.2 Return Loss Curve without Shorting Pin

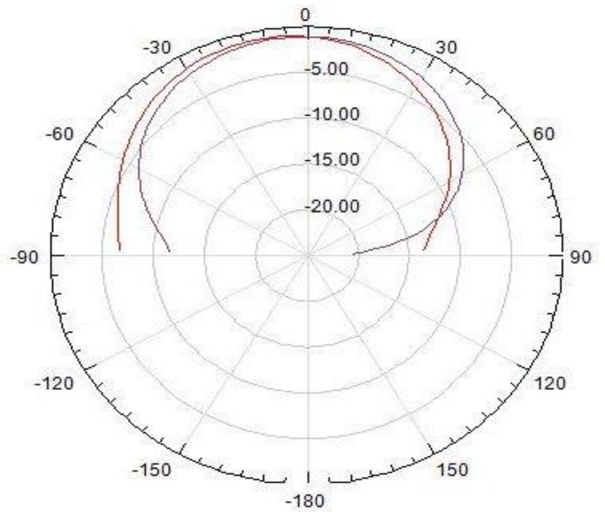


Fig 2.3 Radiation Pattern without Shorting Pin

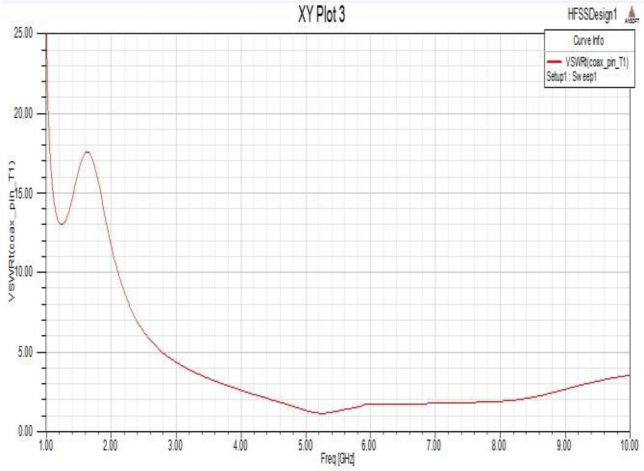
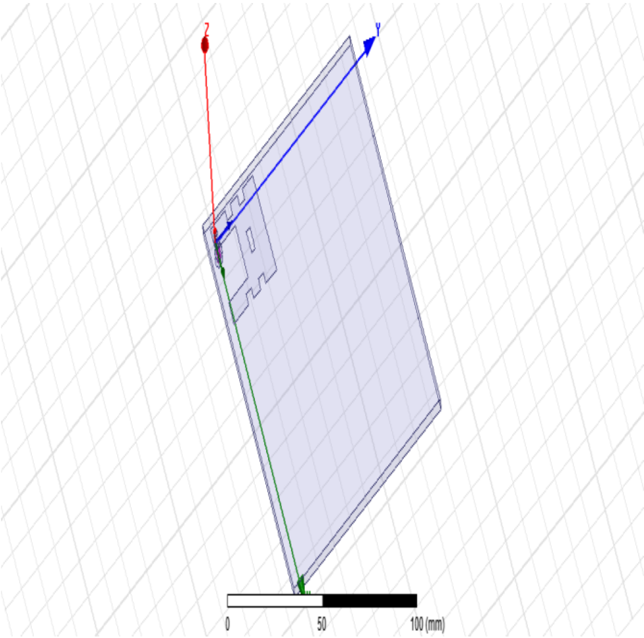


Fig 2.4 VSWR Plot without Shorting Pin

USING SHORTING PIN: Without increasing the cost and decreasing the operational uses, the shorting pin concept improves the radiation efficiency and bandwidth. By using shorting pin concept we can reduce the resonant frequency of the antenna for a given surface[6]



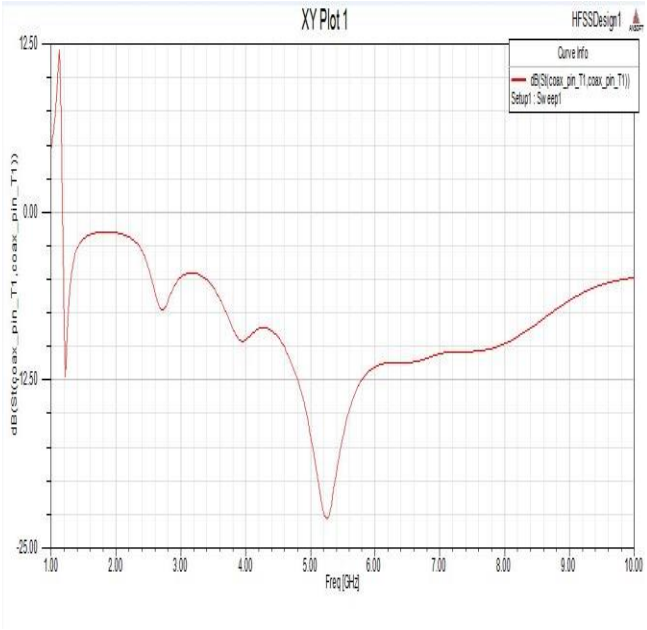


Fig 2.5 Return Loss Curve Using Shorting Pin

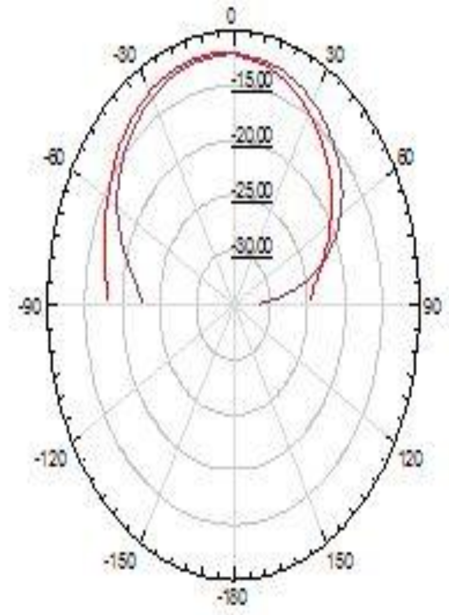


Fig 2.6 Radiation Pattern Using Shorting Pin

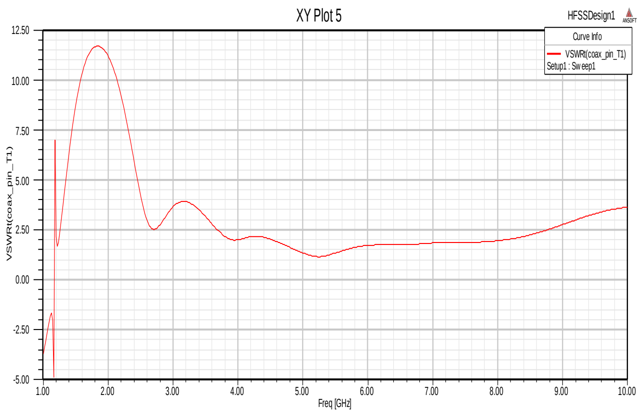


Fig 2.7 VSWR Plot Using Shorting Pin

Conclusion

In this project, we have designed different types of rectangular slot antennas and a microstrip patch antenna. The performance of these antennas in terms of bandwidth is studied. For the rectangular slot antenna with strip line and co-axial probe feed, it is observed that the bandwidth of the probe feed is 14% more than the strip line feed. The Bandwidth of Modified Wang shaped patch antenna without shorting pin is 38.2% and it is verified using shorting pin[4].The percentage of bandwidth achieved is 53.2.The modified Wang shaped patch antenna resonates at frequencies which meets the specifications of Wi-Fi, WI-Max.In future there is chance to increase the bandwidth by varying the slot size, dielectric constant and thickness of the substrate.

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