A Compact and Broadband Microstrip Patch Antenna with Circular Polarization for L-S-C BAND: A Review

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Abstract: - The thesis covers three aspects of Micro strip array antenna designs. The first is the analysis and design of single element rectangular Microstrip antenna which operates at the central frequency of 5 GHz and the second aspect is the design of Compact Broad band rectangular Microstrip antenna which is operates as Compact Broadband. Both antennas have been modeled, designed and simulated. Basically, transmission line is going to use to model both antennas. First, the design parameters for single element of rectangular patch antenna have been calculated from the transmission line model equation and extend the antenna design to Broad Band rectangular Microstrip patch antenna using the appropriate slots and shorting pin at radiating edge. The simulation process has been done through IE3D electromagnetic software which is based on method of movement (MOM). For rectangular Microstrip antenna design used FR-4 material and the result compared between different optimization scheme and theoretical results.

Keywords: IE3D; FR-4 substrate,

I. INTRODUCTION

Satellite communication and Wireless communication has been developed rapidly in the past decades and it has already a dramatic impact on human life. In the last few years, the development of wireless local area networks (WLAN) represented one of the principal interests in the information and communication field. Thus, the current trend in commercial and government communication systems has been to develop low cost, minimal weight, low profile antennas that are capable of maintaining high performance over a large spectrum of frequencies. This technological trend has focused much effort into the design of Microstrip antennas [1]. With a simple geometry, patch antennas offer many advantages not commonly exhibited in other antenna configurations. For example, they are extremely low profile, lightweight, simple and inexpensive to fabricate using modern day printed circuit board technology, compatible with microwave and millimeter-wave integrated circuits (MMIC), and have the ability to conform to planar and non-planar surfaces. In addition, once the shape and operating mode of the patch are selected, designs become very versatile in terms of operating frequency, polarization, pattern, and impedance.

II. HISTORY

A microstrip antenna was firstly introduced in 1950’s but it became popular and took place in various applications in 1970’s. Recently, microstrip antennas are widely used in several applications where small size, low weight and cost, high performance and easily fabricated and installed antennas are required such as air borne, space borne commercial and military applications and mobile and wireless technologies. Some other advantages of microstrip antennas are that they are conformable to planar and non-planar surfaces, easily fabricated using printed circuit technology, and they are mechanically robust. Microstrip patches are resonant type antennas.

III. LITERATURE SURVEY


A multilayer parasitic microstrip patch antenna array concerned on enhancement of gain for WiMAX application .in this paper proposed structure is microstrip patch antenna array which is compose of three layers using different material,substrate .The substrate for the first layer consists of Flame Retardant 4 that has thickness 1.6mm While the second layer and third layer are 3mm thickness using foam substrate so that multilayer microstrip patch Antenna is designed . In this paper gain increased 62.3 % and performance of the designed antenna is to test for return loss , Voltage Standing wave ratio (VSWR),bandwidth, directivity radiation pattern and gain.

2. Design and Analysis of a Low Profile and Broadband Microstrip Monopolar Patch Antenna Juhua Liu, QuanXue, HangWong, HauWah Lai, Yunliang Long

A new Microstrip monopole patch antenna is presented and analyzed in this paper. The antenna has a wide bandwidth and a monopole like radiation pattern. Such antenna is constructed on a circular patch antenna that is shorted concentrically with a set of conductive vias. The antenna is analyzed using a cavity model. The cavity model analysis not only distinguishes each resonating mode and gives a physical insight into each mode of the antenna, but also provides a guide line to design a broadband monopolar patch antenna that utilizes two modes (TM01 and TM02 modes). Both modes provide a monopole like radiation pattern. The antenna has a simple structure with a low profile of 0.024 wavelengths, and yields a wide impedance bandwidth of 18% and a maximum gain of 6 dBi.

IV. PROBLEM IDENTIFICATION

With bandwidths as low as a few percent, broadband applications using conventional Microstrip patch designs are limited. Other drawbacks of patch antennas include low efficiency, limited power capacity, spurious feed radiation,
poor polarization purity, narrow bandwidth, and manufacturing tolerance problems. For over two decades, research scientists have developed several methods to increase the bandwidth and low frequency ratio of a patch antenna. Many of these techniques involve adjusting the placement and/or type of element used to feed (or excite) the antenna. Broadband frequency operations of antennas has become a necessity for many applications in recent wireless communication systems, such as GPS, GSM services operating at two different frequency bands. In satellite communication, antennas with low frequency ratio are very much essential. It is also less sensitive to feed position, which allows the use of an inset planar feed.

V. PROPOSED ANTENNA DESIGN

Figure 1 shows the flowchart for the proposed antenna. In this part, the procedure of analyzing and designing multilayer parasitic microstrip antenna array is explained. Analysis of design criteria will be analyzed and need to be achieved and this required a major evaluation. The antenna will be fabricated then measured using a calibrated vector network analyzer only if the result meets the requirement. Finally, the outcome result from fabrication and measurement is compared and analyzed. In this paper, I design one by using single layered and second by fractal geometries implemented on multilayer. [2]

1 Design Consideration for geometry-1
The proposed design analyses with and without ground plane, analyses done by considering the effect of ground plane for enhancing the bandwidth, antenna efficiency, Gain, Return loss, VSWR.

Antenna Design with Ground plane
The configuration of the proposed antenna is shown in Fig.4.1. The antenna is analyzed and optimized by IE3Dsoftware. The proposed antenna is composed of a FR-4 and foam dielectric material, two square slots, 2 by 2 parasitic L-Slot. The radiating arms are designed as two square slots and two L- slot to obtain compact size.
The dimensions of design at 5 GHz are:
Hence, the essential parameters for the design are:
- $f_0 = 5\text{ GHz}$
- $\varepsilon_r1 = 4.4$
- $\varepsilon_r2 = 1.05$
- $\varepsilon_r3 = 1.05$
- $h_1 = 1.6\text{ mm}$
- $h_2 = 3\text{ mm}$
- $h_3 = 3\text{ mm}$
- Total height of substrate = $h_1 + h_2 + \text{ag}$ =1.6+3+3=7.6 mm
impedance matching we used stub matching technique of transmission line and found position of stub and length of stub, using resonance theory found width of stub. After finding stub dimension, substitute stub on the edges of middle layer patch, optimization completed by using appropriate dimension of ground plan. From this optimization, we found return loss up to -36dB, and VSWR at 4GHz is 1.023.

The essential parameter specifications for the design slotted 2 BY 2 antenna array of the conventional rectangular microstrip Patch antenna are as in fig.

Side view (3-D)

Simulation Setup The software used to model and simulate the Microstrip patch antenna is ZelandInc’s IE3D. IE3D is a full-wave electromagnetic simulator based on the method of moments. It analyzes 3D and multilayer structures of general shapes. It has been widely used in the design of MICs, RFICs, patch antennas, wire antennas, and other RF/wireless antennas. It can be used to calculate and Return loss plot, VSWR, current distributions, radiation patterns etc. For design simplicity of the conventional MSA, the patch's length and width are shows in the table 5.2. Here two different geometry fractal antenna simulated and observe all antenna parameters like Return loss plot, VSWR, radiation patterns, Directivity, Gain and efficiency. Then compare both result and investigated advantages of applying Sierpinski carpet.

The Inset feed used at point (8, 0) to design the rectangular patch antenna. The center frequency is selected as the one at which the return loss is minimum. The bandwidth can be calculated from the return loss (RL) plot. The bandwidth of the antenna is said to be those range of frequencies over which the return loss is below than -7.5 dB. The Implemented Sierpinski carpet antenna simulated return loss data and its operating frequency are as shown figure.
a. Return Loss Plot

For 5 GHz frequency. See the figure represents 2D radiation pattern and 3D radiation pattern respectively.

VI. CONCLUSION
This Paper presents new concept of implementation of Fractal geometry on multilayer Sieperinski Carpet fractal geometry and designed multiband antenna. The aim of this paper work is to find how implementation on multilayer gives better result in achieving antenna parameters like return loss (RL), VSWR, antenna efficiency, Gain, directivity and bandwidth. In this paper work I first design multiband Carpet fractal microstrip patch antenna and simulate its results with IE3D software. Of bands. Hence fractal geometry is a used to obtain multiband application antennas

REFERENCES


