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A Review of Various Types of Patch Antenna

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Abstract – The review article present an overview of the design technique for microstrip patch antenna. The patch antennas are very useful because of their low weight, ability to conform to any geometrical shape, and easy integration and low cost fabrication. Their major drawback is their narrow bandwidth which is not suitable for wireless communication. The current research is majorly focus on the reconfigured antennas. This can give bandwidth performance and frequency can be reconfigured as well .This article open with short introduction of basic characteristics, feeding method, and analysis techniques of patch antenna. And also it has seen for forward to implementation of metamaterial concept.

Index Terms - *Patch Antenna, Simulator, Bandwidth enhancement, Antenna gain, Directivity.*

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I. INTRODUCTION

In the past few decades the researchers all over the word have studied the theoretical and experimental aspects of different types of Microstrip antenna. Recently, development and analysis of arbitrary geometrical antennas have become an interesting area in communication systems. The relevant works in the field of Microstrip antennas are reviewed

II. LITERATURE SURVEY

Microstrip Antennas are printed circuit antennas for the transmission and reception of electromagnetic energy.

In 1953, Deschamps [1] proposed the concept of Microstrip antennas. The concept of Microstrip antennas was not active until the early 1970's, when there was an immediate need for low profile antennas on the emerging new generation missiles.

In1970 Byron [2] described a conducting strip radiator separated from a ground plane by a dielectric substrate. A strip radiator having length of several wavelengths and half wavelength width was fed at periodic intervals along the radiating edges. This is the first reported antenna array in the open literature.

In 1974, Munson [3], demonstrated new class of Microstrip wraparound antenna suitable for missiles using Microstrip radiator and Microstrip feed networks on the same substrate. This low profile Microstrip array offered nearly90% efficiency and nearly omnidirectional coverage.

Lo *et al.* [4, 5, 6] suggested a new mathematical technique, called cavity model, for the analysis of Microstrip antennas. In this model, the upper patch and the section of the ground plane located below it, is joined by a magnetic wall under the edge of the patch. The structure now behaves as a dielectric resonator. The antenna parameters of different patch geometries with arbitrary feed points can be calculated using this approach. The effects of radiation and other losses are introduced in terms of either an artificially increased substrate loss tangent [6] or by employing the impedance boundary conditions.

Another numerical analysis based on finite element method is proposed by Carver *et al* for deciding the field's interior to the microstrip antenna cavity. This is a variational method that gives a solution closest to the true analytical solution. The problem can be solved via the Eigen value problem. They analysed a pentagonal shaped patch using this method

Tuan Q.tran [7] presented a multimode antenna design on a single substrate layer. It consisted of concentric circular patches generating TM_{11} ,TM_{21} and TM_{31} modes and separated by concentric slots for providing isolation between the modes. The antenna can be used to generate limited beam scan performance, circular polarization, and multiple phase centres giving an option for multifunctional communication application. The amplitude and phase at the feed points can be controlled using the signal processing techniques.

Surabhi Dwivedi [8] developed relationship of directivity with the spacing height of copper grid layer over the patch ,termed as randome structure .Numerous designs and models of randome structure are conceptually solved and evaluated using finite element method (FEM)based High Frequency Structure Simulator (HFSS) software tool. And it is concluded forward to implementation of metamaterial concept for radome structure.

Tahsin ferdous [9] presented a comparative study of rectangular and circular patch antennas at an X band and the resonant frequency is chosen at 10GHz .And CST Microwave Studio is used as software for the comparison. The overall comparison is shown in Table 1.

From the table the overall comparison of different performance of parameter like return loss and VSWER

rectangular antenna shows superiority over the circular and when bandwidth and side lobe levels are considered circular patch antenna becomes superior over the rectangular. However, both antennas exhibit same radiation efficiency and total radiation efficiency and nearly same directivity which make them compatible for similar application.

Parameters	Rectangular	circular
Return loss	-21.3db	-18.3db
VSWR	1.18	1.27
Bandwidth	453Mhz	488Mhz
Directivity	7.9dBi	7.8 dBi
HPBW	-16.3dB	-18.4 dB
Side Lobe Level	7.7dB	7.52 dB
Gain	7.7dB	7.52 dB
Radiation Efficiency	94.8%	94.4%
Total Efficiency	88%	88%

Table 1

Vasjadevi Midasala [10] designed as rectangular patch antenna arrays and Substrate with dielectric constant 4.4 and at 13 GHz .And the design is analyzed by finite element method (fem). This rectangular patch antenna array got a gain 8.5dB compare to rectangular patch antenna and impedance, directivity of the antenna are computed. This shows good performance in terms of return loss and radiation pattern and gain.

Sukhjit kaur [11] presented a microstrip antenna with parasitic lines .And for this proposed antenna more efficient the optimization of the antenna design parameters have been done using HFSS. This antenna at these resonance frequency shows better performance in return loss ,bandwidth as shown in Table 2.This designed structure are investigated by using FEM based solver .

Operating Frequency	Return loss(db)	Bandwidths
5.93GHZ	-20	250MHZ
5.79GHZ	-35.97	34MHZ
6.03GHZ	-35.87	167MHZ

Table 2

Kirandeep Randhawa,([12] proposed patch antenna with three circular slots of Different radii for UWB applications. The proposed circular slot antenna has achieved good impedance matching, consistent gain, and stable radiation pattern over operating frequency band of 3.7to11.7Ghz with overall size of 33mm×22mm which is useful for the designers.

M.T.Isam [13]proposed a 20mm X 15mm slotted patch antenna designed and fabricated on the epoxy polymer resin composite material substrate for dual band application .The measured performance results of the proposed antenna exhibit the impedance bandwidth ranges from 14.3 Ghz to 16.2Ghz ,from 17.4Ghz to 18.9Ghz and from 19.3Ghz to19.8Ghz .5.02 dBi,3.21dBi,3.12dBi simulated gain with radiation efficiency 80.3%,81.9%,82.5%at three resonant frequencies 15.15Ghz,18.2Ghz and 19.5 Ghz respectively. The measured almost steady omnidirectional radiation pattern shows proposed antenna is suitable for Ku and k band application.

Ch.sulakshana [14] proposed a compact single feed rectangular patch antenna with reconfigurable circular polarization has been proposed .The basic antenna structure is rectangular patch of dimension 10mm X 15mm printed on a thin FR4 substrate of thickness 3mm.Two rectangular strips are connected through switches at sideway of the main patch to get polarization diversity .The polarization of the proposed antenna can be reconfigured between left hand circular polarization (LHCP) and right circular polarization (RHCP) by the current path ,which is changed by operating the switches is ON and OFF modes. The design and simulated by IE3D moM based electromagnetic simulator The simulated result show good return loss, radiation pattern axial ratio. The antenna has around 15% effective impedance bandwidth over 4.0 GHz 4.8 GHz band at a maximum gain of 3.0 dBi with polarization diversity.

III. CONCLUSION

From the above review, it is clear that design and development of microstrip antenna is an emerging filed. Microstrip antenna can be achieved by any suitable geometrical shape and designed a new geometry for size reduction antenna gain, return loss, bandwidth, and directivity. For military, commercial system and modern radars are having big challenge for producing high power reconfigurable antenna. The present article is the outcome of the experimental and theoretical investigations carried out on a geometrical shape patch antenna by finite element method (FEM)

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