Review on Microstrip Monopole Rectangular Patch Antenna for Ultra-Wide Band

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Abstract—An enormous development in the study of microstrip patch antennas has been observed in the recent years. This review paper presents the work done on micro-strip patch antennas in the last decade. Different antenna structures have been proposed with the focus of improving antenna parameters like gain, directivity, and bandwidth and return loss.

Key words: Micro Strip Patch Antenna, Antenna Parameters, Directivity, Return Loss

I. INTRODUCTION

Microstrip antennas can be incorporated in various geometries, such as: rectangular, circular, triangular, annular patches and others. Rectangular patch is the most popular shape and can be easily analyzed and modified to produce a range of impedance values, radiation patterns and frequencies of operation. Among the four most popular feed techniques, micro-strip-line feed is easy to fabricate, simple to match by controlling the inset position and rather simple to modal [1]

The low profile, light weight, and low cost of manufacturing of monopole micro-strip patch antennas have made them attractive for many applications [2]. The UWB antenna must have the capability to operate over the frequency allocated to ultra-wide bandwidth i.e. 3.1 GHz to 10.6 GHz as allocated by Federal Communications Commission [3]. Different methods have been proposed to achieve wide frequency with stable performance. These methods included using resonant structures [4], filters [5], slots [6], different shaped patch [7], modify Ying the shape of patch [8], modifying the shapes of the ground planes [9-10]. Ultra-wideband (UWB) is a wireless technology that guarantees to transform high speed transmission. UWB technology offer unique advantage which cannot be supported by narrowband technology. The advantage is less power consumption, high data speed, multi-path propagation immunity, and easy hardware configuration. Various applications e.g. localization, tracking, biomedical imaging and monitoring, short-range wireless communication are the cause of ultra-wideband technology is widely used [11].

II. FEEDING TECHNIQUE

A simple Microstrip antenna built with a single patch and substrate is known to have very narrow bandwidth of about 5%. One of the solution to achieve a wider band of the antenna is a multilayer model, one is the coplanar waveguide (CPW). In micro-strip line feed the radiating element is on the back side of the ground plane and in coplanar waveguide the radiating element is on the same side of the ground plane. Due to this quality of CPW antenna has gained wide acceptance as compared to the micro-strip line feed. Also coplanar waveguide is easy to integrate with monolithic microwave integrated circuit. Due to the useful characteristics of CPW feed line like on-plane geometry, simple manufacturing and circuit combination, makes CPW antenna more applicable as compared to the micro-strip line feed. Some drawback of the CPW feed antennas are Narrow bandwidth and poor gain. In micro-strip line feeding technique, micro-strip patch is directly connected to the conducting strip compared to the patch, the width of the conducting strip is small. The advantage of this type of arrangement is that feed can be etched on the same substrate to provide a planar structure. The design started with antenna (A) which is represented by a simple rectangular patch antenna with straight feed line [12]. This antenna covers the whole UWB spectrum (3.1-11.1) GHz. Then, a single rectangular step in the bottom edges of the patch are used as a one step toward improving the impedance matching.

III. PARAMETER ENHANCEMENT TECHNIQUE OF PLANAR MONOPOLE ANTENNA

A. Gain and Directivity

Plot The gain of an antenna is defined as “the ratio of maximum radiation intensity in given direction to the maximum radiation intensity from a reference antenna produced in the same direction with same power input” and has been expressed in dB. The antenna directivity is defined as the ratio of maximum radiation intensity to its average radiation intensity and has been expressed in dB. Parasitic element technique, folding the ground plane technique, suspended ground and metamaterial superstrates technique are used to enhance the Gain of the planar monopole antenna. Inserting slits technique and metal patch reflection technique are employed to improve the gain. Yagi-Uda antenna is used in the parasitic element technique. To increase the antenna, gain and bandwidth L-shaped arm is used. One another technique to enhance the gain of the antenna is the fractal antenna.

B. Bandwidth

A micro-strip fed spade shape planar monopole antenna for ultra-wideband (UWB) applications is use. The techniques like adding shorting post, beveling technique, rounding the lower edge, double feed technique and use of trident shape are used to enhance the bandwidth performance and reduce the antenna height.
In this paper work done on micro-strip patch antennas in the last decade has been discussed. In the last few years, there has been a great progress in the study of micro-strip patch antennas. Authors have proposed different antenna structure with various shapes of patches to enhance the antenna efficiency. It is observed that the gain, directivity and bandwidth of antenna can be enhanced by implementation of rectangular patch in antenna design. Some of them have also worked on bandwidth, return loss and antenna miniaturization. If we attach two ring on a substrate. We observe that the bandwidth of antenna enhanced.

**Table 1:** summary of work done in tabular form

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Paper</th>
<th>Work done</th>
<th>Remark</th>
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</table>
| 1.      | A Novel Wideband Circular Polarization Microstrip Antenna- Combination of different shaped antenna element. [13] | A low profile micro-strip antenna having wideband circular polarization which is the combination of different shaped antenna elements are designed. | 1) Enhancement in gain and bandwidth.  
2) 4 element array antennas can be used in INMARSAT Fleet F33 ship. |
| 2.      | Double printed rectangular patch antennas for ultra-wideband applications. [14] | Antenna with two rectangular patches printed on both sides to get opposite direction currents. The effect of varying the width of the feedline on impedance matching is checked. | 1) The bandwidth from 2.95 to 11.5 GHz is obtained.  
2) Radiation pattern at 3.5, 6 and 9 GHz is observed. |
– The patches used in this antenna are rectangular shaped. Comparison of the characteristics of stacked square shaped patch antennas with stacked E-shaped patch antennas are done. | E-shaped rectangular stacked antenna provide 6.19% enhancement in bandwidth. |
| 4.      | Compact micro-strip antenna for RFID applications. [16] | Short-circuited patch antennas designed with fractal geometries is used. Authors varied the dimensions of the ground plane and compared the S11 parameters and resonance frequency. | 1) 89.8% size reduction  
2) Cost effective tag.  
3) Better results of S11 parameter at the dimensions 76mm X 67mm (Lg X Wg). |
| 5.      | Electronically Tunable Miniaturized Antennas on Magneto electric Substrates With Enhanced Performance. [18] | Antenna designed with metallic films and self-biased Ni-co ferrites is presented. Authors demonstrated the antenna design at 2.1 GHz with tuning resonant frequency ranges of 5-10 MHz (in case of metallic films) and 7-23 MHz in case of ferrite films. | 1) The magnetic antenna showed 42% enhancement in bandwidth as compared to the nonmagnetic antenna.  
2) Tuning range of 11 MHz relative to the nonmagnetic substrate.  
3) 16% increase in bandwidth in contrast to that of nonmagnetic antenna. |
| 6.      | Gain Enhancement in Microstrip Patch Antennas using Hybrid Substrates. [19] | Designed micro-strip patch antenna to enhance the gain, by using hybrid substrate. In this design, constructive interference occurs inside the substrate. this interference is caused due to the introduction of ferrite rings. | 1) Gain enhancement of about 4dB  
2) Nearly 1% improvement in impedance bandwidth.  
3) In the absence of magnetic losses, gain of 9.4 Db is obtained. |
| 7.      | Design and Analysis of Directive Microstrip Patch Array Antennas with Series, Corporate and Series-Corporate Feed Network. [20] | The analysis of different types of micro-strip antennas with different band of frequencies are done using HFSS tool. | Octagonal antennas offer wide bandwidth over the range of 2.5-18 GHz and it also offer good radiation pattern. |

**REFERENCES**


