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A Literature Survey on Different Shape Patch Antenna

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***Abstract*—In this survey paper discuss different shape microstrip patch antenna (MPA). This antenna, which consists of a metallic patch printed on a dielectric substrate over a ground plane, offers several advantages including ease of design and fabrication; low profile and planar structure; and ease of integration with circuit elements. The minimum dimension of a conventional MPA is in the order of half a wavelength. In recent years, with the advent of new standards and compact wireless devices, there has been a need to reduce the size of this type of antenna. This study discusses some of the principal techniques that have been reported in the literature to reduce the size of an MPA. These miniaturisation techniques include material loading, reshaping the antenna, shorting and folding, introducing slots and defects in the ground plane and the use of meta materials. The major features and drawbacks of each of these approaches are highlighted in this study along with their effects on the antenna performance metrics.**

Keywords*—Microstrip patch antenna (MPA),*ultra-wideband (UWB) applications, reduced radar cross section (RCS), octagonal microstrip patch antenna, wireless body area networks (WBAN)

I. Introduction

Antenna is a key device for any wireless communication system. According to the IEEE Standard definitions, the antenna or aerial is defined as “a means of radiating or receiving radio waves.” In other words, antenna acts as an interface for electromagnetic energy, propagating between free space and guided medium. Satellite communication and Wireless communication has been developed rapidly in the past decades and it has great impact on human life. The current trend in commercial and government communication systems has been to develop low cost, minimal weight, low profile and broadband 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 known aspatch antenna. With a simple geometry, patch antennas offer many advantages not commonly exhibited in other antenna configuration. For example, they are extremely low profile, light weight, 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.The variety in design that is possible with Microstrip antenna probably exceeds that of any other type of antenna element. Lower Gain of Microstrip antenna is one of the major disadvantages that restrict its widespread use. If the Gain of Microstrip antenna could be higher, it would be very useful for recent trend of wireless communication. Many researchers have successfully overcome the disadvantage of having low gain of Microstrip antenna by modifying their shape, size or introducing additional element which make it suitable for wireless communication. We have simulated Microstrip antenna with ground plane by using CST microwave studio2013. This simulation software computes most of the useful quantities of interest such as radiation pattern, VSWR, return loss, input impedance and gain etc.

Microstrip antenna has been widely used in many modern communication systems for its small size, low cost, and light weight. Coaxial feeding is a way to feed the Microstrip antenna and exhibits numerous advantages. For instance, the spurious feed radiation can be isolated due to the introduced circular ground plane between the coaxial feed line and patch. Recently, much attention has been focused on the Microstrip antenna. However, the improved gain, enhanced bandwidth and directivity of this kind of antenna need to be further investigated for the practical applications. The enhanced transmission phenomenon, which was first found at the optical range through the sub wavelength feed perforated on a thin metallic film, has been successfully applied to the design of microwave horn antenna for improved performance.

II. Literature Survey

Mahapatra, et.al. (2021), In this research work presented, researcher have presented an octagonal patch antenna fed by a microstrip line at an inset from the edge. The length of the inset was determined through parametric optimization to yield better matching point. The size of the overall antenna structure is kept small, i.e., 2.2 cm x 2.2 cm x 1.6 mm. The antenna was found to resonate in two bands, 4.45 – 4.70 GHz with a resonant frequency of 4.58 GHz and 7.99-8.42 GHz with a resonant frequency of 8.19 GHz. Various antenna parameters like bandwidth, peak gain, peak directivity, and radiation efficiency were determined for antenna in free space, antenna placed on the phantom, and antenna at 5 mm away from the phantom. The average SAR evaluated around 4.6 GHz was found to be around 0.8 W/kg when antenna is placed on the phantom and 0.0081 W/kg when antenna is placed 5mm away from the phantom. The average SAR around 8.2 GHz was found was found to be around 0.9 W/kg when antenna is placed on the phantom and 0.5 W/kg when antenna is placed 5mm away from the phantom. The SAR values were found to be below the cut-off value of 1.6 W/kg. The use of full ground plane served the purpose of reducing the effect of proximity of antenna with the human body by limiting the back-lobe radiations and limiting the detuning effect posed by the human tissue. On the basis of the observations, the antenna was found to be a suitable candidate for wireless body area network applications [1]

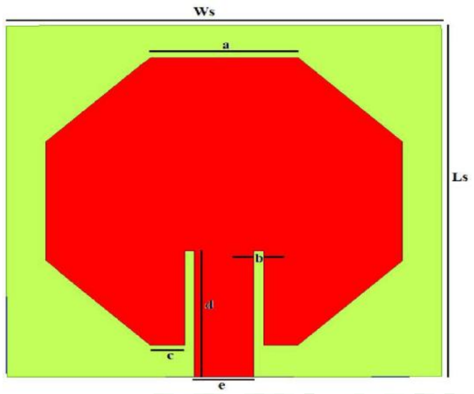

Fig. 1: Structure of the proposed inset-fed octagonal antenna

Sharma, N., et.al. (2020), In this research work presented, octagonal shaped monopole antenna exhibits dual band notch characteristics at Wi-MAX and WLAN frequency bands in UWB pass band. The partial ground plane has been employed in the geometry of proposed antenna to improve the VSWR bandwidth over the entire range of UWB (3.1–10.6 GHz). The octagonal radiating patch with 50Ω transmission line and partial ground plane exhibits the VSWR bandwidth of 9.06 GHz (121.28%) with a frequency range of 2.94–12.0 GHz. After employing the C-shaped slot and CSRR, the proposed antenna depicts dual band rejection characteristics at Wi-MAX (3.5 GHz) and upper WLAN (5.8 GHz). The dimensions of the incised notch filters such as C-shaped slot and CSRR) have been varied to achieve the optimal band notch characteristics centered at frequencies 3.5 and 5.8 GHz. Designed antenna is compact and also skilled to suppress the interference of Wi-MAX and upper WLAN from the UWB passband. The results of simulated and fabricated antenna are juxtaposed and found in reasonable agreement with each other [2].

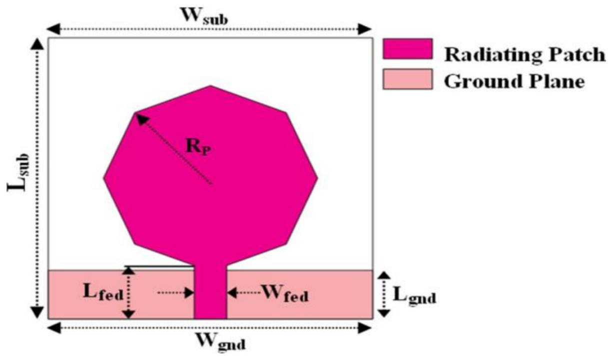

Fig. 2. Shows the geometry of presented antenna

Lopez-Marcos, et.al. (2020, November), In this research work presented, a transparent ITO antenna was presented. The application of a Minkowsky like fractal structure decreases lightly the resonance frequency and improves marginally the reflection coefficient in the desire operation bandwidth. The bandwidth of the antenna is between 3 and 6 GHz, with a peak value in the S11reflection coefficient of -26 dB. The bandwidth of the antenna is longer than the expected and covers all the frequency range for the C-band. The antenna gets a reduction in dimensions in comparison with other transparent antennas without a significative change in the gain. The radiation patterns were measured to show an omnidirectional behavior for the antenna [3].

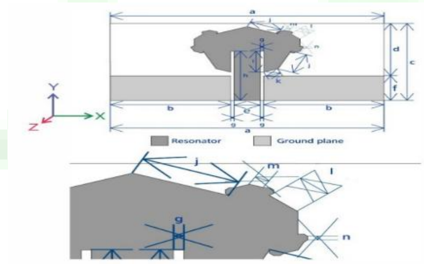

Fig. 3 Presented antenna design

Sanyal, R., et.al. (2019). In this research work presented, a Novel UWB planer monopole antenna with six highly selective notched bands is presented in this work. The basic monopole structure consists of an octagonal nut shaped radiating patch, feed line and a ground plane which exhibit the impedance bandwidth of 3.1–12 GHz. Furthermore, six different half wavelength or quarter wavelength resonators have been integrated to the monopole structure in the form of stub, slot or slot pair and conductor backed plane to realize six stop bands at 3.5, 5.2, 5.7, 7.5, 8.1 and 9.5 GHz. The notches have been tuned to diminish the potential interference from WiMAX, upper WLAN, lower WLAN, X band satellite down- link, ITU 8 GHz band and navigation radio band respectively. It is found that controllability of quality factor and roll-off characteristics of rejection band are successfully achieved by proper meandering of resonators [4]

Fig. 4 Fabricated prototype of the band notched UWB antenna.

Elhabbash, et.al (2019, March), In this research work presented, a dual band 5G octagonal base station antenna is proposed here. The antenna covers eight sectors and operates at the frequencies 28 GHz and 38 GHz. The sub-array consists of four elements of micrsotrip slotted patch antennas and it achieves good impedance matching and maximum realized gain of 12.6 dBi at 28 GHz and 13 dBi at 38 GHz. The proposed base station can switch between vertical and horizontal polarizations. Moreover, it has the capability of fixed beam switching by using three different configurations to tilt the beam with angles -100, 00 and +100 at both frequencies of operation 28 GHz and 38 GHz. The simulated results of the mutual coupling are all below -20 dB for any pair of sub-arrays. The performance of the proposed base station antenna in terms of achieved bandwidth, return loss and realized gain in addition to its features such as polarization switching, MIMO configuration and fixed beam switching makes it an excellent candidate for future 5G communication systems [5].

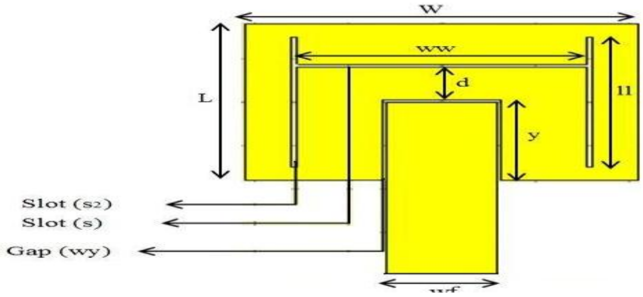

Fig. 5. Single element patch antenna (top view).

Shi, Y., & Liu, J. (2018), In this research work presented, a CP octagon-star-shaped microstrip patch antenna with conical radiation pattern has been proposed. The proposed antenna has a single feed, a low profile, and a very simple structure without any additional feeding network. The omnidirectional CP radiation is obtained by generating two orthogonal degenerated TM11 modes using an octagon-star-shaped patch radiator. The working mechanism is explained with an approximate cavity model analysis. An antenna prototype has been fabricated and measured to validate the simulation and theory. The antenna prototype can provide a conical CP radiation pattern with the peaks located in θ = ±45°, and a 3-dB AR bandwidth covering the GPS L1 band [6].

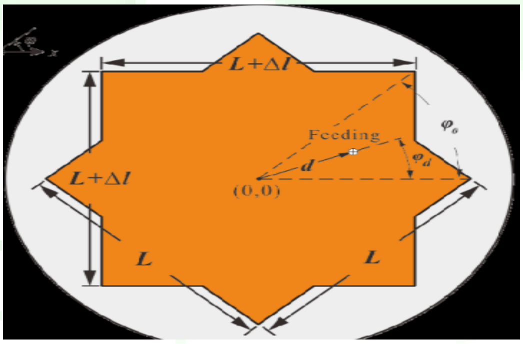

Fig. 6 Configuration of the antenna.

TABLE I Comparison Table of different shape antenna

S. No	Year/Ref	Proposed geometry	Frequency Range(GHz)	Return loss s-11	Bandwidth	No. of Band	Size
1	2021/[1]	flexible antennas,	4-6	4.2GHz= -38db	2GHz	1	22mm x 22mm x 1.6mm
2	2020/[2]	UWB antenna	2-6	6GHz = -34db	4GHz	1	30 mm × 30 mm
3	2020/[3]	transparent planar antenna	3-6	4GHz = -28db	3GHz	1	-
4	2019[4]	UWB antennas	3-15	7.5GHz = -41	12GHz	2	34.6 22 1.6 mm3.
5	2019/[5]	MIMO Antenna	26-28	28GHz = -20db	2GHz	2	16 cm x 12.2 cm)
6	2018/[6]	Circularly-polarized antenna	1.56-1.59	1.56GHz= -11db	3GHz	2	3 mm to 5 mm

7	2018/[7]	Ultra Wide Band antennas (UWB)	5-11	5.5GHz = -28db	7GHz	3	2 x 2 mm^2
8	2017/[8]	meta-material based antenna	2.4-2.5	2.3GHz = -13db	100MHz	1	20x20x1.6mm^3
9	2017/[9]	CPW Fed Wearable Antenna	2.2-2.3	2.1GHz = -15db	100MHz	1	33x35x1.6mm^3.
10	2016/[10]	microstrip patch antenna	1.5-2.5	2GHz = -20db	1GHz	1	-

III. Simulation Results

In this section discussion simulation and result of the proposed survey based research of different shape. The presented work on different shapes of antenna.

Result Parameters

There are different parameters of antenna which are used to analyze efficiency of proposed antenna. The antenna parameters are:

A. Return Loss

It is the power loss in signal. That is reflected due to discontinuity in transmission line. When impedance matching between transmitter and receiver is not perfect. As a result return loss is criteria similar to VSWR. That indicates perfect impedance matching between transmitter and receiver. The return loss is formulated as Where Pi =Incident power

Pr= Reflected power

$$\text{Returen Loss}(S11) = -20\log_{10}\left(\frac{P_i}{P_r}\right) \quad [1]$$

B. Voltage Standing Wave Ratio (VSWR)

The parameter VSWR is a measure that numerically describes how well the antenna is impedance matched to the radio or transmission line it is connected to. VSWR stands for Voltage Standing Wave Ratio, and is also referred to as standing wave ratio (SWR).

$$\text{VSWR}= (1+ Ѓ) / (1- Ѓ) \quad [2]$$

Where

Ѓ =Reflection coefficient Ideally,

VSWR =1 is perfectly matched, that is no power is reflected back.

V.CONCLUSION

In this paper, we have presented an overview of various methods that have been proposed in the literature for MPA miniaturisation. The theory of ESAs was discussed briefly, highlighting the fundamental limits on their Q as well as the trade off between antenna size, bandwidth and gain. The methods used in the literature for MPA miniaturisation included the use of modified and unconventional substrates; shorting and folding of the antenna; changing the shape of antenna; introducing slots in the ground plane; and the use of the MTMs. Some methods provided greater miniaturisation, whereas others only achieved a moderate level of miniaturisation in an attempt to keep a balance between decrease in bandwidth and loss of efficiency, while reducing the size. Moreover, some of these designs were easy to fabricate while others used complex geometries and materials that are low-cost.

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