Review paper on MPA for Wireless Communication Systems

Omprakash Meena, Prof. Prateek Wankhade

***Abstract*— MPA is very useful in communication systems. Due to its properties such as compactness, light weight, high bandwidth, it becomes a good candidate of communication system. This paper reviews the performance of a compact microstrip fed patch antenna with enhanced bandwidth and harmonic suppression (2016) [1], omnidirectional wideband E shape cylindrical patch antenna (2016) [2], design of wideband E shape patch antennas with transmission line mode theory (2016) [3], patch size reduction of rectangular microstrip antennas by means of a cuboid ridge (2015) [4] and RMPA for S and X Band Applications (2016) [5]. The paper also discusses the technology used in order to bring the required changes in terms of improved performance characteristics.**

***Index Terms*— WLAN (Wireless local area network), Microstrip patch antenna (MPA), Monopole antenna, Dual band antenna, harmonic suppression, cylindrically conformal antenna array, omnidirectional antennas, wide-band antennas, wideband, wireless, car to car communication (C2C), E shape patch antenna (ESPA), Rectangular microstrip patch antenna (RMPA).**

I. INTRODUCTION

The MPAs become very useful for wireless communication, spacecraft and aircraft purpose etc. Now they are applicable in almost every communication systems such as radar systems, missile technology, mobile communication, GPS service for land vehicles, maritime vessels to find out their exact position etc. The reason is being its advantages such as compactness, light weighted, low profile, simple and inexpensive, planner structure, compatible with monolithic microwave integrated circuit designs, stable when mounted on rigid body. The motive of this paper is to study some papers on MPA and to analyse the performance parameters based on the comparison found in terms of bandwidth and return loss values. Extensive research work is being carried out in the field of MPA. Our focus is to develop RMPA designs. The following review focused on the comparative study of five different research works; in a recent study Jin-dong zhang et al. proposed a single layer microstrip line fed patch antenna that could be used for bandwidth improvement and harmonic suppression in [1]. λ/4 microstrip line resonators were introduced nearby rectangular patch. Wideband properties were obtained using resonator implementation. The designed antenna shows size reduction, light weight since it was designed using electrically thin and light substrate. Also on reviewing paper λ/4 resonator and capacitive feeding was found a good candidate for harmonic suppression. The designed antenna resonated at 4.9 GHz. The antenna was operating in the range of 4.69 to 5.10 GHz and return loss and bandwidth was obtained -25 dB and 8.4% respectively. The measured bandwidth was 2.7 times wider than that of the traditional insert-fed patch.

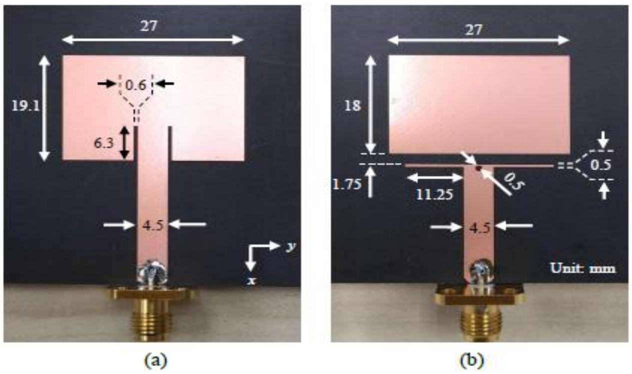

Fig.1. Fabricated antenna (a) Traditional design (b) Proposed design [1]

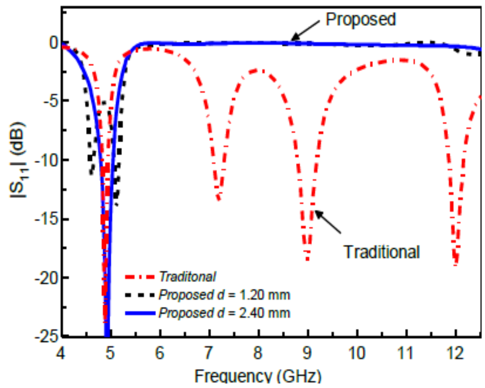

Fig.2. Return loss vs frequency plot of traditional and proposed antenna design [1]

In [2] alexander ye. svezhentsev et al. designed a wide-band omnidirectional cylindrical MPA with two new E shapes. The geometry was designed on a low permittivity flexible textile substrate. Both antennas (Fig.3 and Fig.5) had shown Omni directionality in the horizontal plane, wide-band behavior (for the first antenna) and low side-lobe levels (for the second antenna). The antenna was designed to have 33% and 21% bandwidth, and 2.98 dBi and 4.56 dBi gains, respectively. The return loss values obtained from antenna 1 -25.15 dB (in Fig.4) and for the antenna 2 was -19 dB (in

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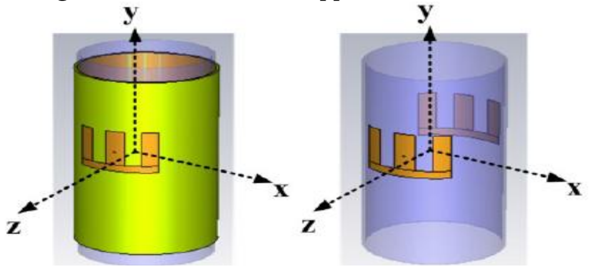
Fig.6). This paper concludes that textile substrate is very promising to be used in WBAN applications.



(a) (b)

Fig.3. (a) Antenna 1 (b) Antenna 2

Side view of double E shape cylindrical patch antenna [2]

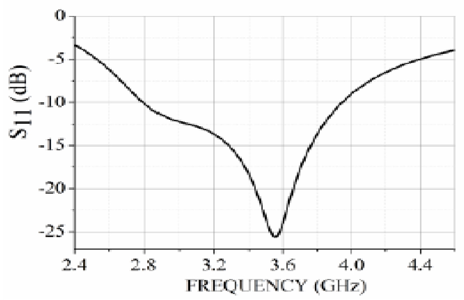
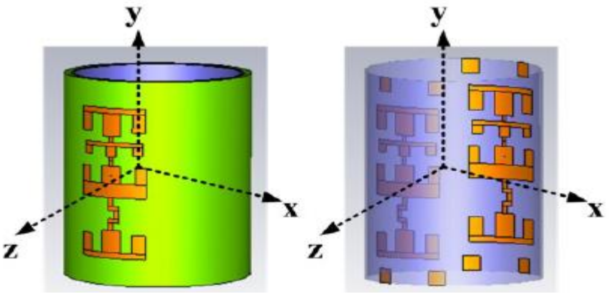


Fig.4. Return loss v/s Frequency plot of double E shape cylindrical patch antenna [2]



(a) (b)

Fig.5. (a) Antenna 1 (b) Antenna 2

Side front view of double E shape quadruple patch antenna [2]

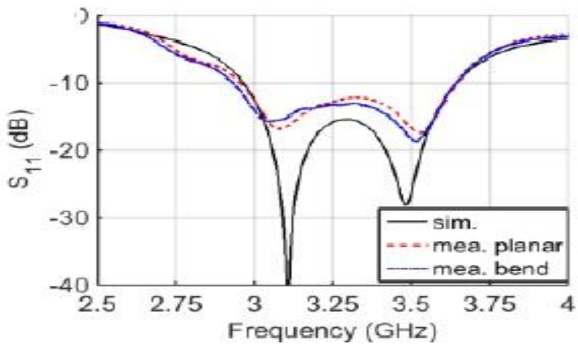


Fig.6. Return loss characteristics of double E shape quadruple patch antenna [2]

Keisuke Noguchi et al. proposed a new model of ESPA using the mode theory in [3]. Paper described that transmission line and radiation modes were generated on E shape patch antenna and an equivalent circuit was derived, it helped in obtaining wideband and multi-band characteristics. Maximum bandwidth was derived for the ESPA. The simulated and measured return loss value was around -25 dB and -22.5 dB. The bandwidth for the wideband design was evaluated 27.7%.

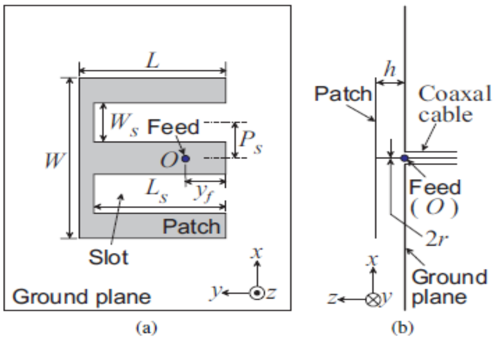


Fig.7. Geometry of E shape patch antenna [3]

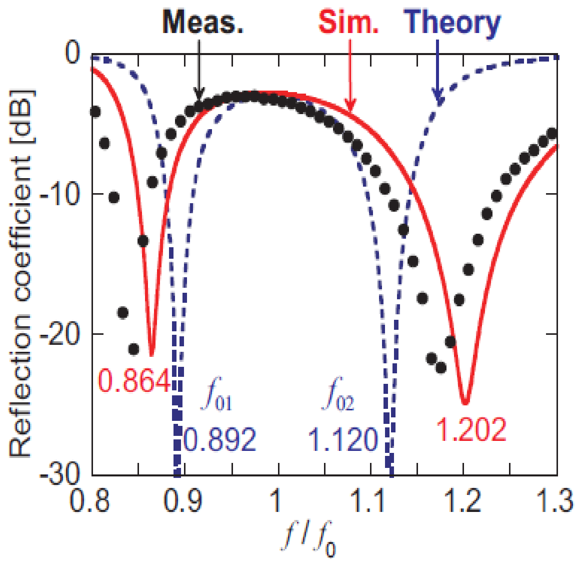


Fig.8. Return loss vs frequency plot [3]

In [4] Alireza motevasselian and william G. whittow presented an approach for the reduction in patch size by loading patch using a cuboid ridge. The cuboid ridge dimensions were 29x7x1.6 mm (in fig.7). The fabricated antenna was found to be resonated at 2.35 GHz. Cuboid ridge was inserted as the part of the transmission line of the patch antenna. The results were generated using CST studio simulation tool. The simulated and measured return loss value was found to be around -15 dB and -21.5 dB respectively. The designed geometry was fed by 50 Ω characteristics coaxial line.

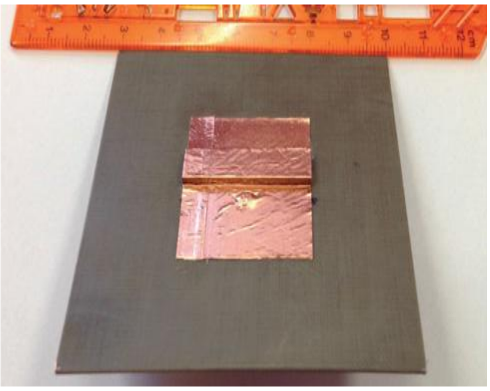


Fig.9. Fabricated antenna design [4]

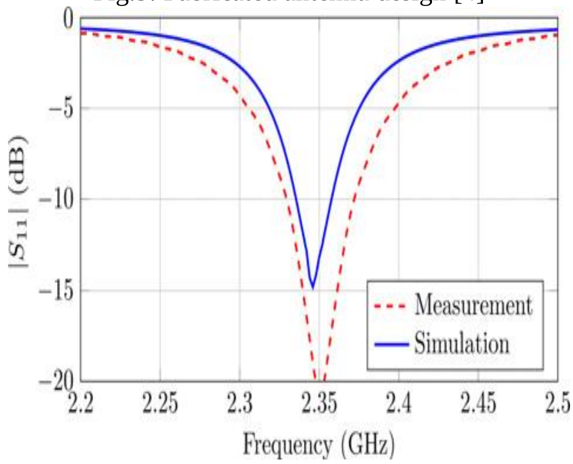


Fig.10. Return loss vs frequency plot [4]

Amandeep kaur sidhu and jagtar Singh Sivia proposed an RMPA with circular slot for S band and X band communication in [5]. RT Duroid material was used as design substrate with $\varepsilon_r = 2.2$. Probe feeding was used for excitation of patch. This paper is based Miniaturisation of antenna structures. Designed geometry size shows 48% size reduction by conventional antenna. The maximum return loss was obtained in the second iteration as -16.20 dB (in fig.12). The gain of the antenna was calculated 8.32 dBi. Proposed antenna was simulated HFSS.

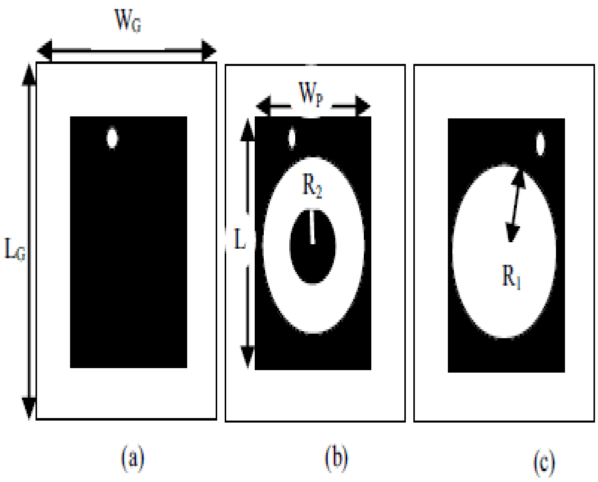


Fig.11. Designed RMPA (a) 0th iteration RMPA (b) 1st iteration RMPA (c) 2nd iteration RMPA [5]

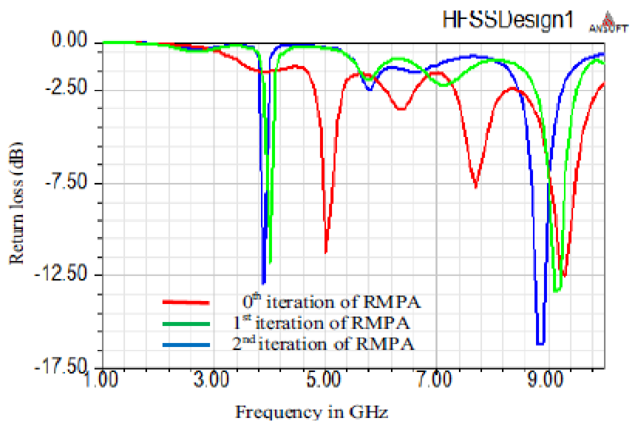


Fig.12. Return loss vs frequency plot of designed RMPA [5]

Table.I. Literature review

Antenna parameters	[1]	[2]	[3]	[4]	[5]
Year	2016	2016	2016	2016	2016
Author	Jin-Dong Zhang et al.	Alexander Ye. Svezhentsev et al.	Keisuke Noguchi et al.	Alireza Moevasselian et al.	Amandeep Kaur Sidhu et al.
Publication	IEEE Transactions on Antennas and Propogation	IEEE Transactions on Antennas and Propogation	IEEE Transactions on Antennas and Propogation	IET Microwaves, Antennas & Propogation	IEEE WISPNET Conference
Software	AnsoftHFSS	CST Microwave Studio	AnsoftHFSS	CST Microwave Studio	AnsoftHFSS
Feeding method	Resonator and Capacitive feeding	Probe feed	Probe feed	Coaxial line feed	Coaxial line feed
Maximum return loss	-25 dB	Ant 1: -25.1 dB Ant 2: -19 dB	-25 dB	-21.5 dB	-16.20 dB
Usable fre-quency	4.69 to 5.10 GHz	2.5 to 4 GHz	0.8 to 2.40 GHz	2.2 to 2.5 GHz	1 to 10 GHz
Band-width	8.4 %	Ant 1: 33 % Ant 2: 21 %	27.7 %	-	-
VSWR	Less than 2	Less than 2	Less than 2	Less than 2	Less than 2

II. Conclusion

Review provides better knowledge of evaluating the performance characteristics of MPA. The bandwidth can be improved by slot implementation on to patch. This review also gives the effects of two feeding techniques in terms of return loss and other parameters. It was also inferred that by introducing slot of different shapes (E-shape, half U-shape and V-shape), we can avoid interference near their corresponding band notch frequencies. Resonator and capacitive feeding is was found to a good approach for harmonic suppression. Single band characteristics can be converted into multiband characteristics slot implementation onto the patch. Return loss and bandwidth characteristics can be improved using slot implementation. This review paper also gives an insight in deriving the filter characteristics.

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