A SMALL – FED MONOPOLE ANTENNAS FOR MULTIPLE WIRELESS APPLICATIONS

Amaresh Singh[1], Dr. Srivatsun G[2].

Abstract **—In this paper a Coplanar Waveguide (CPW) fed Monopole antenna is presented. The proposed antenna operate in 2 different frequency band which makes it suitable for different types of wireless applications such as GSM, Bluetooth, WLAN etc. This antenna satisfies the licensed frequency band (2.4 to 2.45 GHz) having return loss lower than -10dB. This antenna is designed on a substrate with dielectric constant ∈ r = 4.4. With a size 22mmx20mmx1.8mm the antenna operates for WLAN applications. Performance evaluation of the proposed antenna design has been carried out using Advanced Design System (ADS) tool. Simulation result shows that the antenna exhibits an interesting dual frequency resonant behavior making it suitable for dual band communications system including the dual band WLAN applications.**

Index term—**Coplanar Waveguide (CPW), GSM, WLAN,Return loss, Dual-band Antenna, Monopole.**

I. INTRODUCTION

Recently there has been increasing demand of microwave and mobile communication systems, with multiple applications gaining attention to improve the performance of the antenna. Most of the wireless communication systems need a circular polarized antenna to establish a communication link between a base station and mobile device.Among the well-known multiband antenna prototypes, the planar and coplanar monopole antennas of various configurations have become popular because they provide attractive antenna characteristics, namely: low profile, light weight, low cost, versatile configuration for exciting dual or multiresonance modes, and exhibiting wide impedance bandwidth with desirable radiation characteristics. However, the difficulty in designing such antennas is challenging when the size of the antenna needs to be reduced and the number of operating frequency band increased [1].

Usually, multiband antenna design involves many geometry or material parameters. These parameters may be discrete, and often include constrains in allowable values. Optimizing such antennas to closely approximate desired multiresonant performance is similar to searching the global solution from a multidimensional solution space. The particle Swarm Optimization (PSO), based on the simulation of a simplified sociological behavior associated with swarm such as bees, bird flocking, and fish schooling, is a new optimization algorithm first proposed by Kennedy and Eberhart in 1995 for solving multidimensional discontinuous problems. This technique is simpler than the Genetic Algorithm (GA) and has been successfully applied to a variety of fields. Especially, the PSO, used in conjunction with the numerical electromagnetic solver, is found to be a revolutionary new approach to antenna design and optimization [2]. Typically, dual-frequency operations have been obtained by multilayer stacked patches and little attention has been paid to single-layer microstrip antennas. The demand for directional antennas with high gain and wideband radiation characteristics for different wireless applications has increased in the last decade [3] – [4].

A cavity-model based simulation tool, along with a genetic optimization algorithm, was presented in [5] for the design of dual-band microstrip antennas. This used multiple slots in the patch, or multiple shorting strips between the patch and the ground plane.In addition, the use of high dielectric constants of the substrate on the chip antenna always results in difficulty to achieve good antenna gain. Numerous monopole antennas have been proposed so far for size reduction, bandwidth enhancement, and resonance-mode realization. The optimization of the positions of the slots and shorting strips was then performed via a genetic optimization algorithm to achieve acceptable antenna operation over the desired frequency bands [4].

II. RELATED WORK

A compact printed monopole antenna for WLAN/WiMAX applications is proposed. Because of the outstanding features of single metallic layer, broad bandwidth, smaller mutual coupling between adjacent lines and easier integration with system circuits, coplanar waveguide (CPW)-fed structure has been widely used and thus incorporated in the design of the proposed antenna. [5] – [6]. Typical micro-strip antennas have various advantages at the cost of insufficient band-width. Current research efforts on coplanar waveguide (CPW)-fed antennas provide more attractive advantages owing to the fact that CPW-fed antennas can provide a much broader bandwidth and allow

[1]P.G.Scholar/ECE/P.S.G.College of Technology, Coimbatore

[2] Assistant Professor/ECE, P.S.G.College of Technology, Coimbatore

ISSN: 2278 – 909X All Rights Reserved © 2014 IJARECE

easy integration with radio frequency integrated circuits (RFIC), suggesting the feasibility of multi-band operations. The volume of these antennas is relatively large for mobile handheld terminals. [7].

However, these monopole antennas require a relatively large ground-plane structure that can be of various configurations typically in the shape of a square, rectangle, circle, or ellipse. Defected ground structure (DGS) has also been investigated and found to reduce the antenna size as well as excite additional resonance modes [6]–[8]. These antennas possess a simple and clear radiation mechanism, and thus can be easily designed for multiple-band operations. In addition, they are compact in size and easy to fine-tune. A prototype of the antenna has been constructed and demonstrates satisfactory performance.

The antenna length has been analyzed using Particle Swarm Optimization (PSO) algorithm. Resembling the social behavior of a swarm of bees to search the location with the most flowers in afield, the optimization procedure of PSO is based on a population of particles that flying the solution space with velocity dynamically adjusted according to its own flying experience and the flying experience of the best among the swarm. During the process, each particle adjusts its velocity according to its own experience and the position of the best of all particles to move toward the best solution. The further the position of particle to that of particle with the highest fitness, the higher the velocity toward the global best position for the particle.Fig. 1 shows the flowchart of a PSO algorithm. During the PSO process, each potential solution is represented as a particle with a position vector and a moving velocity represented as x and v, respectively [2].

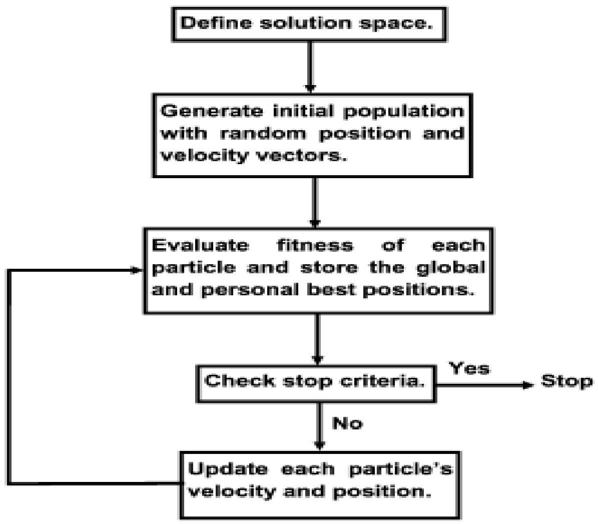

Fig.1 Flow chart of PSO Algorithm.

III. DESIGN SPECIFICATION

The design of the CPW monopole antenna is given in Fig. 2 and 3.

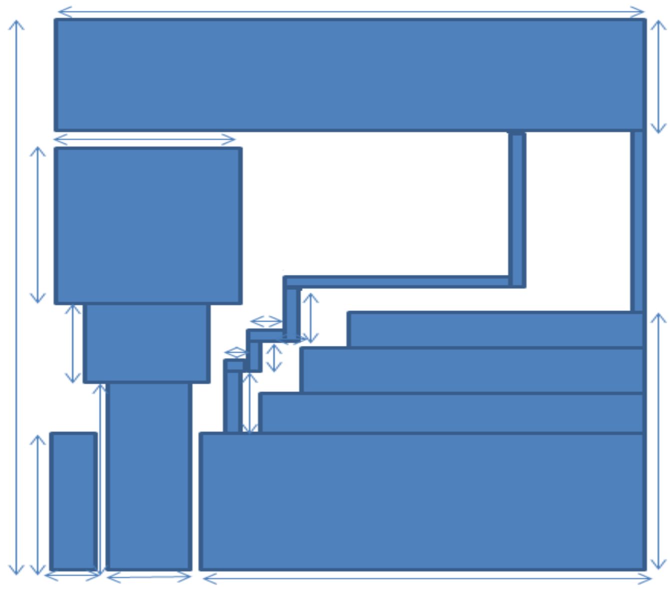

Fig.2 CPW-Fed Monopole Antenna

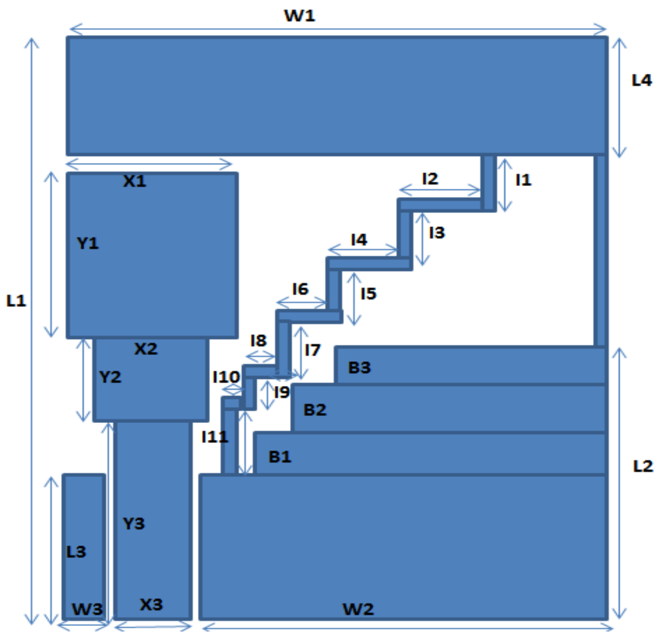

Fig.3 Design of the Proposed CPW –fed Monopole Antenna.

It consists of a CPW-fed monopole antenna with a strip structureinterconnecting the upper and lower ground sections that surround the antenna's radiating element to provide dual-frequency operation. The antenna design was etched on the same side of the printed circuit board (PCB) with a dielectric constant of 4.4and substrate thickness of 1.8 mm.

ISSN: 2278 – 909X All Rights Reserved © 2014 IJARECE

The dimensions of the substrate are 22x20 mm^2. The parameters of the proposed antenna, shown in Table I, were optimized using commercially available software (ADS) from Agilent.The width of the strip, as defined in Fig. 1, interconnecting the upper and lower ground sections is 0.5 mm.

Table 1: Parameters of the proposed CPW – fed Monopole Antenna.

Parameter	Size in mm	Parameter	Size in mm
L1	24.0	B2	1.4
L2	8.0	B3	1.2
L3	4.50	I1	2.2
L4	4.30	I2	1.85
W1	18.0	I3	1.95
W2	12.50	I4	1.7
W3	1.50	I5	1.8
X1	6.0	I6	1.55
X2	3.70	I7	1.65
X3	2.60	I8	1.50
Y1	6.80	I9	1.50
Y2	2.45	I10	0.5
Y3	6.10	I11	2.70
B1	1.7	Strip width	0.5

IV. RESULT AND DICUSSION

The return loss of the proposed antenna and given antenna has been analyzed. Fig. 4, 5 and 6 shows the return loss for the CPW-fed monopole antenna. In fig 4 two dual frequency band are achieved and in fig. 5 the two frequencies band one at 2.4 GHz and another one at 5.5 GHz which are used for different types of wireless applications.

At 2.4 GHz it is useful for GSM and bluetooth and at 5.5 GHz it is useful for WLAN applications. Fig 6 present when the strip length of the antenna has been changed from 0.5 to 0.75 which also cover two frequencies bands which also make it useful for different type of wireless applications.Asshownin the fig. 6, the strip width affects the bandwidth and the magnitude of the resonance of the dual-mode antenna. The strip width of 0.5 mm provides an optimum solution. As can be observed, the parameter severely affects the first mode in terms of its reflection-coefficient magnitude and center frequency. At 2.4 GHz, the surface currents are strong in the feed line, the middle section of the step-shaped ground plane, and the step-shaped ground strip.

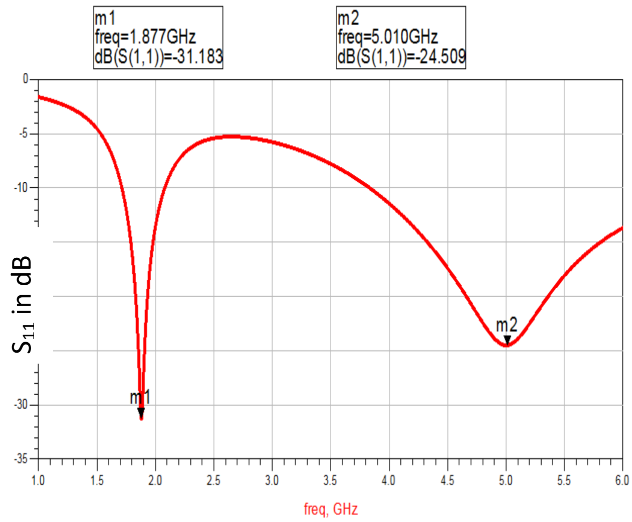

Fig. 4 Return loss of the CPWmonopole antenna.

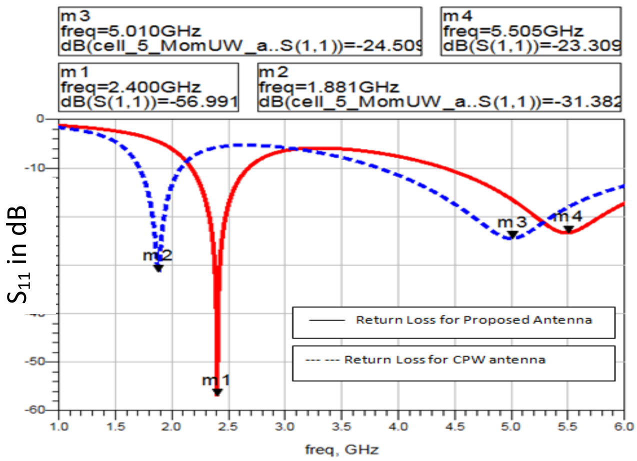

Fig. 5 Return loss of the proposed CPWmonopole antenna.

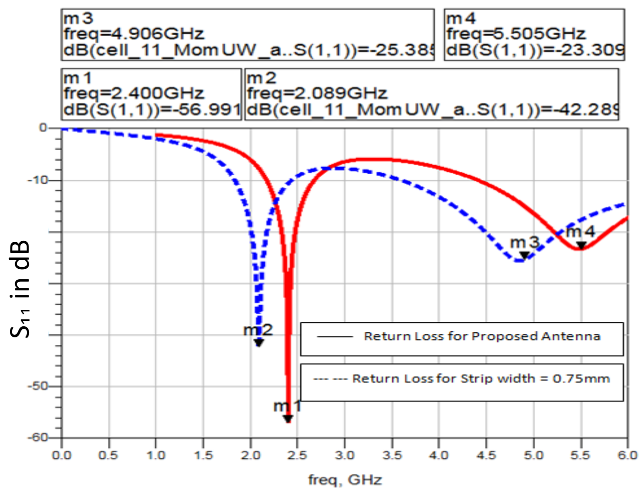

Fig. 6 Return loss for Strip width 0.5 and 0.75.

ISSN: 2278 – 909X All Rights Reserved © 2014 IJARECE

International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 3, Issue 5, May 2014

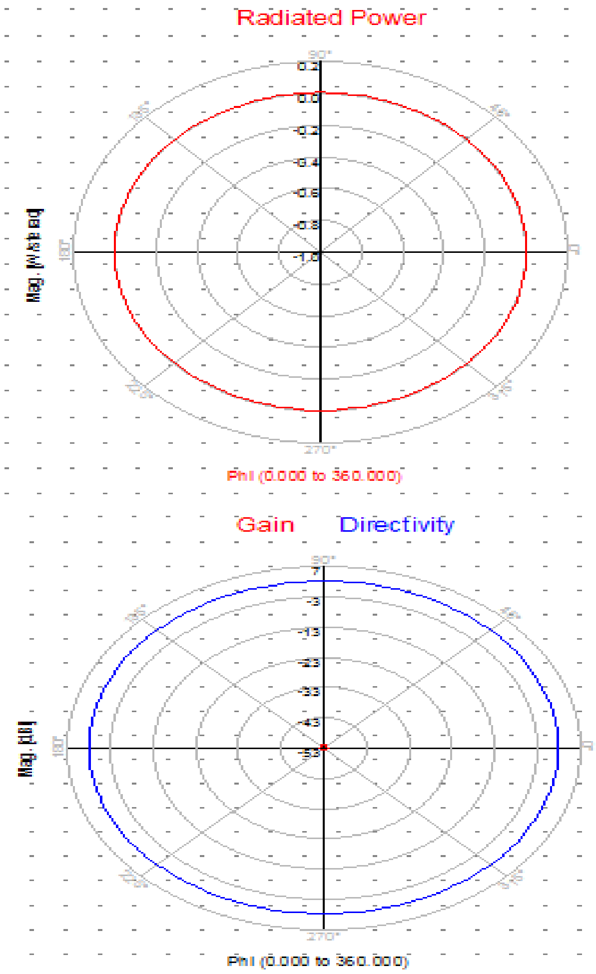

Fig.7 Radiated power and gain of CPW antenna.

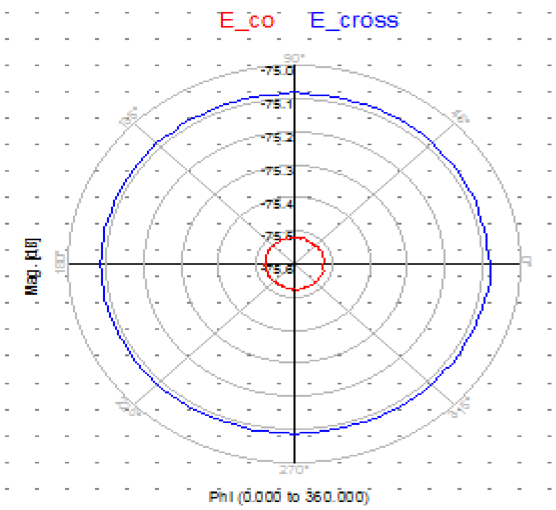

Fig.8 Circular Polarization of CPW antenna.

Fig. 7, 8 and 9 present radiation pattern and polarization of the CPW antenna. The radiation characteristic of the antenna is stable within the operating bands, and the cross-polarization radiation patterns are relatively small.

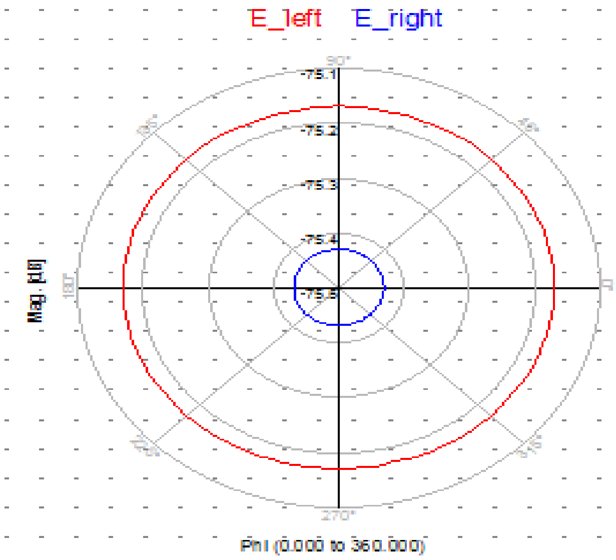

Fig.9 Linear Polarization of CPW antenna.

Radiation patterns for total field in the xz-plane at the center frequencies of all the bands shows fairly good Omni-directional characteristics. The average gain is 2.5dBi.fig 7 illustrates the computed and measured antenna gain in the broadside direction against the operating frequency (note that this is not necessarily the direction of maximum gain, although the main lobe does not deviate far from this direction).Due to the symmetry in structure, rather symmetrical radiation patterns are seen in the – and – planes as depictedin the plots. In addition, very monopole-like radiation patternsIt indicates that the gain linearly increases with the operating frequency.

V. CONCLUSION

In this paper, a CPW-fed planar monopole antenna, which is small in size and covering different frequency, has been presented. The proposed antenna has several advantages such as small size, excellent radiation characteristics, and circular polarization in the WLAN operating band. The antenna exhibits two resonant modes with an excellent impedance performance. From the simulated return loss, it was clearly observed that the proposed antenna provide two desirable resonant frequencies and impedance bandwidths which are applicable for ISM band, GSM, and WLANs. The proposed antenna has a compact dimension and covers wideband frequencies with almost omini-directional pattern and acceptable gain at all resonant frequencies.

ISSN: 2278 – 909X All Rights Reserved © 2014 IJARECE

REFERENCES

[1] M. Naser-Moghadasi, R. Sadeghzadeh, L. Asadpor, and B. S. Virdee, "A Small Dual-Band CPW-Fed Monopole Antenna for GSM and WLAN Applications", IEEE Antennas and Wireless Propagation letters, Vol. 12, 2013

[2] W. C. Liu, "Design of a multiband CPW-fed monopole antenna using a particle swarm optimization approach," IEEE Trans. Antennas Propagation., Vol. 53, no. 10, pp. 3273–3279, Oct. 2005.

[3] Y. J. Han, "Fabrication and measurement of modified spiral-patch antenna for use as a triple-band (2.4 GHz/5 GHz) antenna,"Microw. Opt. Technol. Letters., Vol. 48, no. 7, pp. 1275–1279, 2006..

[4] J. Costantine, K. Y. Kabalan, A. El-Hajj, and M. Rammal, "New multi-band microstrip antenna design for wireless communications,"IEEE Trans. Antennas Propagation.Mag., Vol. 49, no.6, pp. 181–186, Dec. 2007.

[5] K. Seol, J. Jung, and J. Choi, "Multi-band monopole antenna with in-verted U-shaped parasitic plane,"Electron.Letters., Vol. 42, no. 15, pp. 844–845, 2006.

[6] W. S. Chen and Y. H. Yu, "Compact design of T-type monopole antenna with asymmetrical ground plane for WLAN/WiMAXapplications,"Microw. Opt. Technol. Letters., Vol. 50, no. 2, pp. 515–519, 2008.

[7] S.ChaimoolandK.L.Chung, "CPW-fed mirrored-L monopole antenna with distinct triple bands for WiFi and WiMAX applications," Electron. Letters.,Vol.45, no. 18, pp. 928–929, 2009.

[8] J. P. Thakur and J. S. Park,"An advance design approach for circular polarization of the microstrip antenna with unbalance DGS feedlines," IEEE Antennas Wireless Propagation. Letters. Vol. 5, pp. 101–103, 2006

[9] Advanced Design System 2011.10 help, www.agilent.com.

Authors Biographies

Amaresh Singh receive the B.E. (with Hons.) degree from the Hitkarini College of Engineering and Technology Jabalpur (M.P.) and M.E. degree from P.S.G. College of Engineering and Technology Coimbatore Tamilnadu.

Dr. G Srivatsun receive B.E. degree and M.E. degree in Wireless Technology from Bharathiar and Anna University. He completed his Ph. D. in Information and Communications from Anna University Coimbatore. He worked in P.S.G. College of Technology Coimbatore from last five years. He is a life member of ISTE and IEEE.

ISSN: 2278 – 909X All Rights Reserved © 2014 IJARECE