

DEVELOPMENT OF CPW FED DEFECTED MONOPOLE ANTENNA USING ATOMIC ORBITAL SEARCH ALGORITHM

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Abstract

Printed antennas have excited greatly awareness due to the dominance of vast bandwidth and relieve to combine with monolithic microwave integrated circuits. Coplanar waveguide is a class of planar transmission line arrangement, which ground and radiation patch is on the identical surface of standard plate. This article introduces a Co-planar waveguide (CPW) Patch Antenna with equilateral shaped structures possess ultra wideband features performed on FR4 Substrate. The Proposed antenna dimensions are 25mm ×35mm. A modern circumnavigate region approach is common to intensify not uniquely the impedance bandwidth moreover the gain of the antenna. The proposed antenna model balances two ultra wide bands which comprise 1.1–2.7GHz and 3.15–3.65GHz, thus awning 2.4GHz Bluetooth/Wi-Fi band and largest bands are 3G, 4G, and an imminent anticipated 5G band, that is, 3.4–3.6GHz. Materialize a slightly less profile antenna makes it very acceptable for modern 5G Internets of Things (IoT) viable approaches. The antenna is designed, simulated and optimized using the HFSS (High Frequency Structures Simulator) Software. The antenna resulting Return Loss, Input Impedance, Radiation pattern, Gain and VSWR are presented

Keywords: Coplanar Waveguide Feed Antenna, Ultra Wide Band, Internet of Things (IOT)

Introduction

Currently, Microstrip patch antennas (MPA) are generally installed in numerous techniques as it has numeral of advantages like similarity, a small amount, light weight, cheap and comfort to place on hard sides. Although, Printed Antenna is confined with small bandwidth and accordingly, the improvement of bandwidth is crucial for the large band gadgets. This task plans to evolve current application, which acquires a random unbiased representation to aid in calculating the mix positions of antenna limitations. For this, current upgraded optimization theory entitled as Atomic Orbital Search (AOS) is a new metaheuristic algorithm initiated for optimization points. The prime conceptualization of this algorithm is formed on few standards of quantum mechanics and the quantum-based atomic model in which the extensive arrangement of electrons throughout centre is in frame of reference.

In modern period, the widespread conception of atomic physics has been exploited as innovations for new metaheuristic algorithms. Atomic Orbital Search (AOS) algorithm for optimal representation points in which the microscopic movement copy in environment is in frame of reference while the interconnecting forces between atoms are esteemed as essential feature of the geometrical representation of this algorithm. The essential concepts of the electron density arrangement and the inclusion or emanation of potency by atoms which are esteemed in the quantum-place atomic postulate are exploited as the major scheme of the AOS optimization algorithm. This conception is turn to account for the earliest pattern in evolving a metaheuristic algorithm so the originality of this paper can be take into consideration from motivational mark of vision while the difficulty extent of the deployed experiment tasks is further feature that has been taken into consideration.

Application Potential

IOT applications integrate considerable developments of computer networking, microelectronics and modern communication system. This technology permits physical discern and operating tools to be dominated poorly over the internet. To achieve valid conveyance these gadgets are essential to be dense, cost productive and vitality structured to utilize on multiband for LTE, WLAN, WiMAX, ZigBee, and GSM. IOT working on these bands in the year 2003 where the world population was 6.3 billion and attached utensils per person were 0.0793%. In the year 2019 world population was increases to 7.2 billion and reorganized attached utensils respectively expand to 3.4%. This movement is anticipated to enlarge significantly so the insistence for mini gadgets across with greater antenna component will expand moreover. Because of design or construct in small size of implant systems, numerous components can be collected on these mini devices to better cost effectiveness, security and sturdiness for several plots of background examine, modern cities, modern health care, modern grid, military/defence etc… Aside from various ascendancy of capacity choice, elasticity, proficiency of attachment and renewal and there are many summons of configurability, immune, energy reap and reliability supply that require to be communicated for worldwide accuracy

The antenna structure existence the anterior termination of all little broadcasting gadgets is anticipated to protect all extensive frequency bands with tolerable gain and radiation patterns for diverse unified system. Additionally it is expected that latest antenna structure should be tensile adequate to synchronize impedance bandwidth for several interior frequencies separately. Contrarily non segregated Bluetooth implementation have also enhance distinct frequent in modern years. FCC declared the 3.1-10.6GHz for ultra wide band implementations. R&D attempts in the streaming decade have indicated that UWB technique has enchanted lots of regard for low speed transmission telecommunications. Since many advantages of the UWB such as exceedingly excessive, low power dissipation, less cost and effortless equipment organization. Both UWB characteristics and Bluetooth have to operate through a single antenna. They are having some approaches in which antenna employs in UWB & Bluetooth bands concurrently.

Antenna Design

. The proposed antenna dimension is just 25mm × 35mm. A modern circumnavigate region approach is accustomed to intensify not just the impedance bandwidth similarly the gain of the antenna. The proposed antenna design balances two ultra wide bands which comprise 1.1–2.7GHz and 3.15–3.65GHz, thus comprising 2.4GHz Bluetooth/Wi-Fi band and the largest bands of 3G, 4G, and a modern awaited 5G band, is, 3.4–3.6GHz. The antenna is manufactured on FR4 substrate with relative permittivity of 4.4 having a quality thickness of 1.6mm. The length, width, and the wavelength of the major equilateral patch is considered and slowly altered by considering the resonant frequencies. The strip lengths $L4$ and $L2$ are enhanced near to area wavelength of center frequency allowing $f$min around 2.1GHz and $f$max at 3.6GHz. The space in the length of the feed line is 18.7 mm and middle of ground & feed elements are 1mm, something very different to the extension of tiny circumnavigates region on the major antenna section is 1.4 mm. The exhaustive antenna pattern specification values are demonstrated in Table 1 below.

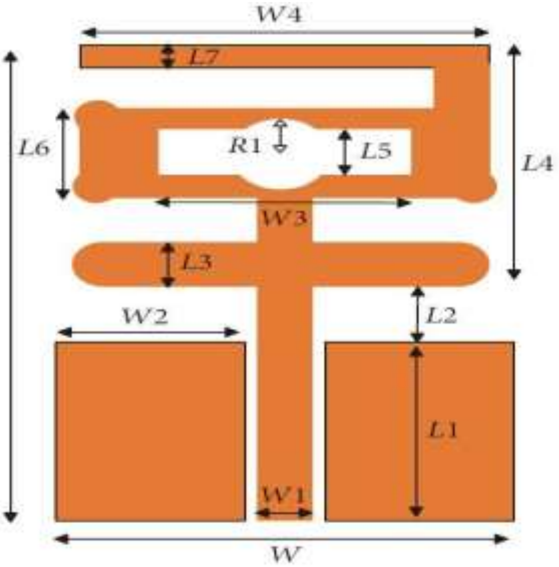


Figure 1: Structure of CPW Printed antenna

Parameter	L	W	L1	W1	L2	W2	L3	W3
Value/mm	35	25	14.8	2	3.7	10.5	2	13
Parameter	L4	W4	L5	L6	R1	L7	h	g
Value/mm	14.3	17	3	7	2.5	0.5	1.6	1

Table 1: CPW Printed Antenna pattern specification values

Simulation using HFSS

The above antenna design is simulated and studied using HFSS (High-Frequency Simulation Software) version 13.0 software as shown below in Fig.2

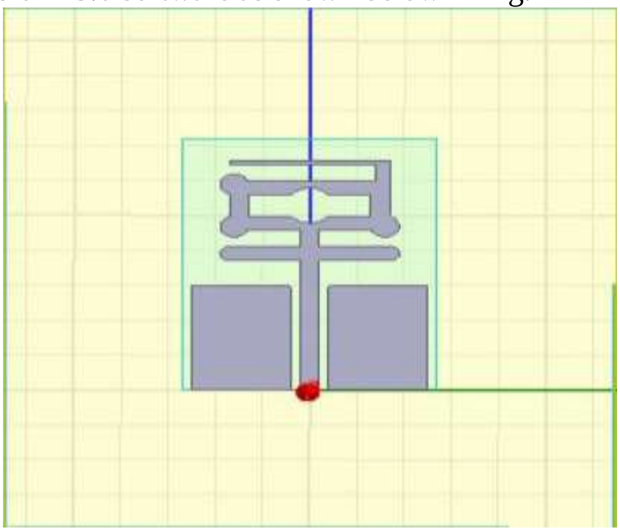


Figure 2: Top view on the antenna designed in HFSS

Simulation Results of CPW Antenna using HFSS

RETURN LOSS

The return loss obtained for the rectangular-shaped CPW antenna designed in HFSS corresponding to figure 2 is shown in figure 3. From this figure observed below, the return loss is -10.39 at 2.50 GHz and -14.79 at 3.30 GHZ range and between 2.27 GHz and 3.4 GHz, the return loss lies below -10dB.

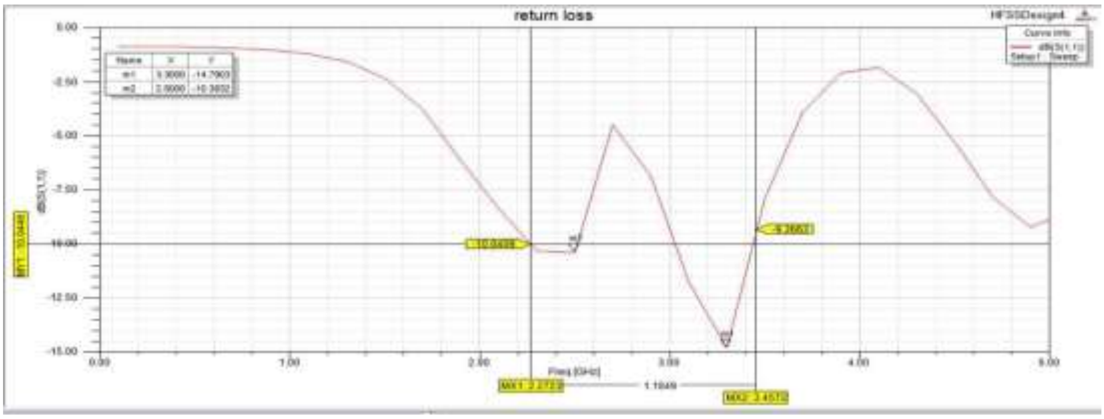


Figure 3: Return loss for CPW Printed Antenna

VSWR

The lowest VSWR which communicates to an ideal equal is integration. The VSWR of the CPW fed rectangular shaped printed antenna designed in HFSS corresponding to figure 2 is shown in figure 4. For reasonable approach, it must be in the middle of 1 and 2. It is observed that the VSWR at 3.3GHz is 1.44 and the VSWR at 2.5GHz is 1.86

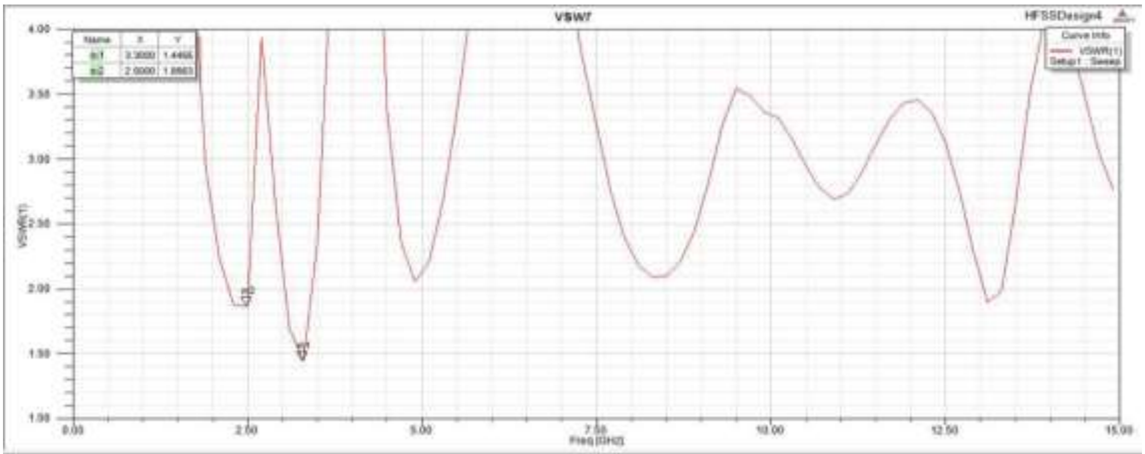
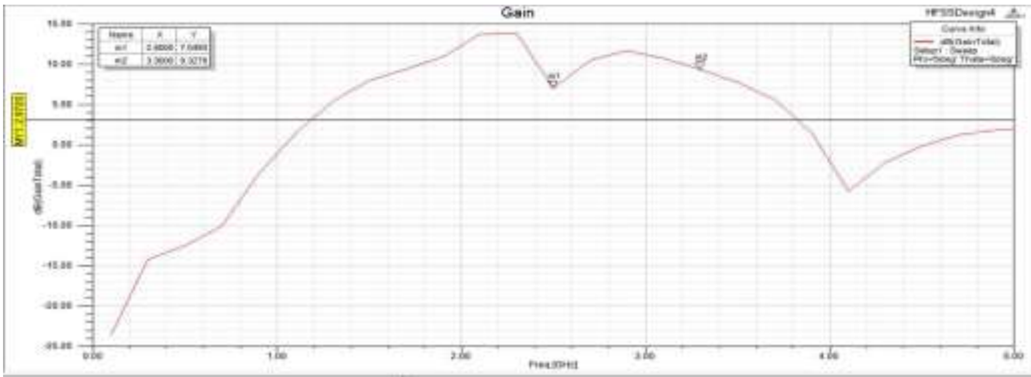


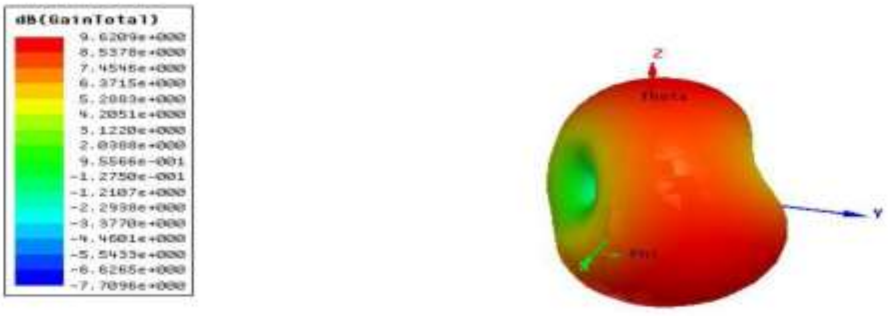
Figure 4: VSWR of CPW Printed Antenna

GAIN

Gain is naught even so the capacity transferred per quantity solidified point of view. The gain of CPW fed Rectangular microstrip patch antenna designed in HFSS corresponding to figure 2 is shown in figure 5. The gain of any antenna should more than 3dB for any applications. The gain observed for this antenna is 7.0 dB and 9.32dB respectively at the resonating frequencies of 2.5 GHz and 3.3 GHz.



(a) Graphical



(b) Polar

Figure 5: Gain for CPW Printed Antenna (a) graphical (b) polar

RADIATION PATTERN

A radiation pattern defines the variation of the capacity scattered by an antenna as a outcome of the supervision aside from the antenna. This capacity inequality as a outcome of the approach inclination is discerned in the antenna's far-field. The radiation pattern of dual-band CPW fed antenna designed in HFSS corresponding to figure 2 is shown in the figure 6.

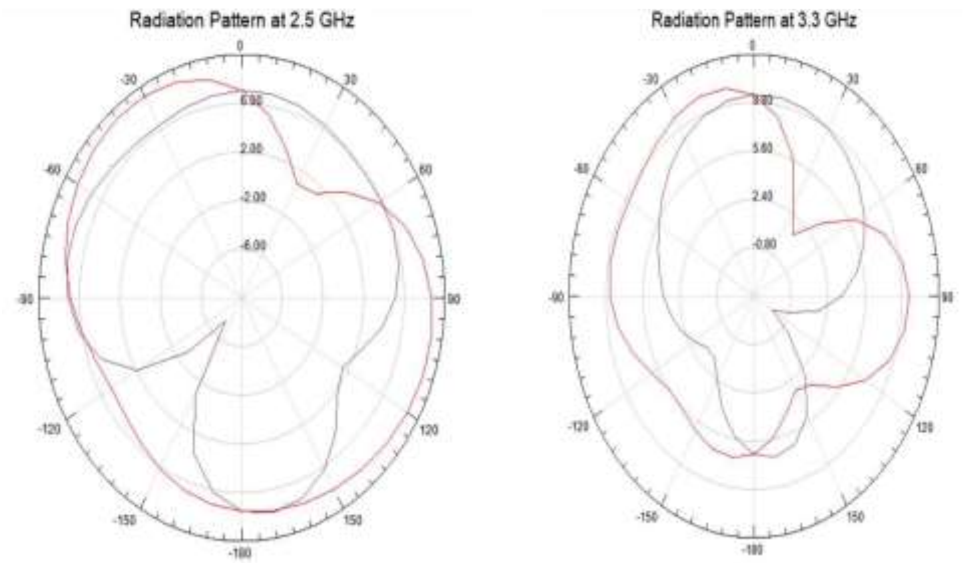


Figure 6: Radiation pattern of CPW antenna (a) at 2.5 GHz (b) at 3.3 GHz

Fabrication Model of CPW Antenna

The simulated results of the designed antenna in HFSS (High-frequency Simulation Software) and practically obtained results from the fabricated model like return loss, VSWR of novel rectangular-shaped CPW fed printed antenna with overlapped slots and circular edges are compared in graphical representation below.

Practical Results

RETURN LOSS

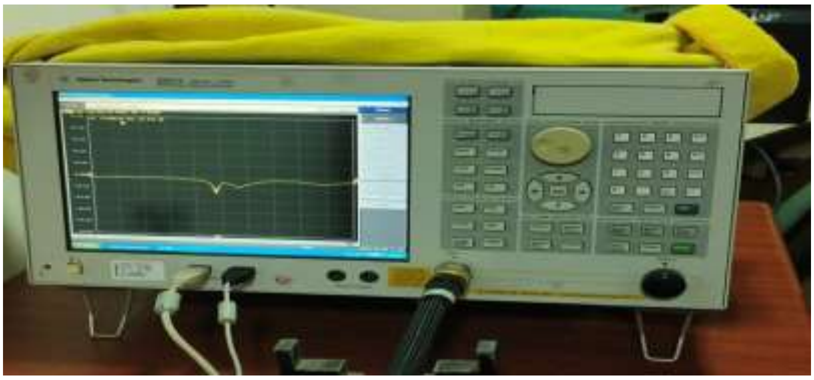


Figure 8: Return loss of fabricated CPW Antenna

VSWR

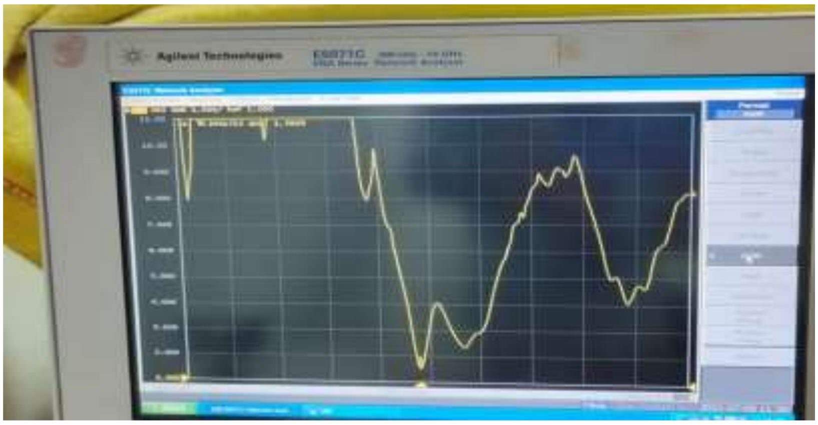


Figure 9: VSWR of fabricated CPW Antenna

Comparison Results

RETURN LOSS

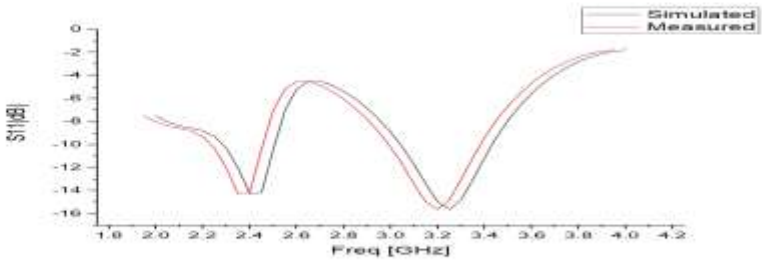


Figure 10: Comparison of Return loss

VSWR

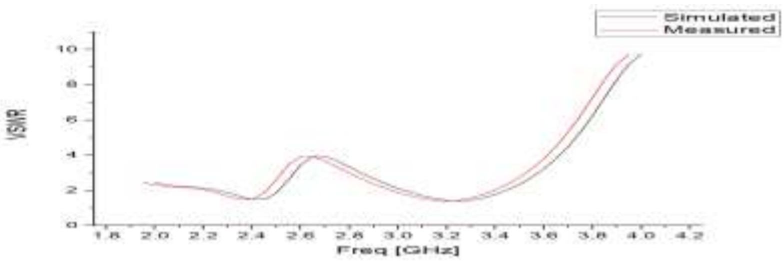


Figure 11: Comparison of VSWR

The practically results and comparison results of the designed CPW Printed Antenna is obtained through a network analyzer and check the parameters of Return loss and VSWR

Result Analysis

Ref	Antenna size	S11	VSWR	Gain
1	25*35*1.6mm3	-28.5dB	<2	2.44 dB
2	33.1*32.7 *0.254mm	-10dB	<2	4.87 dB
3	138mm * 40mm	-10dB	<2	4 dB
4	54mm * 38 mm	-22.5dB	<2	6 dB
5	24*28*1.6mm3	-18.3dB	<2	1.9 dB
Proposed Work	25mm * 35mm	-14.79dB	1.86	9.32 dB

The reference papers are related to CPW Antenna for IOT Applications and above result analysis, compared the size of an antenna, return loss, VSWR and Antenna Gain. Antenna gain is more in proposed work when compared to CPW Antennas which taken the reference.

Conclusion

In this Paper, dual band rectangular shaped Coplanar Waveguide Feed Antenna with convergent round slits and rounded slots are proposed and implemented. It produces standard 2.4GHz and 3.4GHz resonance bands. Rounded corners technique is used to attain ultra wide bandwidth of 1.1GHz–2.71GHz at first resonance band and 3.15–3.65GHz for second resonance band and to improve antenna gain. All bands can be separately adjusted by inequality of cover and extremity clear measurements. The CPW Fed Printed antenna exhibits radiation pattern, superior return loss, and greater gain with sustainable radiation efficiency. The proposed design is very less in size which makes it an appropriate entrant for different portable and handheld IOT applications.

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