International Journal for Research in Engineering Application & Management (IJREAM)
ISSN : 2454-9150 Vol-06, Issue-12, MAR 2021

An improved design of Elliptical dipole antenna for Wireless Communication Applications

Dr Krishna Samalla, Professor, Sreenidhi Institute of Science and Technology, Hyderabad

drkrishna.oume@gmail.com

Dr SPV Subbarao, Professor, Sreenidhi Institute of Science and Technology, Hyderabad

Dr T Ramaswamy, Associate Professor Sreenidhi Institute of Science and Technology, Hyderabad

Abstract: In present days, antenna design is one of the major technologies to deliver the signal in large covering area. The radiation pattern is one of the very important performance parameters in antenna design. Based on the antenna design size, all the performance parameters will be varied. So, size optimization also playing vital role in the designing of antenna. In this paper, Elliptical Dipole Antenna with Inset Feeding (EDA-IF) is introduced to evaluate the dipole antenna gain, directivity, radiation pattern, mean capacity, return loss, radiated power, voltage standing wave ratio (VSWR), power consumption and efficiency. IF is efficient feeding technology to improve all the performance parameters. Finally, all the performance parameters such as dipole antenna gain, directivity, radiation pattern, mean capacity, return loss, radiated power, voltage standing wave ratio (VSWR), power consumption and efficiency will be improved in EDA-IF method than conventional method

Keywords — Elliptical Dipole Antenna with Inset Feeding (EDA-IF), voltage standing wave ratio, MIMO, PLPDA, EBG

I. INTRODUCTION

Nowadays, wideband antennas have considered in remote correspondence and broadcasting framework. High data rate and numerous applications are utilizing radio frequency channel with high exactness and information rate. These are basically implemented in military and radar applications. The utilization of wideband antenna moves forward the pickup, transfer speed and the directional radiation patter. Modern radars, for example, air traffic control, air guard, climate mapping and galactic applications are planned with various thought and specification to meet the coveted flag and waveform [1]. As of now, the requirement for wideband and high gain antenna turns out to be exceptionally basic for current remote communication systems to accomplish rapid and high information rates with greater conceivable scope [2]. Consequently, antennas having wide transmission capacity, high pick up and stable radiation designs over the frequency band of interest are highly demanded. Moreover, those candidate antennas should exhibit compact size, low profile with ease of integration with other components on the same printed circuit board (PCB) [3]. Printed log-periodic dipole array (PLPDA) antennas are great possibility for remote communication applications on account of their immense transmission capacity with a decent gain over the whole frequency range, and straight forward geometrical design for simplicity of manufacture [4], [5].

Multiple input–multiple-output (MIMO) antennas are fundamental for these 4G remote systems, which can help high information rates of more than 100 Mbps. Lessening of receiving wire impression and decline in the connection among receiving wire components are two basic parts of such MIMO antenna frameworks [6]. Distinctive differences procedures, for example, spatial diversity qualities, edge diversity and polarization diversity qualities are utilized to support adaptive beam-forming and combat multipath blurring impacts [7] [8]. A few electromagnetic decoupling structures, for example, parasitic components, neutralizing lines and electromagnetic band gap (EBG) structures are used to lessen the connection among nearly dispersed antenna components. Acknowledgment of novel printed MIMO radio wire frameworks for the 4G remote benchmarks, which simultaneously ensure backward compatibility to 2G/3G antenna systems, has recently emerged as a topic of research [9]. Commonly, the essential antenna components for MIMO frameworks are mono poles and slots of different topologies and measurements. In, a printed wide opening receiving wire structure is presented for multi-band MIMO/differing quality applications which covers the ultra-wideband range alongside an extra lower frequency band [10], [11]. One author has introduced printed log periodic dipole antenna (PLPDA) with wide band substrate. This antenna is fed by substrate integrated waveguide (SIW). In this paper, gain of the entire antenna is increased due to the SIW fed. The PLPDA receiving wire has the antenna gain and the radiation design about indistinguishable to those of 2-component PLPDA receiving wire exhibit with just a large portion of the quantity of dipole components and the feeder lines. However, the enhancement of the apex angle between the feeder lines increase the design complexity. Also, the data transmission of the receiving wire is restricted by the apex angle [12].

 DOI : 10.35291/2454-9150.2021.0084

Another author has implemented low profile and wide band quasi – Yagi antenna for end fire radiation. The antenna comprises of one driven mono cone with two spaces cut on the stacked top cap, five indistinguishable grounded cones filling in as a move of reflectors and another two parasitic cones adjacent to the driver to suppress the side-flap level and enhance the front-to-back proportion. But it is very difficult to be compatible with modern planer communication systems [13]. Log periodic dipole array antenna also implemented using a line feed technique. This antenna has a few dipoles, which associated together by a few non-radiating transmission lines. Each of which is set at limited separation from each other. The measurement of the biggest dipole relies on the lowest frequency of operation. This LPDA antennas are very difficult to merge with planner circuits, and also not suitable for mass production, especially at millimeter-wave frequencies [14] [15]. To solve this problem, EDA-IF method is introduced to improves the performance, such as gain, radiation pattern, directivity, and etc. This inset feed is connected to dipole antenna, which is used to improve the antenna performance. With the help of inset feeding technology, we can minimize the loss of input signal. This paper also introduced, Elliptical patch to increase the radiation pattern and gain. Finally, dipole antenna gain, directivity, radiation pattern, mean capacity, return loss, radiated power, voltage standing wave ratio (VSWR), power consumption and efficiency will be improved in the EDA-IF method than conventional methods

II. Problem Definition

A. Network planning - Preceding obtaining the communications equipment, Wireless Internet Service Providers (WISP) should concentrate on the earth around the future system establishment. To calculate the power requirements using link budget is very difficult. Without knowledge of network planner can't avoid the line-of-sight (LOS) obstacles *B. Antenna basic* - Without knowledge of basic of antenna, it is too difficult to design high gain antenna. When selecting network antenna, it is very difficult to change from gain to consideration. Power loss is more, when Effective Radiated Power (ERP) is in active mode. Poorly designed antenna, will affect the wireless broadband network efficiency.

C.Signal interference **–** To clear the LOS and Fresnel zone, 2.4 GHz frequency is required, which must be at least 80% free from obstacles. Generating a reliable signal and strong gain signal in every link is ultimate challenge for designers. The output signal can be destructed, when sudden changes in temperature, atmospheric pressure and heavy rain.

D.Antenna selection and installation **–** Due to heavy load, the steadiness of the transmitted signal is affected. If select the unknown antenna, the propagation delay and time consumption is becomes more. Area coverage also minimum, because of the low transmitted signal steady rate. To find out the destination is too hard, when the antenna is operating at low frequency.

*E.Cost expenses***-** Each high gain antenna operations are done with more than a single tool type and requires various materials externally that lead to increased expensive values. In real time system management, it is highly impossible to produce such type of expensive manufacturing system.

*F.Energy consumption***-** The energy and power consumption is considered to be the foremost problem in the antenna manufacturing systems contained in all industries. The implementation of highly reliable systems will normally tend to acquire more power, which is to be noted as an issue

II.I. OBJECTIVES

The design of antenna is a major task for designers to make high efficient antenna with more radiation pattern. The size of the antenna and the metal of the antenna also very important to get more gain with respective directivity. To design an effective dipole antenna, the following points are mainly concentrated,

- Maximize the radiation pattern.
- Minimize the return loss.
- Analysis the electric field pattern and absolute field.
- Increase the gain.
- Improve the directivity.
- Maximize the radiated power.
- Increase the maximum intensity.
- Maximize the mean capacity.
- Maximize the efficiency.
- VSWR, Input impedance, and E and H plane radiation patterns will be obtained.

- These antennas provide broadband and multi band frequency response that derives from the inherent of the dipole geometry of the antenna.
- These antennas are compact in size as compared to antenna of conventional design while maintaining good to excellent gain.

Mechanical simplicity the dipole array antennas may be obtained due to its geometry and not by the addition of discreet component

EDA-IF methodology

In this EDA-IF method, we have designed dipole antenna with the combination of balun feeding and inset feeding. This dipole antenna, elliptical patch also plays a vital role to increase the radiation pattern. In this letter, we introduce an elliptical slotted planar elliptical dipole antenna (ESPEDA). The EDA-IF antenna apparatus works from 1.1 to 11 GHz by utilizing the circular openings. In the frequency range, the circular spaces deliver great execution at high frequencies, the antenna gain is expanded from 2.7 to 11 GHz, and return loss of 94.4% is not as much as dB (dB) from 1.1 to 11 GHz.

 DOI : 10.35291/2454-9150.2021.0084

ISSN : 2454-9150 Vol-06, Issue-12, MAR 2021

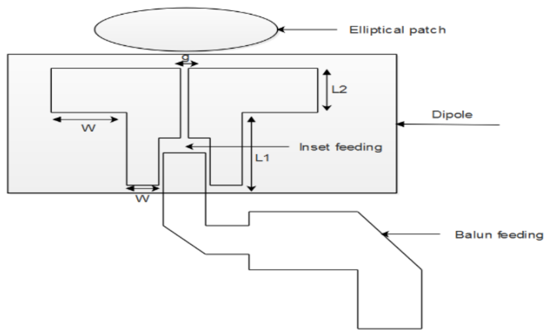

Fig.1. EDA-IF antenna design with elliptical patch

In is a kind of micro strip line feeding procedure, in which the width of directing strip is small when contrasted with the pitch and has the advantage that the feed can give a planar structure. The motivation behind the inset cut in the patch is to coordinate the impedance of the feed line to the patch input impedance without the requirement for any extra coordinating component. This can be accomplished by appropriately changing the inset cut position and measurements.

The EDA-IF antenna design is presented in fig.1. From this antenna design, we can easily understand the antenna is designed by combination of both balun and inset feeding technology. Balun feed is connected to inset feed which is used to avoid the input loss. Dipole antenna shape also modified according to width and length measurement. From the elliptical patch we will get high gain and directivity

With the help of Elliptical patch and inset feeding, dipole antenna gain, directivity, mean capacity, radiated power, radiation pattern, voltage standing wave ratio (VSWR), power consumption, return loss and efficiency will be improve in proposed method than existing method.

III. LITERATURE REVIEW

AUTHOR NAME	METHOLOGY EMPLOYED	ADVANTAGE	LIMITATION
X.m. Ding et al. [16]	❖ ultra high frequency (UHF) near field RFID reader antenna in designed in this paper based on magnetic coupling technique	❖ Higher bandwidth can be achieved up to 845MHz and this antenna required low transmitting power.	❖ Significant grating lobes is generated, which occupy more area. ❖ High frequency signal cross coupled with incident signal, which limits the application and isolation is not good.
Goksenin Bozdag et al. [17]	❖ In this paper, LPDA antenna was designed which is operating between 1.1 GHz to 13.8 GHz. ❖ This antenna was designed by tapered feed line.	❖ Improve the feeding point, high speed and antenna size is minimum.	❖ Low power handling capability, and small coverage area. ❖ Not possible to increase the Directivity
Botao Feng et al. [18]	❖ By using composite feed structure a planar printed dual wide band U shape antenna was designed.	❖ With the help of U shape antenna, electric pole provides dual wide band by changing the surface current distribution.	❖ Narrow bandwidth ❖ Low data rate ❖ Low radiation pattern
Son Xuat ta et al. [19]	❖ Printed dipole antenna was designed for 5G wireless communication. ❖ Integrated balloon was used for feed technique.	❖ High radiation pattern, High gain, and lower side- lobe level in low frequency.	❖ Large size ❖ Low frequency ❖ Consume more power
Glaucio Ramos et al. [20]	❖ Printed met material enhanced antenna was designed for S- band operation. ❖ FDTD/WP-PML/NUFFT algorithm have been used to design this antenna.	❖ Enhance the antenna structure, reduce the storage cost, less input noise.	❖ Poor polarization purity ❖ poor scan performance ❖ less accuracy

IV.EXISTING WORKS WITH RESULTS

Author	Methodology	Results
X.M.Ding et al. [16]	Ultra high frequency near field RFID reader printed dipole antenna	Size of the antenna – 96mm x 96mm x 2mm Resonance frequency – 842MHz Transmit power – 17dBm
Goksenin Bozdag and Alp Kustepeli	Log periodic dipole array antenna with feeding point patch	Frequency – 1.1 GHz to 13.8 GHz Deviation – 1.5ns Gain – 5.2 dB
Botao Feng et al. [18]	Printed dual wide band magneto electric dipole U and T shape antenna	Bandwidth – 0.78 to 1.12 GHZ Gain – 3.8 dBi Radiation pattern – 0.9, 1.8, and 2.6 GHZ
Son Xuat Ta et al.[19]	Broad band printed dipole antenna and its applications	Dipole angle – 45 deg Bandwidth – 26.5 to 38.2 GHz Gain – 4.5 to 5.8 dBi Radiation pattern – 28 and 32 GHz
Glaucio l.Ramos et al. [20]	A printed metamaterial enhanced antenna by using FDTD/WP-PML/NUFFT algorithm	Gain – 7.16 dBi Directivity – 10 dBi Radiation pattern – 2.25 GHZ

 DOI : 10.35291/2454-9150.2021.0084

V.POSSIBLE OUTCOMES

The EDA-IF dipole antenna will be implemented using High Frequency Structure Simulator (HFSS) and the performance are evaluated in terms of, Directivity of the dipole antenna will be increased Radiation pattern of the antenna will be improved due to the elliptical patch, Antenna gain will be increased, The EDA-IF antenna will be planar and compact structures which can directly be put inside the hand set., Analysis the return loss, electric field, efficiency, input impedance, VSWR and mean capacity This antennas will operate at more than one frequency at a time with large gain and large radiation efficiency

VI. CONCLUSION

In this work, EDA-IF antenna will be designed to improve the performance parameters such as dipole antenna gain, directivity, radiation pattern, mean capacity, return loss, radiated power, voltage standing wave ratio (VSWR), power consumption and efficiency. This work elliptical patch and inset feeding technique plays a vital role in antenna design. The antenna size also optimized while design the EDA-IF. As per the design, the performances like dipole antenna gain, directivity, radiation pattern, mean capacity, return loss, radiated power, voltage standing wave ratio (VSWR), power consumption and efficiency will be improved in EDA-IF than pervious methods.

REFERENCES

[1] Kashwan, K. R. "Design and implementation of printed strip collinear dipole array antenna for C band." *Computation of Power, Energy Information and Commuincation (ICCPEIC), 2016 International Conference on*. IEEE, 2016.

[2] Boryssenko, Anatoliy, and Tom Goodwin. "Broadband antenna array aperture made of tightly couple printed dipoles." *Phased Array Systems and Technology (PAST), 2016 IEEE International Symposium on*. IEEE, 2016.

[3] Park, Dong-Hee. "Design of Millimeter-Wave Monopole Yagi-Uda-Fed Waveguide Pyramidal Horn Antennas." *Platform Technology and Service (PlatCon), 2017 International Conference on*. IEEE, 2017.

[4] Haraz, Osama M., Saleh A. Alshebeili, and Abdel-Razik Sebak. "Low-cost high gain printed log-periodic dipole array antenna with dielectric lenses for V-band applications." *IET Microwaves, Antennas & Propagation* 9.6 (2014): 541-552.

[5] Liu, Qi, Shuai Zhang, and Sailing He. "Compact printed two dipole array antenna with a high front-back ratio for ultra-high-frequency radio-frequency identification handheld reader applications." *IET Microwaves, Antennas & Propagation* 9.1 (2014): 73-78.

[6] Taeb, A., Rafi, G.Z., Santillan, C., Kohli, J. and Safavi-Naeini, S., 2010, July. An overhead V-shape printed dipole array antenna for toll plaza application. In *Antennas and Propagation Society International Symposium (APSURSI), 2010 IEEE* (pp. 1-4). IEEE.

[7] Sarkar, Debdeep, Kushmanda Saurav, and Kumar Vaibhav Srivastava. "Dual band complementary split-ring resonator-loaded printed dipole antenna arrays for pattern diversity multiple-input–multiple-output applications." *IET Microwaves, Antennas & Propagation* 10.10 (2016): 1113-1123.

[8] Zhai, G. H., Cheng, Y., Min, D., Zhu, S. Z., & Gao, J. J. (2013). Wideband simplified feed for printed log-periodic dipole array antenna. *Electronics Letters*, *49*(23), 1430-1432.

[9] Zhai, G., Cheng, Y., Yin, Q., Zhu, S. and Gao, J., 2014. Gain enhancement of printed log-periodic dipole array antenna using director cell. *IEEE Transactions on Antennas and Propagation*, *62*(11), pp.5915-5919.

[10] Mohammad, Sajad, Hamid Reza Hassani, and Ali Foudazi. "A dual-band WLAN/UWB printed wide slot antenna for mimo/diversity applications." *Microwave and Optical Technology Letters* 55.3 (2013): 461-465.

[11] Rajendran, Jolly, and GA Shanmugha Sundaram. "Design and evaluation of printed log periodic dipole antenna for an L band electrically steerable array system." *Computational Systems and Communications (ICCSC), 2014 First International Conference on*. IEEE, 2014.

[12] Zhai, G. H., Hong, W., Wu, K., & Kuai, Z. Q. (2010). Wideband substrate integrated printed log-periodic dipole array antenna. *IET microwaves, antennas & propagation*, *4*(7), 899-905.

[13] Zhao, Yun, Zhongxiang Shen, and Wen Wu. "Wideband and Low-Profile Monocone Quasi-Yagi Antenna for Endfire Radiation." *IEEE Antennas and Wireless Propagation Letters* 16 (2017): 325-328.

[14] Mathew, Pristin K. "Log Periodic Dipole Array Antenna for Television and FM broadcasting." *array Antennas television* .284-289.

[15] Peng, C.M., Chen, I.F., Shen, S.M. and Lin, D.B., 2013, July. Dual-band printed asymmetric dipole antenna array for LTE applications. In Antennas and Propagation Society International Symposium (APSURSI), 2013 IEEE(pp. 692-693). IEEE.

[16] Ding, X. M., Zhang, K., Yu, H., Zhu, L., Feng, C. N., & Wu, Q. (2014). A novel magnetic coupling UHF near field RFID reader antenna based on multilayer-printed-dipoles array. *IEEE Transactions on Magnetics*, *50*(1), 1-4.

[17] Bozdag, Goksenin, and Alp Kustepeli. "Subsectional tapered fed printed LPDA antenna with a feeding point patch." *IEEE Antennas and Wireless Propagation Letters* 15 (2016): 437-440.

[18] Feng, B., Li, S., An, W., Hong, W., Wang, S., & Yin, S. (2014). A printed dual-wideband magneto-electric dipole antenna for WWAN/LTE applications. *AEU-International Journal of Electronics and Communications*, *68*(10), 926-932.

[19] Ta, Son Xuat, Hosung Choo, and Ikmo Park. "Broadband Printed-Dipole Antenna and Its Arrays for 5G Applications." *IEEE Antennas and Wireless Propagation Letters* (2017). 1 - 4

[20] RAMOS, GLAUCIO L., ET AL. "A NOVEL FDTD/WP-PML/NUFFT ALGORITHM APPLIED TO THE DESIGN OF A PRINTED METAMATERIAL ENHANCED ANTENNA." *AEU-INTERNATIONAL JOURNAL OF ELECTRONICS AND COMMUNICATIONS* 70.9 (2016): 1187-1191

AUTHOR PROFILE

Department of Electronics and Communication Engineering in Sreenidhi Institute of Science and Technology. Ghatkopar, India. He published several research in various International Journals and International Conferences. His research interests are Signal Processing, Image processing. Handling more than 30 Lacks Projects under R&D

 DOI : 10.35291/2454-9150.2021.0084