A Literature Survey on Log-Periodic Dipole Antenna for ISM Applications

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***Abstract*: Now a days wireless and mobile communication systems are at the forefront of research activities. An indispensable element of any wireless communication system is an antenna. The transmission of data at higher rates requires wider bandwidths for the elements constituting a communication link. This requirement for the antenna, which is the subject of interest, means wideband antennas need to be designed and used. The design of one such Antenna that is Log Periodic dual band Antenna for the ISM applications. The design of LPDA for the ISM applications is to be carried out at 2.4GHz and 5GHz for better gain values and VSWR.**

Index Terms: Log periodic dipole array antenna, PCB, ISM bands, dipole elements, FR4 material, VSWR.

I INTRODUCTION

Log-periodic antennas (LPAs) have been widely used as receiving antenna for very high frequency and ultrahigh frequency applications due to wide bandwidth, high gain, and good radiation characteristics. Many applications require wideband or ultra wideband (UWB) antennas, such as in radio astronomy and in UWB communication or radar systems. Log-periodic array antennas can provide a constant radiation performance and good reflection co-efficient performance over a wide frequency band, which can be considered as an important characteristics of this type antennas. Log-periodic array antennas are widely used in wideband applications since it was introduced 50 years ago.

II RELATED WORK

The Design of a Printed Log Periodic Dipole Antenna (PLPDA) which is able to operate over Ultra Wide Band frequency range (3.1 GHz to 11.6 GHz) was designed. The advantage of the antenna is that it is compact and easy to integrate with planar circuits which are suitable for applications that need wide bandwidth and high gain and directivity antenna. The antenna is modeled using a CST simulation tool. The analysis and simulations are done to measure the S parameter, directivity, gain, return loss and VSWR. Then a prototype was fabricated and tested by the Network Analyzer[1].

A compact log-periodic dipole array (LPDA) antenna is developed at 0.5 – 10 GHz. This LPDA structure constitutes fewer dipole elements than a conventional LPDA antenna that exhibits similar resonant frequencies. The structure of the proposed dual-band dipole is achieved without a ground plane as opposed to many existing dual-band antenna types. As a result, the dipole antenna has a simple geometry with omni directional characteristics. A 25-element LPDA antenna is designed with a much reduced boom length[2].

A novel wideband log-periodic monopole end-fire antenna fed by a microstrip-to-slotline transition feeding network is been presented in this paper. The proposed transition consists of a microstrip stub and slot stub to achieve the wideband impedance matching and remove the inverting converter and correct the errors in conventional log-periodic antenna array. The proposed novel log-periodic monopole antenna covers 6 GHz – 18GHz (S11< -10 dB) with flat gain of 7-8 dBi, and front-to-back ratio better than 18 dB[3].

A dual-band dual-polarized feed for a symmetrical single-reflector antenna is presented in this paper. Antenna system receives telemetry information in the meter (120 - 225 MHz) and decimeter (625 - 650 MHz) frequency bands. Reflector has a low F/D ratio 0.25. The feed consists of two log-periodic dipole array antennas (LPDAs) formed by metallic tubes. Measured VSWRs are less than 2.2 in meter band and about 1.8 in decimeter band[4].

A compact, dielectric-loaded and wideband log-periodic dipole array (LPDA) antenna operating between 200 and 803 MHz for VSWR less than 2 is presented in this letter. The antenna consists of sinusoidal dipoles and parallel strip line printed on a substrate partially loading an air layer, as well as two stepped dielectric materials. Good agreement is achieved between simulated and measured results. The antenna is also shown to work normally through the experimental results of VSWR under the 100-W continuous wave (CW) power excitation for 30 minutes[5].

A novel printed log-periodic monopole array (PLPMA) antenna is proposed and investigated in this work. The antenna has advantages of easy design, wide bandwidth and high gain. A PLPMA with 12 printed monopole elements is designed. A prototype of the antenna is fabricated using the standard PCB process. Measured results shows that the design has a broad operation band from 8.4 GHz to 14.6 GHz, in which the VSWR is lower than 2.0 and the gain is high and stable with a variation from 6.5 dBi to 9.5 dBi [6].

In the paper, the condition for constant radiation characteristics for log-periodic array antennas has been derived. From this condition, a general guide rule for designing a log-periodic array with constant radiation performance has been obtained. Two examples are used for verifying the analysis in the paper and the reason that the Eleven antenna has constant radiation characteristics is well explained and demonstrated[7].

A novel design of multiple input–multiple output (MIMO) antenna based on the log-periodic dipole array (LPDA) for the mobile handsets is presented. The antenna operates in a wide frequency range of 1.86–3.84 GHz compatible with GSM, LTE, WLAN, and WiMAX. The performance of the MIMO antenna is analyzed in terms of S-parameters, radiation pattern, gain, total efficiency, envelope correlation co-efficient, mean effective gain, multiplexing efficiency and then it is verified through the measurements. The results demonstrate that the proposed MIMO antenna has good characteristics of wideband, gain, radiation pattern, isolation, and diversity[8].

This paper presents the step-by-step design procedure and simulated performance investigation of a printed log periodic dipole antenna (LPDA) that is able to operate cover wide frequency range (800-2500 MHz). The advantages of this antenna are compact size and wide bandwidth better than conventional LPDA and typical printed antennas. Consequently, it is interesting to use this antenna in various applications such as wireless power transmission, rectennas, and electromagnetic energy harvest in GSM (850-900 MHz), mobile (1800 MHz), 3G (2100 MHz), or WiFi (2400 MHz) Bands[9].

A 3D-printed comb-mushroom-like dielectric lens for stable gain enhancement of the printed antipodal log-periodic dipole array (PLPDA) antenna is presented in this paper. The low-profile dielectric lens (DL) is specially designed to be easily integrated with the antenna source for improving its gain performance. Periodic comb-like structure is also utilized in the DL to obtain desired effective permittivity according to the effective medium theory. With this specially designed DL, excellent flat gain performance (11.2 ± 0.7 dBi in 14-20 GHz) as well as stable radiation patterns, can be realized while maintaining compact lens size and low lens profile[10].

III PROPOSED METHODOLOGY

The goal of this project is to design and build high gain, low cost, dual band Log Periodic Antenna at 2.4GHz and 5GHz. The LPA is designed using CST studio software. One of the most important parameters that describe log periodic antenna is scaling factor. This scaling factor allows the antenna dimensions to remain constant in terms of wavelength λ. The condition is necessary to maintain the same impedance and radiation characteristics over a wide range of frequencies. Spacing factor and reflection coefficients are the other two parameters. The designing steps for the log periodic antenna are shown below.

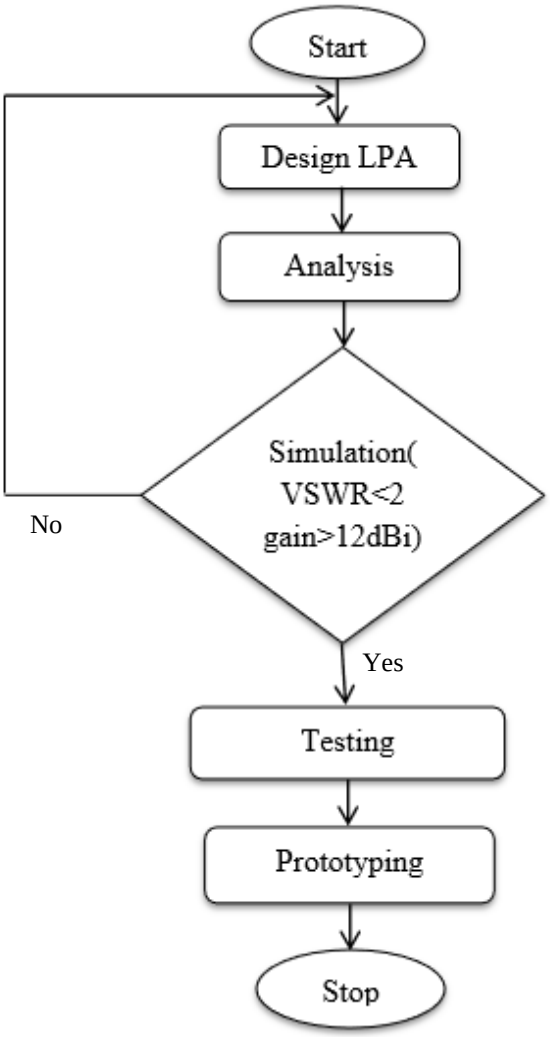

Figure 1: Flow chart of proposed methodology

IV PROBLEM FORMULATION

The 2.4GHz and 5GHz dual band Log Periodic Antenna for the ISM application has to be designed which is the most emerging application. The number of dipole needed to reach a band is a very important parameter and it depend usually on the antenna parameter such τ, σ and α (scaling factor, spacing factor and reflection coefficient).The antenna design is done for the better gain and the VSWR for the dual band ISM application. The antenna operates in a wide frequency range of 2.4GHz and 5GHz compatible with GSM, LTE, WLAN, and Wi-MAX.

V TOOLS USED

The CST(computer simulation technology) offers accurate, efficient computational solutions for electromagnetic design and analysis. CST 3D EM simulation software is user-friendly and enables to choose the most appropriate method for the design and optimization of devices operating in a wide range of frequencies. Passive microwave & RF component design is a major application of this software and supporting it is one of CST's core competencies. CST DESIGN STUDIO™ (CST DS) allows the hybrid co-simulation of the effect of an attached circuit on the antenna performance. The System Assembly and Modeling framework in CST DS allows the user to set up coupled simulations which can combine different solvers automatically by making use of field sources.

A network analyzer is an instrument that measures the network parameters of electrical networks. Network analyzers are used mostly at high frequencies, operating frequencies can range from 5 Hz to 1.05 THz. Special types of network analyzers can also cover lower frequency ranges down to 1 Hz. These network analyzers can be used for example for the stability analysis of open loops or for the measurement of audio and ultrasonic components.

VI CONCLUSION

The log periodic antenna is the most commonly and widely used antenna for the wide band applications such as ISM applications. The feed to be designed for the LPA are having their own advantages over conventional feed. In this survey paper the

LPDA antenna is to be designed for the frequencies 2.4 GHz and 5 GHz dual band using CST tool and it will be tested in Network analyzer for better Gain and VSWR values for various applications.

REFERENCES

[1] **Dr.R.Prabha, K.Madhubala, G.R.Sai Pranathi and S.Lavanya** "Smart Log Periodic Dipole Array Antenna (3.1 GHz-11.6 GHz) for UWB Applications", (Open Access Quarterly International Journal) Volume 2, Issue 2, Pages 193-199, April-June 2018.
[2] **Kyei Anim and Young-Bae Jung**, Member, "Shortened Log-Periodic Dipole Antenna using Printed Dual-band Dipole Elements",DOI 10.1109/TAP.2018.2874710, IEEE. [3] **Yuanhua Sun, Yongjun Huang, Guangjun Wen and Haobin Zhang** "A 6-18 GHz Log-Periodic Monopole End-Fire Antenna Based on Microstrip-to-Slotline Transition" 978-1-5386-3284-0/17/$31.00 ©2017 IEEE.
[4] **A. N. Plastikov, V. A. Vasiliev and S. E. Chadov** "Dual-Band Dual-Polarized Log-Periodic Feed For Reflector Antenna" , 978-1-4799-2897-2/13/$31.00 ©2013 IEEE.
[5] **Lei Chang, Shuai He, Jian Qiang Zhang, and Dan Li** " A Compact Dielectric-Loaded Log-Periodic Dipole Array (LPDA) Antenna",DOI 10.1109/LAWP.2017.2744983, IEEE.
[6] Xiaoshuai Wei, Juhua Liu, Member, IEEE, and Yunliang Long, Senior Member, IEEE "Printed Log-Periodic Monopole Array Antenna with a Simple Feeding Structure ",DOI 10.1109/LAWP.2017.2773606, IEEE.
[7] **Jian Yang**, "On Conditions for Constant Radiation Characteristics for Log-Periodic Array Antennas", 0018-926X/$26.00 © 2010 IEEE, VOL. 58, NO. 5, MAY 2010.
[8] **Abdurrahim Toktas**, "Log-periodic dipole array-based MIMO antenna for the mobile handsets", http://dx.doi.org/10.1080/09205071.2015.1114432.
[9] **Ajalawit Yodchai Chantaveerod, Thunyawat Limpiti**, "Design of a Printed Log-Periodic Dipole Antenna (LPDA) for 0.8-2.5 GHz Band Applications".
[10**] Yi-Xuan Zhang, Student Member, IEEE, Yong-Chang Jiao, Senior Member, IEEE, and Sui-Bin Liu**, "3D-Printed Comb-Mushroom-Like Dielectric Lens for Stable Gain Enhancement of Printed Log-Periodic Dipole Array", DOI 10.1109/LAWP.2018.2851298, IEEE.