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Design of Rectangular Stepped DRA for Wireless Local Area Network (Wlan) Applications

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Abstract

In this paper, a dielectric resonator antenna (DRA) is presented for wireless local area network (WLAN) applications. Here three rectangular dielectric resonators are used as stepped manner. The DRA is excited by microstrip line which is an effective feed mechanism to obtain better radiation. In this design, rectangular shape was used as the dielectric resonator as it offers more option to control the resonant frequency. Simulated results show that DRA array has a better resonant frequency for DR height, hr = 1 mm each and micro strip line fed by at -5.5 mm . The retune loss is 15.0 dBi ,directivity achieves 6.2 dBi and the gain of 6.48dBi at 5.5Ghz frequency. The proposed design is suitable for Wireless Local Area Network (WLAN) IEEE 802.11standard applications & HIPERLAN (high-performance radio LAN) applications which operate at 5.15 GHz to 5.50 GHz.

Keywords

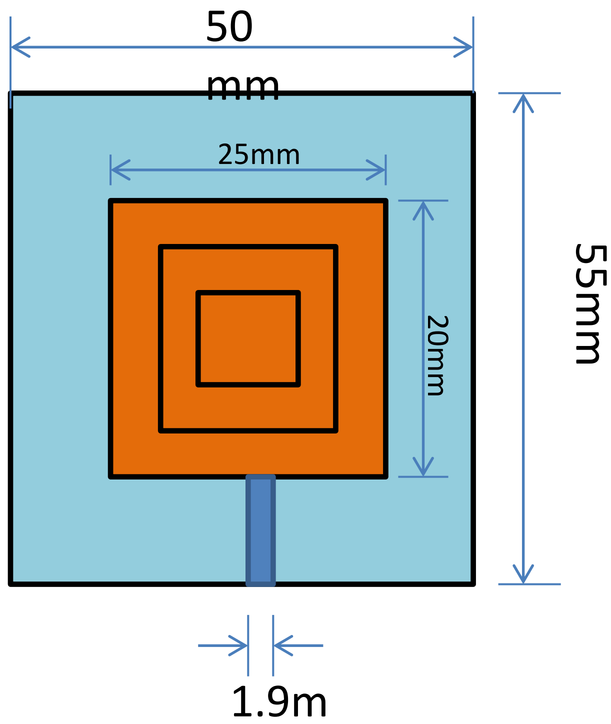
***Stepped Dielectric resonator antenna, WLAN, Resonant Frequency**.*

1. Introduction

In recent years, the dielectric resonator antenna (DRA) has been widely studied due to its several advantages such as high radiation efficiency, light weight, low profile, various DR shapes (rectangular, cylindrical, spherical etc.) [1]. DRA's size and bandwidth can be easily controlled by varying the dielectric constant of materials in a wide range [1]. In many cases with a single element DRA, desired specifications cannot be achieved. For example high gain, high efficiency, directional radiation pattern cannot be synthesized with a single DRA of any shape. In these applications, a DRA array with appropriate element arrangement and feed configurations can be used to provide desired specifications. Dielectric Resonator Antenna is widely used in today's electronic warfare, missile, radar and communication systems. They find use both in military and commercial applications. The wideband technology has become one of the most fascinating technologies in in-door communication due to its great advantages including large capacity of data, high speed data rate and small size. However, WLAN (5.15 to 5.825 GHz) .In this paper, we proposed a Rectangular stepped dielectric resonator antenna fed by micro strip line for WLAN applications. The performance of the purposed designed antenna such as S parameter, input impedance, radiation patterns, gain and directivity are analyzed and discussed. The obtained results show significant performance improvement in terms of impedance bandwidth and radiation pattern. In this paper, the rectangular-shape stepped DRA of permittivity $\varepsilon r = 55$ is designed and simulated at 5.5GHz .

2. Antenna Design

The structure of the antenna is shown in Figure 1. The DRA is fed with direct 50 Ω micro strip line which has dimension 1.9 X 33mm^2. This microstrip line is photo-etched on substrate of permittivity $\varepsilon r = 3.38$. The height of the substrate was 0.813 mm while the width and length are 50 mm and 55 mm, respectively. The dimension of the 1st rectangular DR is 25mm (length) and 20mm (width) with height of 1mm. The dimension of the 2nd rectangular DR is 18.75mm (length) and 15mm (width) with height of 1mm. The dimension of the 3rd rectangular DR is 16.41mm (length) and 11.25mm (width) with height of 1mm In this design, the distance between rectangular DRA and open end of the microstrip line is 6mm .



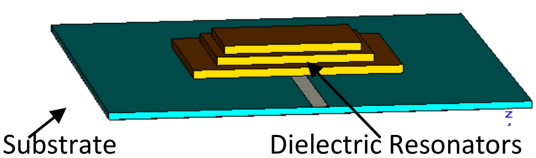


Figure 1: Geometry of the purposed Stepped DRA. a) Top View. b) 3-D Front View

3. Result and Discussions

The commercial 3D full wave electromagnetic (EM) simulation software CST Microwave studio, based on FIT method is used for simulation purposed stepped DRA whose return loss is -15.0 dB at frequency of 5.5 GHz shown in the Figure 2. . The lowest the return loss, the minimum is the loss and the DRA can accept maximum power from the source.

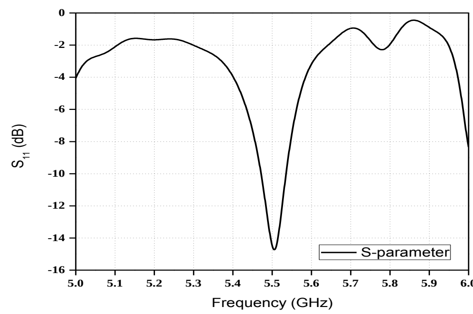


Figure 2: Simulated Gain of the Log Periodic DRA versus Frequency

Figure 3 and Figure 4 represent radiation patterns for both the E-plane and H-plane, respectively. Besides, it can be clearly observed that there is no radiation below the ground plane for the simulated pattern. E-plane radiation pattern shows a broad side plot where as H-plane radiation pattern shows Omni directional. The gain of antenna is well above 6dBi in the frequency range. The figure 5 shows the relation between the gain and frequency range.It shows at 5.5GHz the gain is 6.48dBi. The current distribution is shown in Fig.6 at 5.5 GHz .

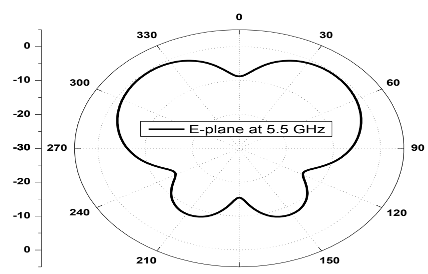


Figure 3: Radiation in E-Plane at 5.5GHz

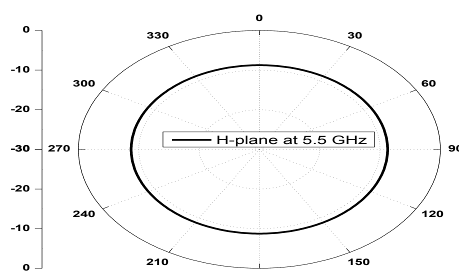


Figure 4: Radiation in H-Plane at 5.5GHz

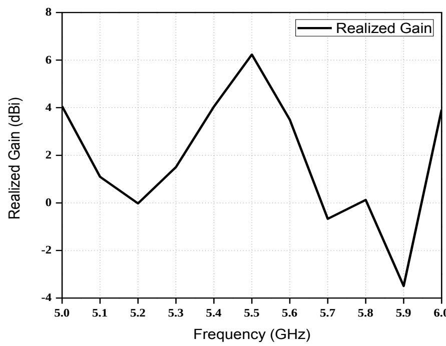


Figure 5: Simulated Gain vs. Frequency curve

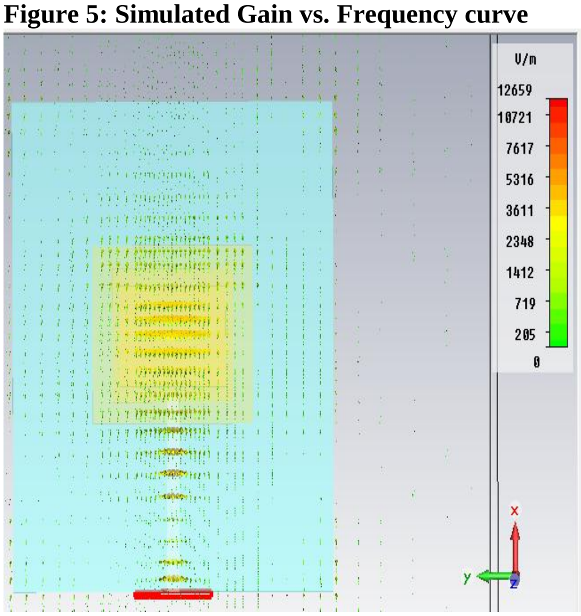


Figure 6: Current Distribution at 5.5 GHz

4. Conclusion

This paper presents rectangular DRA operating at 5.5 GHz. Hence, it provides high degree of freedom in controlling antenna performance. The simulated results show that the antenna is suitable for 5.5 GHz WLAN applications. Fabrication of proposed antenna will be carried out in future.

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