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APERTURE COUPLED CYLINDRICAL DRA WITH RECTANGULAR PARASITIC ELEMENT FOR GAIN IMPROVEMENT

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Abstract: *An aperture coupled cylindrical DRA with rectangular parasitic elements is proposed in this paper. The proposed MIMO system is operating at 7.93GHz frequency. Using ROGERS 3010 as upper substrate and ROGERS 5870 as lower substrate with alumina (99.5%) lossy as DRA material the proposed antenna is designed. The proposed design has improved its performance in parameters like bandwidth and gain in the working frequency range 4 – 8 GHz. It provides high isolation up to 25.69 dB at frequency 7.93GHz. The proposed antenna is used in fixed satellite services which allows users in a specific area to make and receive phone calls.*

Keywords: Parasitic elements, Isolation, Bandwidth, Gain, DRA.

1. INTRODUCTION

Dielectric resonator antennas (DRA's) have largely being emphasized in last two decades because of several attractive features such as small size and light weight [1]. Due to several advantages over the micro strip antenna such as wide impedance, bandwidth, gain, DRA's have been introduced as vigorous candidates for wireless communications [2]. Moreover, present wireless communication devices require reconfigurable antennas because of various features in terms of frequency, radiation pattern, VSWR that provide to improve overall system performance [3]. Recent studies on DRA's have indicated the DRA's have some intriguing advantages such as wider bandwidth and lower loss compared to Micro strip antenna [4]. Parasitic elements in DRA antennas have been investigated from the view point of increasing the gain of the antenna [5]. [6] In this paper parasitic elements are placed next to the fed DR, which are usually of different same dielectric constants of same sizes. However, [7] illustrates the concept of gain enhancement by using parasitic elements in an H – plane asymmetric by placing parasitic elements on one side of active elements. A Yagi – uda is a directional antenna consists of a row of parallel straight cylindrical conductors of which only is driven by a source and all others are parasitic elements (Director and Reflector) [8].

2. CONCEPT AND DESIGN

The proposed design consists of two element array with pentagon shaped DRA with one reflectors and three directors. Reflectors are placed after the fed DR and directors are placed before the fed DR [9]. Reflectors are mainly used to direct radiation in wanted directions, whereas director's focus to improve gain. As the number of directors increases gain also increases.

The proposed antenna is excited with aperture coupled feed [1], which consists of two substrates separated by ground plane. Feed is given to the bottom side of the substrate whose energy is coupled to the path through a slot on ground plane. It has narrow bandwidth and eliminates spurious radiation. In this paper we used cylindrical DRA [10] because of its advantages i.e. various shapes, and has great design flexibility. Here we have taken the pentagon shaped DRA in which all sides lengths are equal l=5mm.

The schematic diagram of proposed antenna is shown in the below figure 1.

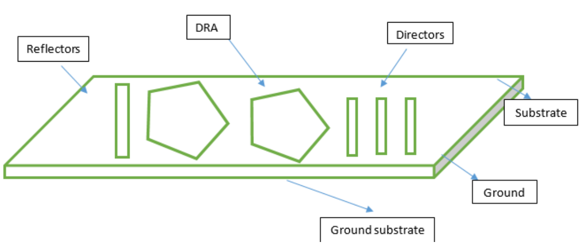

Figure 1: schematic diagram

The resonant frequency for cylindrical DRA can be calculated by

$$f_0 = \frac{6.324}{\sqrt{e_r+2}}\left[0.27 + 0.36\left(\frac{D_c}{4h}\right) + 0.02\left(\frac{D_c}{4h}\right)^2\right]$$

Where,

e_r = Dielectric constant

D_c = Diameter of DRA

h = Height of the DRA

The bandwidth can be calculated by

$$\%\ \text{Bandwidth} = \frac{f_H - f_L}{f_R} \times 100\ \%$$

The scattering parameters of the antenna system are calculated using CST software. Figure 2 shows the isolation of system.

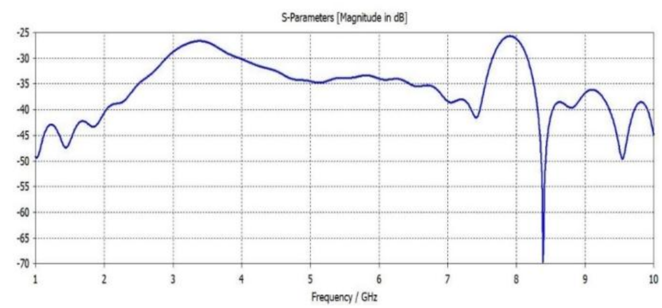

Figure 2: Mutual coupling plot (S_{12}).

Return loss of -40.97 dB. As the coupling between the two antenna is reduced and the antenna works more efficient as shown in figure 3.

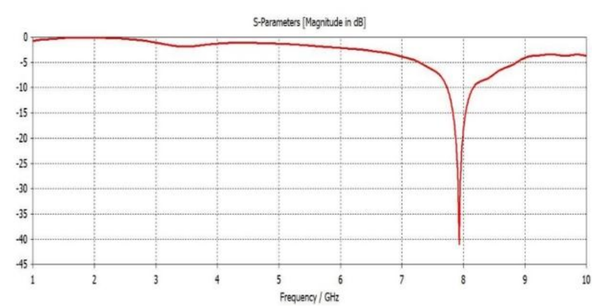

Figure 3: Return loss plot (S_{11}).

A great way to implement wireless throughout is to move to a MIMO output. That means you have a radio capable of transmitting and receiving multiple data streams simultaneously. The Envelope correlation coefficient plot at resonant frequency is shown in figure 4.

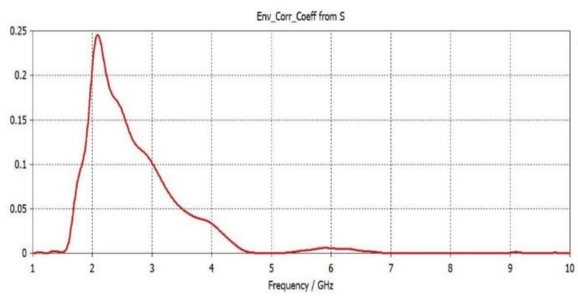

Figure 4: Envelope correlation coefficient plot.

Radiation Pattern is defined as a mathematical function or a graphical representation of the radiation properties of the antenna as a function of space coordinates. It is determined in the far field region.

The proposed antenna has a gain of 6.120dB.

The radiation pattern of the proposed antenna at the resonant frequency is shown in the figure 5.

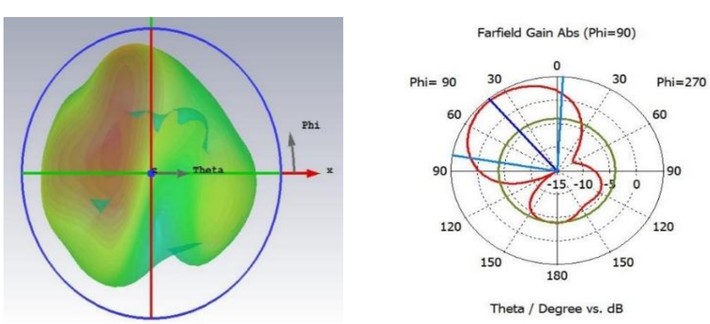

Figure 5: Radiation pattern at 7.93GHz.

3. CONCLUSION

This paper presents the design and results obtain with reflector and directors in order to concentrate the radiation in one direction. This paper compares the variation of gain versus the addition of directors for simulation. The proposed design gets the maximum gain of 6.120dB. Best performances are obtained with antennas built with 1 to 8 directors. But as the complexity increases we can take directors up to 3. If 1 director is used the gain is 4.21 dB, if 2 directors are used the gain is 5.74 dB and for the proposed design the gain is 6.120 dB. The proposed antenna is used in fixed satellite services.

4. REFERENCES

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