



International Journal of Emerging Technologies in Computational and Applied Sciences(IJETCAS)

www.iasir.net

A Multi Band Compact Dielectric Resonator Patched Antenna using Multiple Feed Techniques

¹Neeraj Kumar, ²Ajay Kumar Thakur, ¹Arvind Kumar

¹Amity Institute of Telecom Technology & Management, Amity University, Noida, Uttar Pradesh

²C. M.Sc. College, L.N.M.U,
Darbhanga, Bihar, INDIA

Abstract: In this paper, a multi feed Dielectric Resonator Patched Antenna has been presented. DRA of suitable shape, size and material can be used in MIMO technology where several antennas are implemented in the transmitting as well as in receiving devices. A co-axial probe fed Rectangular DRA has been proposed, with proper design it is found that antenna offers multiple frequency of operation over which the antenna polarization and radiation pattern are preserved. Theoretical performance of the antenna is verified by full-wave simulations and experimental data obtained from a prototype.

Index Terms: MIMO Technology, Dielectric resonator Antenna, Co-axial Feed, Multiple frequency Operation

I. INTRODUCTION

Rapid development and innovation in communication system demands huge bandwidth for the efficient transmission of multimedia data. Radiating structure, popularly termed as antennas, plays a very important role. Antennas are used as transmitting and receiving element at the transmitter and the receiver end, in wireless medium of communication. Antenna capable of working in multi band of frequency eliminates the need of several antennas for different frequency of operation. This paper presents an antenna design, which is capable of working in different frequency bands of wireless communication system.

Dielectric resonator antennas (DRA) have been the interest of research and investigation due to its highly desirable characteristics such as small size, light weight, highly efficient in microwave and mm wave spectrum[1-3]. The most popular shape studied for practical antennas applications have been the cylindrical dielectric resonator antennas, rectangular dielectric resonator antennas, spherical dielectric resonator antennas and many more different structure are reported[4-7].

Antenna has been excited using coaxial probe feed technique. Coaxial probe feed; it is a feeding method in which the inner conductor of the coaxial is attached to the radiating element of the antenna while the outer conductor is connected to the ground plane[8].

II. CALCULATIONS

The RDRA is characterized by a height h , a width w , a depth d , and a dielectric constant ϵ_r . The rectangular shape offers two degree of freedoms, making it the most versatile of the basic shapes. The ratios w/h and w/d can be chosen independently. Thus either a tall and slender or a thin and wide aspect ratio can be selected, depending upon the particular application. The choice of aspect ratio will also have an impact on the radiation Q-factor, which again allows for greater design flexibility.

Basic rectangular shape of dielectric resonator has been performed theoretically on MATLAB software, where the mathematical equations were solved to get the desired dimensions of radiating structure of antennas for $TE_{\delta 11}^x$ mode, resonant frequency of 2.5 GHz, VSWR of 2, relative permittivity of resonator as 15. Minimum to maximum value of w/h and d/h is $1 \leq (\text{ratio}) \leq 3$, where ratio is w/h or d/h . Result obtained for the selected mode is presented in Table I.

Table I: Dimension of RDRA obtained on Matlab

W (cm)	D (cm)	H (cm)	Q-factor	BW (%)
1.784	5.352	1.784	6.93	10.2

III. Antenna Structure

The proposed design uses a substrate of material Rogers RT/Duroid 5880 (tm) having relative permittivity of 2.2 and dimension 10 cm X 9 cm X .32 cm. The upper surface of the substrate has finite conductivity layer. This has been done to minimize the back lobe radiation phenomenon. The rectangular dielectric resonator of relative permittivity 18 is used, having dimension of 5.352 cm X 1.784 cm X 1.784 cm. A perturbation in radiating material has been designed by removing a portion of dimension 5.352 cm X 1.338 cm X 0.288 cm from it. The top surface of the dielectric resonator is perturbed by embedding a strip of thickness 0.01mm. Antenna has been excited using two coaxial feeds, which makes antenna fit for multiband operation.

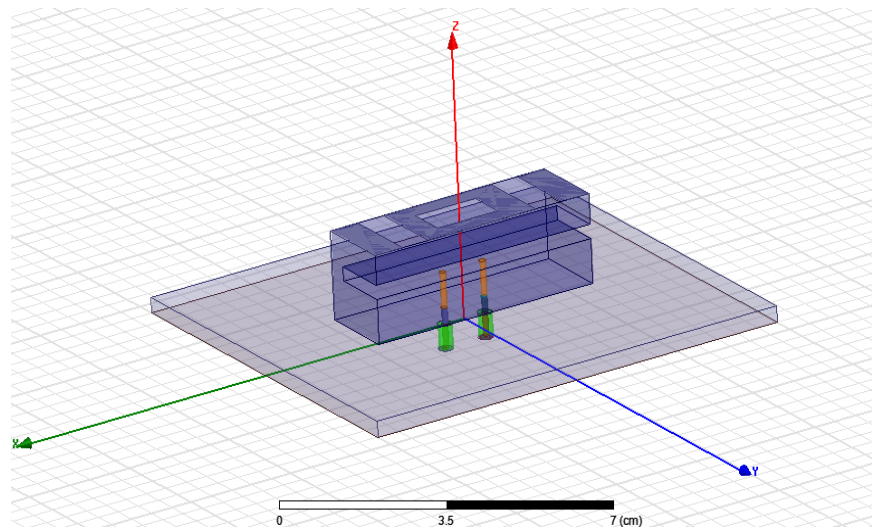


Fig. 2(a) 3D View of MIMO C-DRP Antenna

IV. Simulation

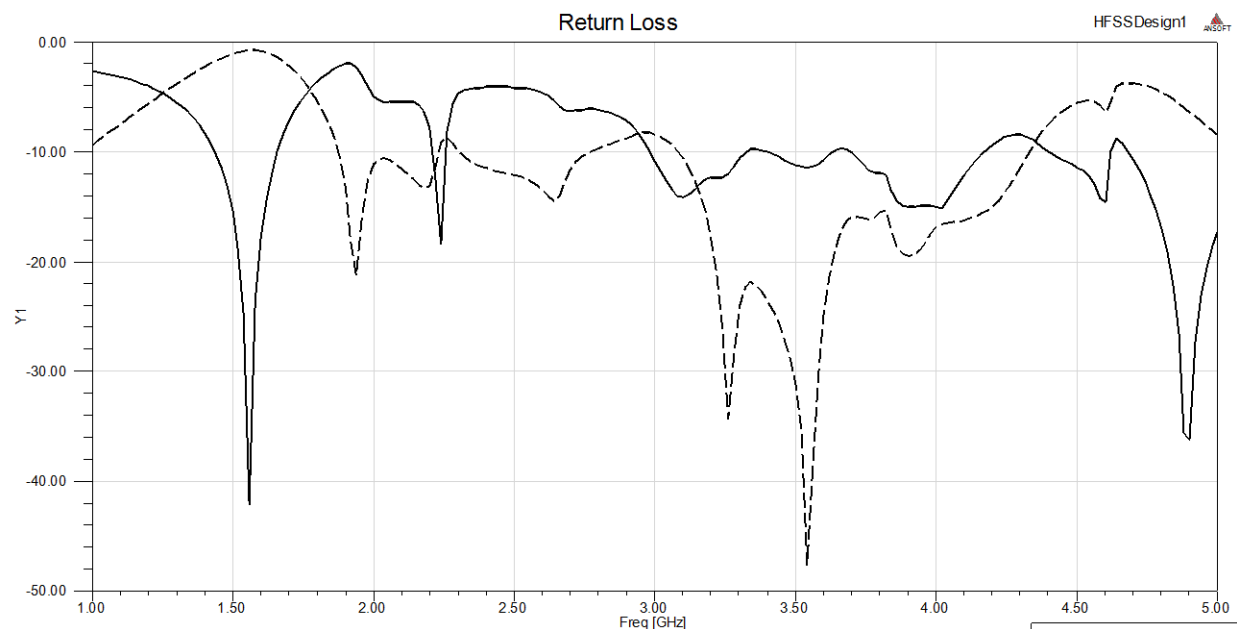


Fig. 2(a) S_{11} Vs Frequency Plot of MIMO C-DRP Antenna graph showing response obtained from Probe 1 and 2 simultaneously

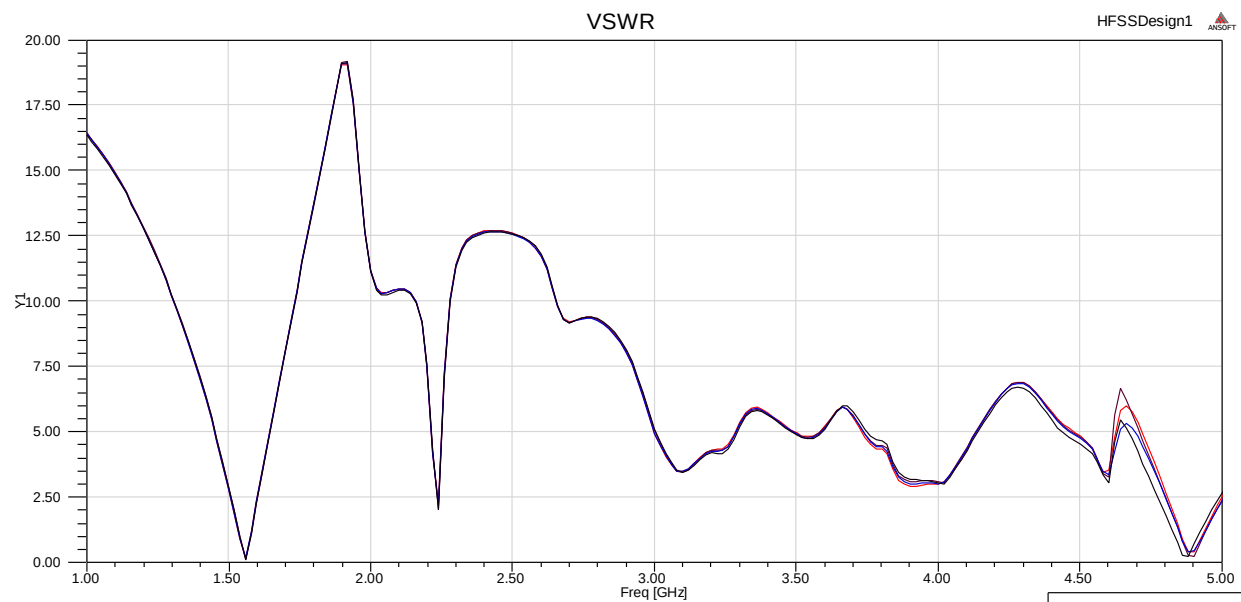
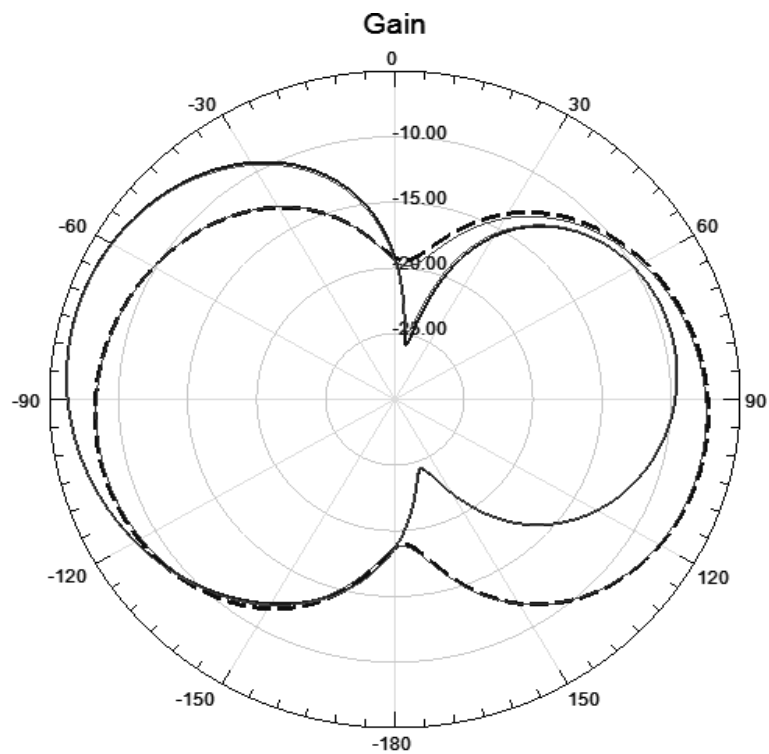


Fig. 2(b) VSWR Vs Frequency Plot of MIMO C-DRP Antenna graph showing response obtained from Probe 1 and 2 simultaneously



V. Result

The S_{11} Vs Frequency plot of antenna is shown in Fig. 2. It can be seen that antenna is well matched at different frequency interval within frequency range 1.56 GHz – 4.9 GHz, by operating the antenna using two different coaxial probes. Antenna can be simulated by either of the exciting probes or simultaneously excitation can be done using both of the ports. With the excitation we have observed that the antenna has resonant frequency of 1.56, 1.94, 2.24, 3.26, 3.54 and 4.9 (frequency measured in GHz) having maximum return loss of -42.16, -21.29, -18.43, -34.28, -47.57 and -36.26 (measured in dB) respectively.

From Fig. 3, VSWR value of the antenna is found to be in between 1-2.5 for the matching frequency of the antenna, which is advantageous. Gain of the antenna in terms of radiation pattern has been presented in Fig.4, which is found to be -20dB, which needs further medication and optimization.

VI. Conclusion

This antenna has capability to perform on different frequencies. This antenna can replace different antennas which act on a particular frequency. It is well matched at three different frequencies which fit in range defined for IEEE 802.11 standards. Antenna gives overall bandwidth of 2400 MHz. By controlling the dimensions of the two pairs of the inserted probes and using the antenna volume, the successful ending of generating different resonance frequencies independently tuned has been achieved. This structure is particularly simple to fabricate, uses a low cost substrate and occupies a small space.

References

- [1] Gerard J. Foschini and Michael. J. Gans (January 1998). "On limits of wireless communications in a fading environment when using multiple antennas". *Wireless Personal Communications* **6** (3): 311335. doi:10.1023/A:1008889222784.
- [2] Gerard J. Foschini (autumn 1996). "Layered space-time architecture for wireless communications in a fading environment when using multi- element antennas". *Bell Labs Technical Journal* **1** (2): 4159. doi:10.1002/bltj.2015.
- [3] A. Paulraj, R. Nabar and D. Gore. *Introduction to Space-time Communications*.
- [4] L. Zheng and D. N. C. Tse (May 2003.) "Diversity and multiplexing: A fundamental tradeoff in multiple-antenna channels". *IEEE Trans. Inf. Th.* **49** (5):1073-1096. doi:10.1109/TIT.2003.810646
- [5] D. Gesbert, M. Kountouris, R. W. Heath, Jr., C.B. Chae, and T. Salzer, Shifting the MIMO Paradigm: From Single User to Multiuser Communications, *IEEE Signal Processing Magazine*, vol. 24, no. 5, pp. 36-46, Oct., 2007 .
- [6] Kishk, A.A., A.W. Glisson, and Y. Yin., "Conical Dielectric Resonator Antennas Excited by a Coaxial Probe," *Microwave Optical Technology Letters*, Vol. 29, No. 3, May 2001, pp. 160- 162.
- [7] Luk, K.M., et. al., " Technique for Improving Coupling Between Microstrip Line and Dielectric Resonator Antenna," *IEEE Letters*, Vol. 35, No. 5, March. 1999, pp. 357-368.
- [8] Petosa, A., et. al., "Investigation of Various Feed Structures for Linear Arrays of Dielectric Resonator Antennas," *IEEE Antennas & Propagation Symposium Digest AP-S 1995*, Newport Beach, CA, pp. 1982-1985.

Acknowledgement

We are very much thankful Amity Institute of Telecom Technology & Management, Amity University for providing essential lab facility to complete this project.