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Compact Cylindrical Dielectric Resonator Antenna excited by a Microstrip Feed Line

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ABSTRACT: This letter proposes a novel compact cylindrical Dielectric Resonator Antenna excited by a microstrip feed line. The matching bandwidth is 16.9 – 21.523 GHz and the maximum radiation gain are 9.08 dBi at 17.474 GHz, 12.42 dBi at 18.715 GHz, 12.51 dBi at 19.8 GHz and 10.65 dBi at 20.986 GHz. The performance of the dielectric resonator antenna is simulated by electromagnetic simulator CST Microwave Studio.

KEYWORDS: Dielectric resonator antenna, matching bandwidth, microstrip, compact antenna.

1 INTRODUCTION

In recent years, Dielectric resonator antennas (DRAs) have received broad attentions in various applications due to their attractive features in terms of high radiation efficiency, low dissipation loss, small size, low profile, and light weight [1]-[6]. They were originally proposed by the professor S. A. Long [7], and over last decades, many bandwidth enhancement techniques have been developed [8].

In this letter, we present a new design of a compact cylindrical Dielectric Resonator Antenna. Details of the simulated results exhibiting the characteristics of the studied antenna are presented and discussed.

2 ANTENNA DESIGN

The proposed configuration of the compact cylindrical Dielectric Resonator Antenna excited by a microstrip feed line is depicted in Fig. 1. The DRA is fabricated by using Rogers RO3010 with relative permittivity ε_{r1} = 10.2, with radius R = 5 mm and height H = 2 mm. The developed prototype is printed on a FR-4 dielectric substrate with a relative dielectric constant ε_{r2} = 4.3 and a thickness of 0.794 mm (t). The length and width of the microstrip feed line are L1 = 34 mm and W1 = 1.56 mm, and the length and width of wide strip are L2 = 11 mm and W2 = 3 mm. The DRA is placed on the substrate such that the wider edge of the microstrip line coincides with the DRA's center [9].

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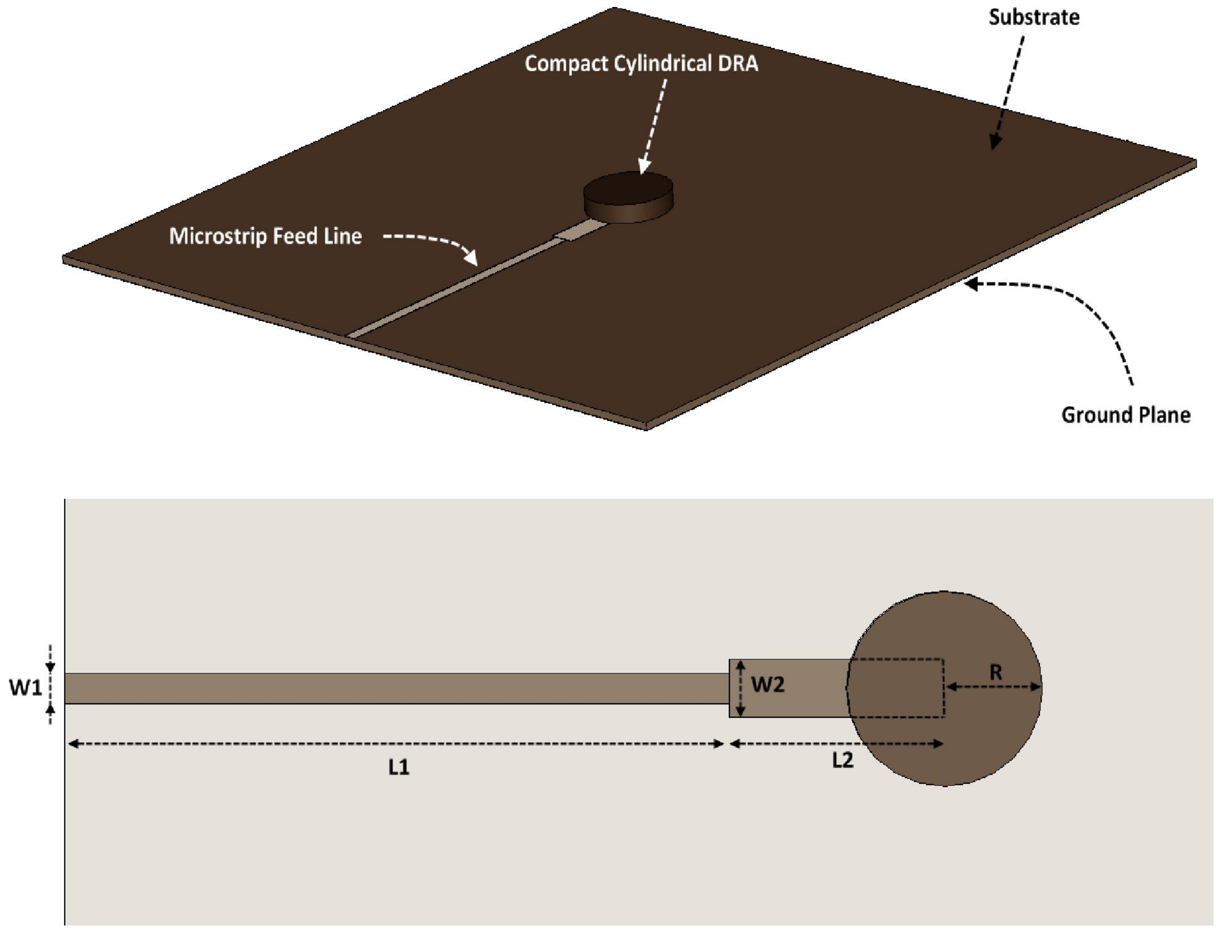

Fig. 1. The geometry of the proposed antenna

The bottom of the dielectric is completely covered by foil and grounded. The ground plane dimensions are 90 mm by *90* mm and the metal cladding is *mc* = 0.05 mm.

3 RESULTS

Fig. 2 shows simulated return loss of the proposed compact cylindrical Dielectric Resonator Antenna. So, we can notice that for the DRA provides an impedance matching bandwidth in excess of 24.06%. Moreover, four modes are excited: 17.474 GHz, 18.715 GHz, 19.8 GHz, and 20.986 GHz.

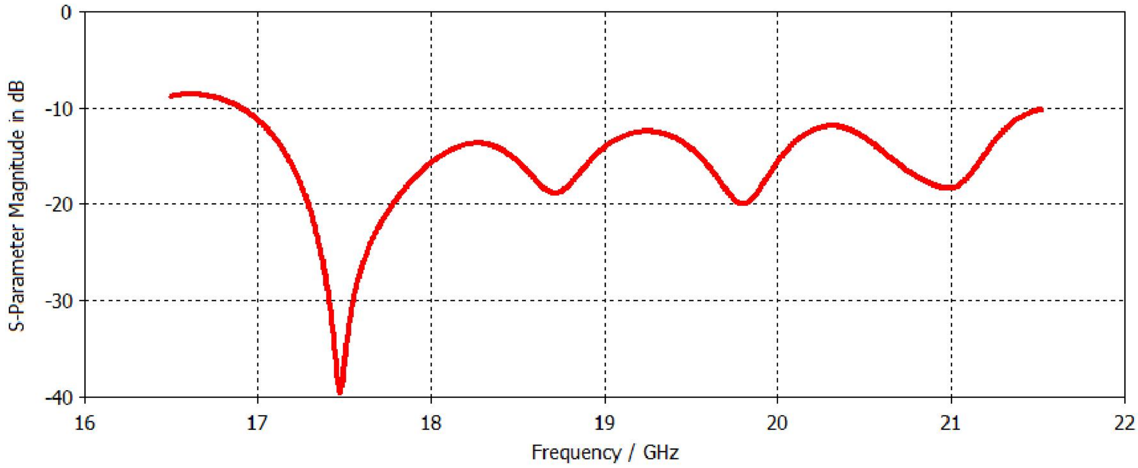

Fig. 2. Reflection coefficient for the cylindrical DRA

Fig. 3 shows the realized gain of the proposed antenna computed using CST Microwave Studio. The maximum obtained gains are 9.08 dBi at 17.474 GHz, 12.42 dBi at 18.715 GHz, 12.51 dBi at 19.8 GHz and 10.65 dBi at 20.986 GHz.

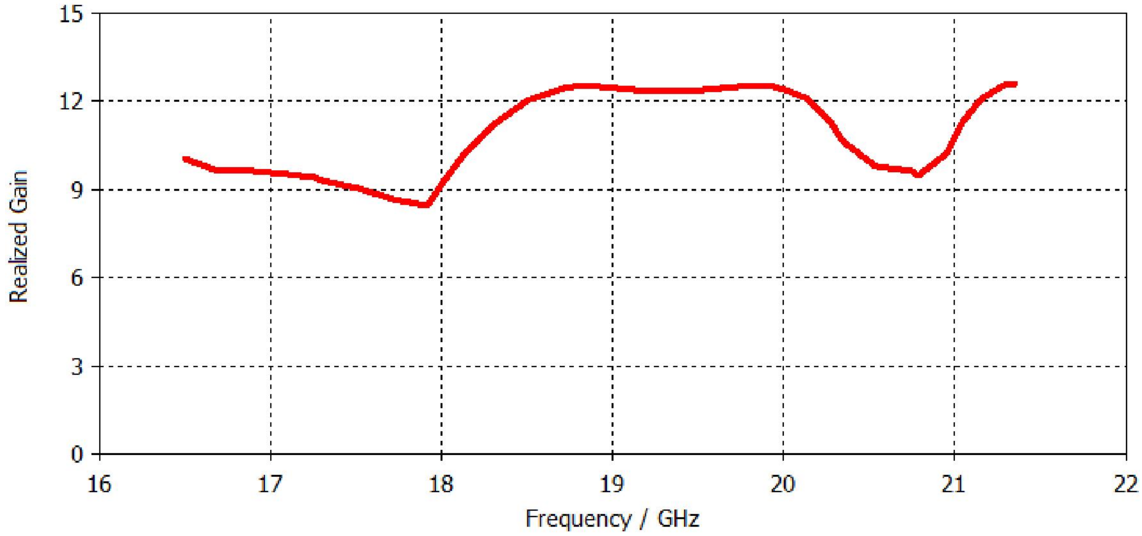

Fig. 3. Simulated realized gain of the proposed antenna

Fig. 4 shows the simulated VSWR of the proposed antenna using CST Microwave Studio. It is clearly that the VSWR is less than 2 along the matching band.

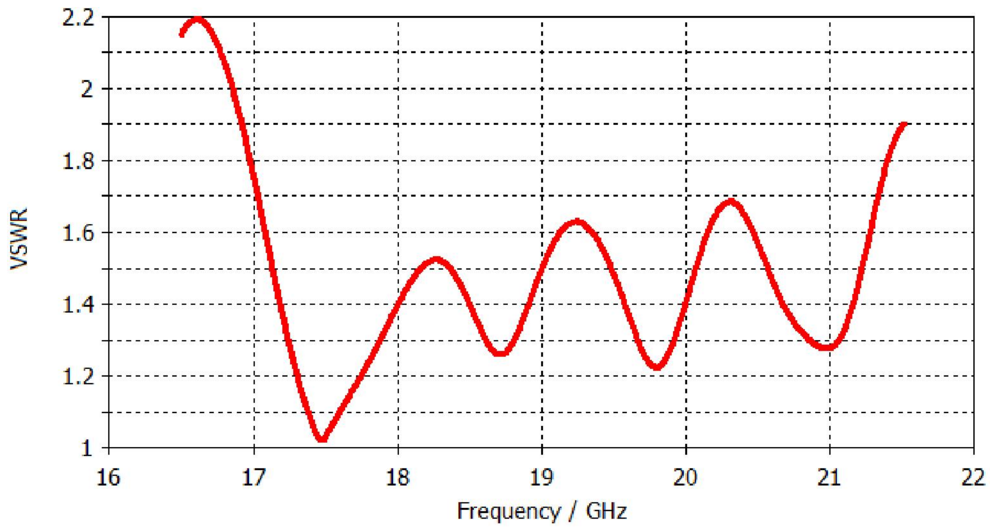

Fig. 4. Simulated VSWR of the proposed antenna

Figures 5, 6, 7 and 8 represent the radiation patterns of the proposed antenna in the x-z, y-z and x-y planes at 17.474 GHz, 18.715 GHz, 19.8 GHz and 20.986 GHz respectively.

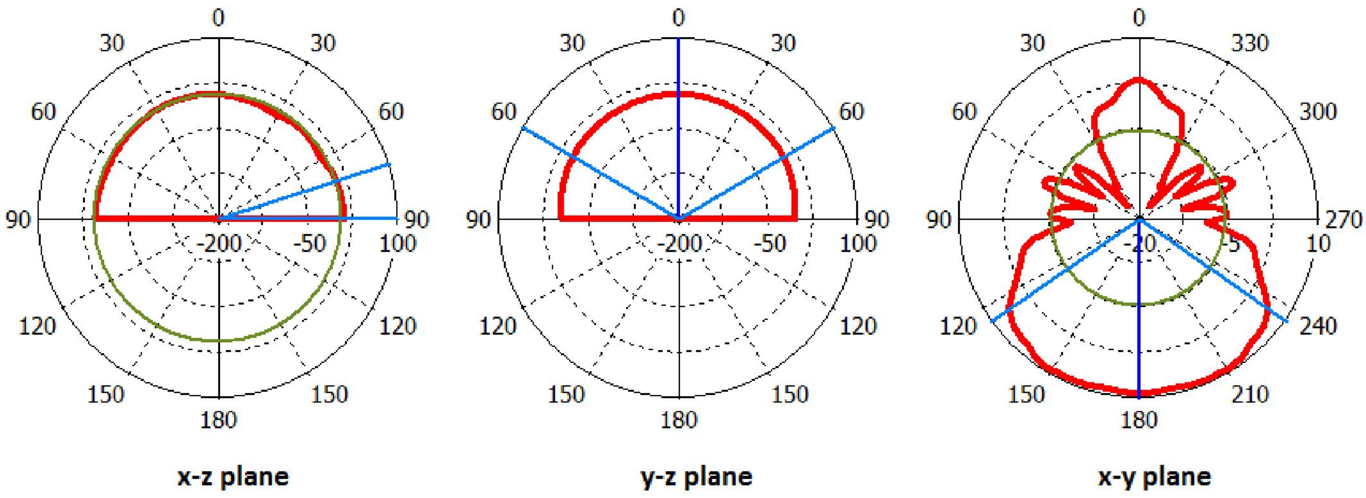

Fig. 5. Simulated radiation patterns of the proposed antenna at 17.474 GHz

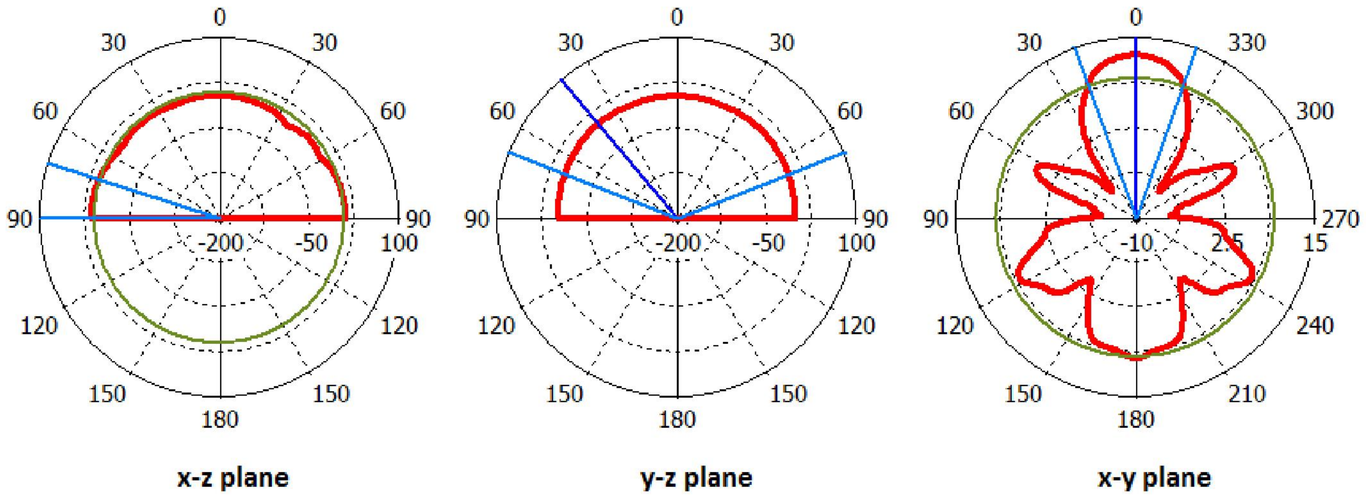

Fig. 6. Simulated radiation patterns of the proposed antenna at 18.715 GHz

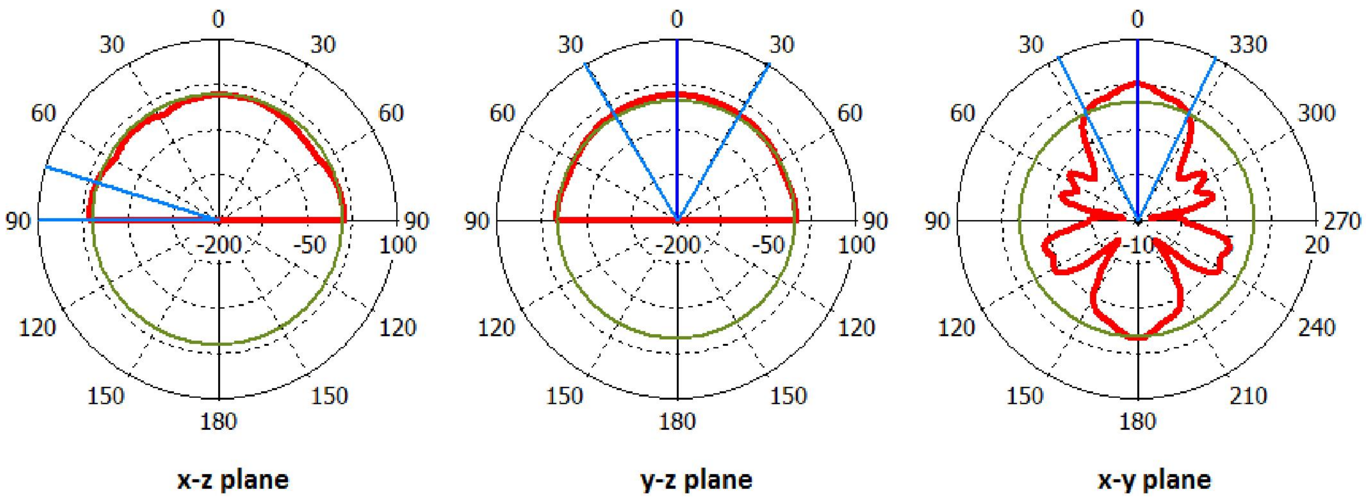

Fig. 7. Simulated radiation patterns of the proposed antenna at 19.8 GHz

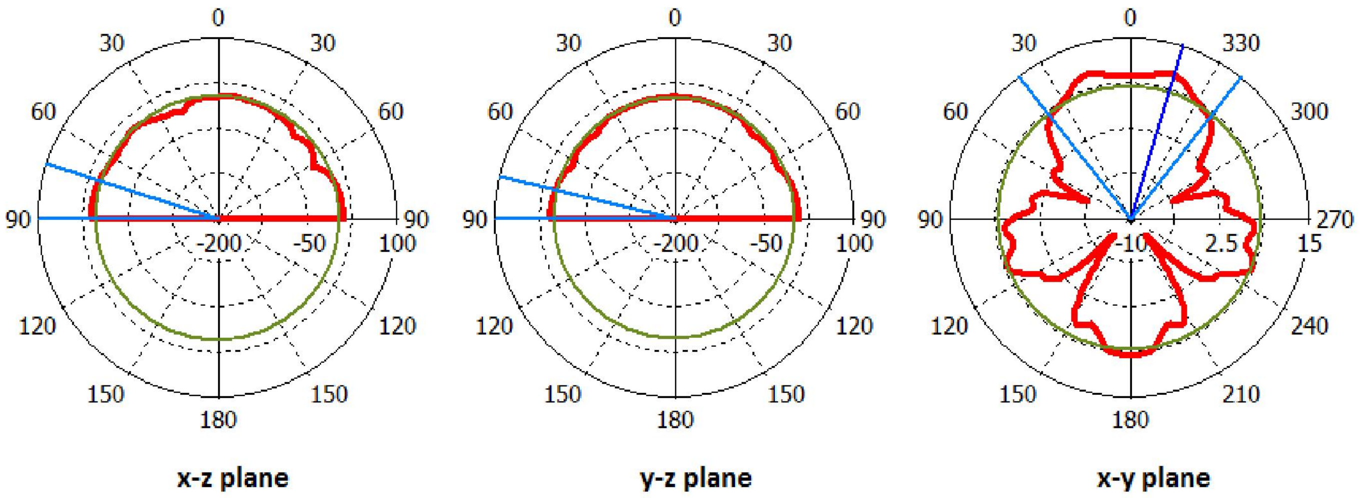

Fig. 8. Simulated radiation patterns of the proposed antenna at 20.986 GHz

It is observed that the radiation patterns in x-z and y-z are unidirectional, however, in the x-y plane are almost omnidirectional for the four resonance frequencies.

4 Conclusion

In this paper, a novel compact dielectric resonator antenna having cylindrical topology and excited by a microstrip feed line, for [16.50 - 21.55] GHz frequencies band applications is proposed. The return losses coefficient and the radiation patterns of the suggested antenna design are presented. As results, this antenna has a bandwidth in excess of 24.06 % (between 16.9 and 21.523 GHz). The maximum radiation gain obtained is 12.51 dBi at 19.8 GHz.

References

[1] Drossos, G., Wu, Z. and Davis, L.E., “A comparative study of circular microstrip and cylindrical dielectric resonator antennas,” *Antennas and Propagation, Tenth International Conference on (Conf. Publ. No. 436)*, vol. 1, pp. 38-42, 1997.

[2] Kishk, A. A., Yan Yin and A. W. Glisson, “Conical Dielectric Resonator Antennas for Wideband Applications,” IEEE *Transactions Antenna and Propagations*, vol. 50, pp. 469-474, 2002.

[3] Kishk, A. A., “Elliptic Dielectric resonator Antenna for Circular Polarization with Single Feed,” *Microwave and Optical Technology Letters*, vol. 37, no. 6, pp. 454-456, 2003.

[4] Kishk, A. A., “Experimental Study of Broadband Embedded Dielectric Resonator Antennas Excited by Narrow Slot,” IEEE *Antennas and Wireless Propagation Letters*, vol. 4, 2005.

[5] Mongia, R. K., Ittipiboon, A. and M. Cuhaci, “Measurement of Radiation Efficiency of Dielectric Resonator”, *IEEE Microwave and Guided Wave Letters*, vol. 4, no. 3, pp. 80-82, 1994.

[6] Qinghua Lai, Georgios Almpanis, Christophe Fumeaux, Hansruedi Benedickter, and Ruediger Vahldieck, “Comparison of the Radiation Efficiency for the Dielectric Resonator Antenna and the Microstrip Antenna at Ka Band”, *IEEE Transactions Antennas and Propagation*, vol. 56, no. 11, pp. 3589-3592, 2008.

[7] Long, S. A., McAllister, M.W., and L. C. Shen, “The resonant cylindrical dielectric cavity antenna”, *IEEE Trans. Antennas Propag.*, vol. 31, no.5, pp. 406-412, 1983.

[8] Qinjiang Rao and Tayeb A. Denidni, “Study of Broadband Dielectric Resonator Antennas”, *Progress In Electromagnetics Research Symposium 2005*, Hangzhou, China, August 22-26, pp. 137-141, 2005.

[9] M. Saed and R. Yadla, “Microstrip-fed low profile and compact dielectric resonator antennas,” *Progress In Electromagnetics Research, PIER 56*, pp. 151-162, 2006.