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Modified microstrip fed of pentagon shape aperture coupling with RDRA for 5G wireless application

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ABSTRACT

In this paper, a rectangular dielectric resonator antenna (RDRA) with modified microstrip feed is proposed. A pentagon-shaped aperture coupling with a bifurcated modified microstrip-line (MSTL) was used to excite the DRA element on the FR4 substrate's backside, resulting in a 3.8 GHz band. Optimizing the design parameters yields a 10% increase in impedance bandwidth, covering frequencies between 3.08 and 3.8 GHz. Maximum gain and radiation efficiency are shown to be 4.85 dB and 90%, respectively, in the operational band using the proposed DRA. As a result, the proposed antenna may be appropriate for use in 5G NR band systems.

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1. Introduction

The dielectric resonator was used as energy storage device for filters and oscillators since 1980. DRA has lot of versatile futures when compare to traditional microstrip patch antenna in terms of metallic, bandwidth, radiation efficiency [1]. Because of its low conductor losses, great degree of freedom, small size, high gain, wideband, high radiation efficiency, and compatibility with diverse feeding approaches, the dielectric resonator antenna is widely employed in wireless communications [2]. According to shape the rectangular dielectric resonator has more advantage than cylindrical and hemispherical DRA in terms of bandwidth control and avoids the mode degeneracy by choosing appropriate aspect ratio of the DRA [3]. Because DRA's bandwidth is inversely related to its dielectric constant, selecting a low value for the dielectric constant results in wideband performance. Several methods has been addressed for wideband configuration in DRA such that stacking DRA [4], Notched DRA [5], Chamfered DRA [6], Parasitic DRA [7], Hybrid DRA [8], Fractal DRA [9], Effect of different feeding and various geometries of DRA such as conical, Asymmetrical T-shaped, Tetrahedral, Ring shaped DRA [10–13].

In this paper initially a single fed rectangular DRA has been excited by two arms of bifurcated fashion microstrip lines with 90° phase difference between them. A pentagon shape slot has been used extensively for the excitation of DR antenna. The bifurcated fashion of microstrip feeding technique and aperture coupling slot excites the TE_{111} mode inside the dielectric resonator antenna. The proposed antenna has simple construction by use of RDRA with simple microstrip feed only. The evidence reveals that the simulated outcomes reflect the real-world data quite well. The rest of the paper can be summarised as follows: Parametric analysis and experimental data are presented in Sections 2 and 3, respectively. Section 4, the paper's conclusion, wraps things up.

2. Antenna geomentry

A modified microstrip fed pentagon shape slot coupled RDRA has shown in Fig. 1 along with dimension in Table 1. Fig. 1(a), (b) and (c) shows the 2D and 3D view of proposed structure, respectively. A ceramic material having dielectric constant (ε_r = 9.8 and tanδ = 0.002) and dimension of (length × width × height) is used as DRA. The substrate material used as FR4 having dimension (Lg × Wg × H) with relative permittivity of (ε_{rs} = 4.4 and tanδ = 0.02). The DRA is excited by the etched pentagon-shaped stub (f mm) and aperture slot (d mm) on the ground plane. The

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