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Research Article

A Compact 5.5 GHz Band-Rejected UWB Antenna Using Complementary Split Ring Resonators

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A band-removal property employing microwave frequencies using complementary split ring resonators (CSRRs) is applied to design a compact UWB antenna wishing for the rejection of some frequency band, which is meanwhile exercised by the existing wireless applications. The reported antenna comprises optimization of a circular radiating patch, in which slotted complementary SRRs are implanted. It is printed on low dielectric FR4 substrate material fed by a partial ground plane and a microstrip line. Validated results exhibit that the reported antenna shows a wide bandwidth covering from 3.45 to more than 12 GHz, with a compact dimension of $22 \times 26\,\text{mm}^2$, and VSWR < 2, observing band elimination of 5.5 GHz WLAN band.

1. Introduction

The formation of the split ring resonator (SRR) was discovered by Pendry for the first time to construct metamaterials where the electromagnetic (EM) wave conducted in an opposite route according to the convectional manner [1–4]. The band-rejected properties are applied to extrude the undesired band for an ultrawide band antenna. In the field of short-distance wireless communication, a new opportunity is introduced by the Federal Communications Commission (FCC), with the announcement of 3.1–10.6 GHz frequency band for unlicensed radio communication [5]. Antennas include a spacious range of cellular mobile phones in the running society resulted in enhancing concerns combining its harmful radiation [6–8]. Because of having the opportunities of high data transmission rate, inexpensiveness, simplicity, and low spectral power density, UWB technology has been considered as one of the most fruitful candidates in wireless communications. Conventional antennas used parasitic strips, SRRs, and different slots to create rejected frequency bands. Some of these antennas had relatively large size or did not cover 5.5 GHz band rejection. Some UWB antennas are designed with band-notched, which are referred to below to face the effect created with respect to the frequency interference operating in WLAN (5.15–5.825 GHz) [9] as well as WiMAX (5.25–5.85 GHz) systems.

A new ring antenna fed by a microstrip line was proposed for UWB communication, where a proximity-coupled configuration was adopted [10]. The average gain was 2.93 dBi where the overall antenna dimension was $44 \times 40\,\text{mm}^2$. An UWB monopole antenna was presented with band-rejected features in the reported reference [11]. Two identical square complementary split ring resonators (CSRRs) were inserted on the radiating patch to achieve rejected bands. The antenna dimensions were 30 mm × 34 mm which was too large than our proposed antenna of compact size 22 mm × 26 mm. A miniaturized crescent microstrip antenna was proposed with an elliptical radiating patch by carving a circular hole inside symmetrically for UWB application [12]. The antenna had a relatively large size ($45 \times 50\,\text{mm}^2$) and did not cover the upper edge frequency of the UWB. A tapered-shape slot antenna was proposed for ultrawide band applications [13]. For the radiating patch and the slot, different types of shapes such as triangular, rectangular, elliptical circular, and square were compared to each other. The antenna achieved ultrawide band properties with medium average peak gain of 3.6 dBi. Some antennas were proposed based on SRRs with metamaterials characteristics [14–16].

In [17], a monopole antenna was presented with single notched-band properties for UWB application. An open-looped resonator is inserted to originate notched-band