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New Design of a Compact 1×2 Super UWB-MIMO Antenna for Polarization Diversity

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Abstract
This paper proposes a new design of compact coplanar waveguide (CPW) fed -super ultra-wideband (S-UWB) MIMO antenna with a bandwidth of 3.6 to 40 GHz. The proposed antenna is composed of two orthogonal sector-shape monopoles (SSM) antenna elements to perform polarization diversity. In addition, a matched L-shaped common ground element is attached for more efficient coupling. The FR-4 substrate of the structure with a size of 23 × 45 × 1.6 mm^3 and a dielectric constant of 4.3 is considered. The proposed design is simulated by using CST Microwave Studio commercial software. The simulation shows that the antenna has low mutual coupling (|S21| < -20 dB) with |S11|<−10 dB, ranging from 3.6 to 40 GHz. Envelope correlation coefficient (ECC) is less than 0.008, diversity gain (DG) is more than 9.99, mean effective gain (MEG) is below - 3 dB and total active reflection coefficient (TARC) is less than -6 dB over the whole response band is reported. The proposed MIMO antenna is expected efficiently cover the broadest range of frequencies for contemporary communications applications.

KEYWORDS: Two Ports, MIMO, Super UWB, High Isolation, ECC, TARC.

I. Introduction

In recent years, antenna designs for not only ultra-wideband (UWB) applications (3.10 GHz-10.6 GHz), but also Super UWB (S-UWB) antennas with bandwidth ratios more than 10 to 1 have emerged as solutions for multiple applications, resulting in a new approach in wireless technologies such as microwave imaging, cognitive radio, sensing networks, higher data rate wireless communications, X-band Radar, and K-band Satellite [1], [2]. The demand for high data rates and good channel capacity has always been the top consideration in modern wireless communication systems. Wireless communication systems depend on ultra-wideband UWB and multi-input-multi-output (MIMO) technologies for high-speed data streaming [3]. Multipath fading is one of the main problems that degrade the performance of UWB systems, and it can be overcome using MIMO technology [4]. MIMO systems can use diversity to improve communication device reliability without requiring additional transmitted power or bandwidth by mitigating the vulnerable multipath fading issue [5]. MIMO antennas have received much attention recently as critical devices in UWB MIMO systems. Those UWB antennas are also successfully used in the Internet of Things (IoT) [6], the radar sector, the microwave and other applications, not restricted to new mobile technologies [7].

Practical UWB antenna design challenges include broad impedance matching, radiation stability, a low profile, and a cheap cost [8]. There are two major challenges in designing MIMO antennas for UWB systems. One major challenge for MIMO systems is to reduce antenna elements' size. The other is to make the antenna elements more isolated from each other [9]. It is important to note that UWB wideband impedance matching should be unaffected by the methods employed to decrease mutual coupling.

Within the last several years, many proposals for S-UWB antennas have emerged [10]–[13]. In [10], a CPW-fed slotted circular monopole achieves a bandwidth of (11.66-56.1) GHz. To achieve a frequency range of 3.32 to 20 GHz, a monopole structure made of circular corrugations on a defective ground is reported [11]. A bow-tie-shaped vertical patch with two asymmetrical ground planes to get bandwidth (3.035–17.39) GHz is proposed [12] . The suggested structure in [13] is a triangular patch fed by a CPW to achieve a bandwidth of 4.9-25 GHz.

Because of their ubiquitous usage in modern applications, S-UWB MIMO antennas have garnered much attention in recent years. Many studies have been conducted