New monopole Antennafor Ultra Wideband Applications

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ABSTRACT
There has been a flourishing prospect of UWB technology in recent years in both communication and other purposes like microwave imaging and radar applications. Recent studies of UWB antenna structures are specially concentrated on microstrip [1], slot and planar monopole antennas [2]. In this work, a small monopole antenna with diamond shape of the patch (30 x 26 mm²) printed microstrip fed monopole antenna has been designed, some parameters like return loss (S11), Voltage Standing Wave Ratio (VSWR), radiation pattern has been performed to test the validity of simulation and verify eligibility of the antenna for the wireless communications purpose.

The proposed antenna is simulated in CST Microwave Studio and has surpassed the bandwidth of UWB requirement, which is from 3.1 to 10.6 GHz, and exhibits good UWB characteristics. The -10 dB return loss bandwidth of this antenna element is from 3.34 GHz to more than 19.5 GHz.

General Terms
Return-loss, Voltage Standing Wave Ratio (VSWR), 2D/3D Radiation Pattern, Gain.

Keywords
Ultra Wideband Antennas(UWB), Planar Monopole Antenna,Finite Integrate Technique (FIT),Method of Moment (MoM).

1. INTRODUCTION
Ultra Wideband (UWB) utilizes narrow pulses (on the order of a few nanoseconds or less) for sensing and communication. The Federal Communications Commission (FCC) in the U.S.A allocated the UWB frequency spectrum from 3.1 to 10.6 GHz below the transmitter noise threshold of –41.3 dBm/MHz [2], [3]. Antennas are in high demand for various UWB applications such as wireless communications, medical imaging, radar and indoor positioning [4]. This is due to its ability to enable high data transmission rate and low power consumption.

Microstrip patch antenna is frequently used in UWB antenna designs due to its advantages such as lightweight, ease of integration, small size and compact [5]. Many UWB microstrip patch antennas have been discussed in the literature to achieve the requirement for different applications, one of which to increase the bandwidth. Since microstrip patch antennas inherently have narrow bandwidth characteristic, there have been numerous techniques developed for bandwidth enhancement in order to achieve the UWB characteristics [6]. These antennas have been discussed in the literature, for instance, Square-ring slot antenna, dual-band slotted antenna[7][8], and dual-band notched antenna. Other techniques employed to increase the bandwidth of antennas include meandered ground plane, slot loading and fractal antenna [9].

In this paper, the antenna is printed on microstrip substrate with a diamond shape of the patch, which operates in the range of 3.34–19.5 GHz, thus achieving the UWB bandwidth enhancement. Section II describes the basic configuration of the antenna design, whereas Section III discusses a simulated result of the antenna performances. Lastly, the findings of the simulated results are summarized in the conclusion.

2. ANTENNA GEOMETRY
Fig.1 shows the geometry of the proposed planar antenna whose parameters have been obtained using commercially available simulations software CST Microwave Studio [10] which contains different techniques and calculation methods. This antenna is printed on FR4 Rogers substrate $\varepsilon_r = 4.5$ with thickness 1.6 mm and size 30 x 26 mm² and the antenna feeding structure is 50 Ω microstrip line.

Several techniques have been adopted to acquire large impedance bandwidth including a diamond like triangular radiating patch with five steps of various sizes and a partial ground plane[11]. The feed line is denoted by *Wf*.

The patch antenna structure is printed on one side of the FR4 substrate with the ground on the other side. The ground plane is denoted by *G* and rounded corner with rayon *F* as shown in "Fig.1".The physical structure of five steps with various dimensions have been adopted to increase the effective electrical length at the lower frequency band (3-4 GHz).

The design parameters such as the patch shape, steps, the feed line width and shape of partial ground plane are optimized to obtain the best return loss[12][13], S11 and impedance bandwidth before determining the best dimensions for the proposed antenna. The dimensions of the antenna structure are as shown in Table 1.