DESIGN OF DUAL PORT SLOT MIMO ANTENNA FOR RADAR APPLICATION

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Abstract:
Multiple Input Multiple Output (MIMO) antenna plays a major role in modern wireless and satellite communication due to their high data rate, Bandwidth, minimum power consumption capability for propagating multiple path via multiple antennas. The design of a dual port slot MIMO antenna using defected ground structure for Radar application is proposed. The overall dimension of the antenna is 65.9x65.9x1.6mm3. It covers the bandwidth of 0.7GHz from 8.7GHz-9.4GHz. Here, the resonating frequency is 9GHz which is obtained by the proposed dual port MIMO antenna with microstrip feed structure. Here, the greater isolation S_{21}<-20dB is obtained by V-shaped dumbbell slot over the ground plane of proper dimension. The simulated return loss, isolation, gain, directivity, radiation pattern are presented using advanced design software (ADS) software. With high impedance, bandwidth, good isolation the antenna is expected to be useful for UWB transmission incorporating MIMO, radar and medical imaging applications.

Keywords— Multiple input Multiple output (MIMO); defected ground structure (DGS); isolation; microstrip feed; multiband.

I. INTRODUCTION

A four port reconfigurable MIMO antenna for WLAN application is proposed. The frequency of operation of antenna is from 4.9GHz to 5.725GHz with the isolation greater than -14dB. The overall size of the antenna is 40x20x1.6mm^3 and is printed on FR-4 substrate [1]. Multiple Input Multiple Output (MIMO) antenna plays a major role in modern wireless and satellite communication due to their high data rate, Bandwidth, minimum power consumption capability for propagating multiple path via multiple antennas [2]. Bow-tie broadband slot antenna with asymmetric coplanar waveguide feed with high gain of 5.53dBi. This antenna can operate from 2.76GHz to 8.1GHz is discussed [3]. Two F-Shaped slots were etched on the radiator with defected ground structure is discussed in [4] for triple band operation. Microstrip Patch Antenna is designed for Ku band 12GHz to 18GHz. The proposed antenna on a Teflon substrate with dielectric constant 2.1. Return loss at resonant frequency 12.54GHz is found to be -26.55dB with bandwidth of 4.1GHz is presented[5]. Three co-located slots on a square columnar structure for penta-band is presented. Here, the slots play the roles of radiating element also as defected ground structure for impedance matching [6]. Multiband antenna is the type of antenna which is capable of operating in multiple bands of frequencies. A compact multiband antenna applicable for mobile handset and tablet is presented. The overall dimension of the radiating element is 35x11x5mm^3. Here the ceramic substrate is used, which is costly compared to the formal FR4 substrate [7]. In recent years, MIMO antenna with single and multiple operating bands and omni-directional radiation is widely used. Defected ground structure (DGS) is the simple and popularly known technique to design a antenna, used for wide range of applications. The equivalent circuit model for various DGS structure is discussed in [8].

II. DUAL PORT MIMO ANTENNA DESIGN

2.1. Dual Port MIMO Antenna Configuration

The proposed dual port MIMO antenna is designed using FR-4 substrate. The radiator or antenna element is placed over one side of the substrate and the ground plane on the other side. The substrate is sandwiched between the two planes. The dimension of the patch and the resonating frequency is determined using the expressions sited below. The resonance frequency of the rectangular microstrip patch antenna is computed from equation (1) where L is the patch length, L_{eff} is the effective length. Effective relative permittivity is calculated from equation (2) as shown. Efective length of the patch is computed from equation (4).

$$f_r = \frac{C}{2L_{eff}\sqrt{\epsilon_{reff}}} \quad (1)$$

$$\epsilon_{reff} = \frac{\epsilon_r+1}{2} + \frac{\epsilon_r-1}{2}\left(1+\frac{12h}{W}\right)^{-1/2} \quad (2)$$

Where C is the velocity of light in free space,
ε_{reff} is the effective relative permittivity,

$$\frac{\Delta L}{h} = 0.412\frac{(\epsilon_{reff}+0.3)(\frac{W}{h}+0.264)}{(\epsilon_{reff}-0.258)(\frac{W}{h}+0.8)} \quad (3)$$

$$L_{eff} = L + 2\Delta L \quad (4)$$