CHAPTER 7

Summary

The significant advancement was observed in antenna designs for wireless technology, during last two decades to fulfill the requirement of high data rate and large channel capacity. Apart from this, compactness of design is also important due to need of portable devices. On one hand, portability can be achieved by placing number of antenna elements on the single printed circuit board. On the other hand, placement of multiple antenna elements creates a problem of mutual coupling or isolation among them. To resolve the issue of mutual coupling or isolation, different isolation techniques are adopted in MIMO antenna design. The details of these isolation techniques, their advantages and disadvantages, mathematical aspects of MIMO antenna parameters has been reviewed and analyzed in initial part of the thesis. The designing of compact and isolated MIMO antennas with single band and multiband, for portable devices is of prime concern of the thesis. In this regards different MIMO antennas designs have been carried out to satisfy the requirement of wireless technology.

Various MIMO antennas have been proposed in this research for wireless, compact, and portable devices in Wi-Fi, Bluetooth, WiMax, S-Band, C-Band, ISM and other WLAN application. Now a day’s wireless technology has become a part of daily human life like electricity. The most of electronic deceives like LCD projector, T.V, Washing Machine, watches, mobile, Laptop, iPad, DVD player, coffee maker, refrigerator etc. can be connected via wireless technology easily. However, the body
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absorbs the amount of radiation due to the uses of such radiating devices. Therefore, the effect of radiating in terms of SAR is also studied in the presented research.

In the first design, modified circular common element antenna for 2.4 GHz WLAN application is proposed. The big challenge in common element MIMO antenna is to maintain the isolation among physically connected antenna radiators, which has been successfully achieved by modified circular common element antenna geometry and by the use of diagonal parasitic element. The diagonal parasitic element improves the isolation among antenna ports and provides more than 10 dB of isolation in 2:1 VSWR frequency band. The proposed design fulfills all the needs of MIMO antenna technology, and has bandwidth of 220 MHz in 2.34-2.56 GHz. The design achieves an isolation of more than 10.0 dB, ECC < 0.01, MEG ≤ -2.70 dB, TARC bandwidth of 202 MHz, and specific absorption rate (SAR) ≤ 0.17 W/Kg in the band.

In the second design, a modified feed technique is used along with the combination of T-shaped structure and horizontal parasitic element to control the effect of mutual coupling. The modified feed line and isolation structure enhance the impedance matching and reduces the mutual coupling among radiating elements. The proposed octagonal-shaped ring radiator achieved 1.9 GHz wide bandwidth in the frequency range of 2.1-4.0 GHz. The design achieves ECC of 0.026 in the 2:1 VSWR band, TARC bandwidth of 1.2 GHz, and MEG ≤ -3 dB in whole band.

In the third design, a wideband 2x2 meander-line MIMO antenna has been presented to satisfy the requirement of 5.8 GHz WLAN application in 5.3-6.7 GHz
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band. The designed ML antenna has 1.40 GHz bandwidth, ECC < 0.0004, isolation > 10.0 dB, TARC bandwidth > 1.00 GHz, gain > 4.0 dBi, and SAR in the safety limit.

The fourth MIMO antenna design covers 2.24-2.50 GHz, 3.60-3.99 GHz, 4.40-4.60 GHz, and 5.71-5.90 GHz frequency bands to cover Wi-Fi, Bluetooth, WiMAX and C-Band applications using spider-shaped structure. The prime advantage of the fourth design is its novel structure, which maintains the 10 dB isolation between radiating ports without any other isolating element. The design provides MIMO antenna gain ≥ 2.0 dBi, and ECC ≤ 0.08 in the entire frequency spectrum.

The antenna design parameters like return loss, isolation, gain, ECC, MEG, E-Field, H-field, TARC, and SAR are analyzed and discussed for all the proposed MIMO antennas. All the designs are simulated and optimized using CST MWS tool and fabricated on FR4 dielectric substrate, and tested using VNA.