

Rolled Fat Monopole with Band-notch Function for UWB Applications

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ABSTRACT

In this paper, the rolled fat monopole antenna with band-notch function for UWB systems is proposed. The proposed antenna has the omni-directional patterns in azimuth and very small size. It covers 3.1~9.0 GHz band for VSWR < 2, using the rolled fat monopole structure.

The proposed antenna has wide bandwidth and band-notch function of 5 GHz WLAN band limited by IEEE802.11a and HIPERLAN/2. To achieve these two characteristics of wide bandwidth and partial band-notch, the fat monopole and $\lambda/4$ slits are used, respectively. From the simulated results, it is observed that that wide bandwidth from 3.1 to 9.0 GHz for the VSWR<2 is achieved, while 5 ~ 6 GHz WLAN band is band-notched.

I. Introduction

Recently, Ultra-wideband(UWB) technique has become one of the most fascinating technologies in indoor communications. It has the merits of high speed transmission rate, low power consumption and simple hardware configuration over conventional wireless communication systems. According to the regulations released by FCC, the UWB systems for indoor communications have been allocated to the spectrum from 3.1 to 10.6 GHz in order to prevent unnecessary interference with other radio systems. Recently, many laboratories and firms have developed UWB antennas satisfying such specifications [1-4], but the use of 5.15~5.825GHz band is limited by IEEE 802.11a and HiperLAN/2. To avoid the interference between the UWB and these bands, a band notch filter in UWB systems is necessary. The proposed antenna in this paper is designed to reject the limited band by inserting $\lambda/4$ slits into the monopole antenna. This antenna not only covers UWB band but also rejects the limited band. Moreover, it has a compact size and omni-directional pattern in azimuth.

II. Antenna design

We proposed the rolled fat monopole antenna for the miniaturization and ultra-wide bandwidth, and it has the similar radiation patterns to monopole antenna over entire bandwidths. The proposed UWB antenna is fabricated by Cu metal plate and FR4 substrate with dielectric constant of 4.5 and height of 1.0mm. The configuration of the proposed antenna is presented in Fig. 1. It is composed of the rolled fat monopole, microstrip feed line and rolled ground plane. To obtain wide bandwidth, the proposed

antenna is designed to have the fat monopole structure. It makes it possible to have broadband impedance matching. To reject 5.15~5.825 GHz band limited by IEEE 802.11a and HiperLAN/2, the $\lambda/4$ slits are inserted to the fat monopole. The $\lambda/4$ slits used for band-rejection operate as bandstop filter. As the length of slits varies, the rejection band can be changed. The parameter study for the length of slits is shown in Fig. 2. The optimized parameters are summarized in Table 1.

III. Experimental results

The simulated return loss of the proposed antenna is shown in Fig. 3. The proposed antenna can cover the frequency band 3.0 ~ 9.0 GHz for VSWR<2 and reject the band 5.0 ~ 6.0 GHz, which includes the limited band by IEEE802.11a and HIPERLAN/2. The gain varies from 2.5 dB to 5.5 dB on the azimuth plane except the notched band. The simulated radiation patterns are shown in Fig. 4 and Fig. 5. As shown in Fig. 4, E plane patterns are similar to those of monopole antenna and in Fig. 5, H plane patterns are omni-directional. From the simulated radiation patterns, the results show the omni-directional pattern. However, the E plane patterns lean to one side a little and the reason is asymmetry of radiator. It is after all a cause of rolled structure.

In simulated results, it shows that rolled structure can maintain similar antenna characteristics to planar fat monopole antenna.

IV. Conclusions

The rolled fat monopole antenna with band-rejection characteristic is proposed. To obtain the wide bandwidth,