A UWB Antenna design with Adjustable Second Rejection Band using a SIR

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Abstract—A UWB (ultra wide band) antenna using a SIR (Step Impedance Resonator) that eliminate signal interference at 5 GHz WLAN as the first rejection band and can adjust the second rejection band is proposed. The proposed antenna is satisfied to cover full UWB band with return losses less than -10 dB and push the second rejection band to out of band. The design process is done with numerical analysis and the optimization is given by PSO (particle swarm optimization) algorithm. The radiation patterns show $\alpha \gamma$ directivity characteristics in H-plane and the group delay variations are within 1.0 ns.

Index Terms—ultra wideband antenna, resonator filters

I. INTRODUCTION

The designs of antenna for UWB applications face many challenges including their impedance matching, radiation stability, compact size, low manufacturing cost and electromagnetic interference (EMI) problems. The EMI problems are quite serious for UWB systems since there are several other existing narrowband services which occupy frequency bands within the UWB bandwidth [1]. A few examples of hostile systems are WiMAX (3.3–5.8 GHz), WLAN 5GHz (5.15–5.825) and ITU 8GHz (8.025–8.4 GHz) band [2]. For the band rejecting, many methods have been reported. The most popular approach is to embed resonance slots in the radiating patch or in its ground plane [3]. Those designs are with flat skirt characteristics and can not control bandwidth and ripple because they have one-pole rejection characteristics using one or more resonators. To overcome these shortcomings, the two-pole band-rejected UWB antenna using two resonators have been proposed [4-5].

In this paper, we propose a new band-stopped Bow-Tie monopole UWB antenna with second rejection SIR. The size of the resonator is determined by the center frequency of rejecting band and the second harmonic frequency is arisen according to the ratio of the step impedance. We placed the SIR at the side of the Bow-Tie antenna and optimally design parameters by numerical analysis to reject full range of WLAN and push the second reject band out of UWB range. The SIR can be placed around the radiating patch without degradation on the operation of the main UWB antenna except the band-rejection band. Also they need no extra space for adoption.

II. DESCRIPTION OF FILTER AND ANTENNA

Fig. 1 shows the model of the proposed Bow-Tie antenna. The angle values $\alpha$, $\beta$ and $\gamma$ are corresponded with the return loss in the high and low frequency band. And please note that the start edge is overlapped to get an impedance matching with feeding line.

III. RESULTS AND DISCUSSION

The proposed antenna is printed on the Taconic RF60-A substrate with thickness of 0.64 mm, relative dielectric constant of 6.15 and loss tangent 0.0025. The EM-simulation tool is the commercial HFSSTM. And the Particle Swarm
Optimization algorithm is implemented to find final values. Fig. 3 shows the effect of Gap to return loss, for primary research. As the Gap goes narrow, the rejection band is lowered and has high rejection characteristics. And as the Gap goes wide, the frequency of the rejection band is raised and has poor rejection characteristics.

Table 1 and Fig. 4 illustrate several types of SIRs and the resulting return losses each. The second rejection band is varied by SIR type and parameters. For SIR type1, it rejects 8 GHz band, and the band goes up to 13 GHz in case of Type 2 and 4. Thus, it is denoted that the second rejection band is controllable by SIR.

![Fig. 3. The return loss distribution according to the Gap](image)

Using the above data as initial values, we obtain the optimal values as shown in Fig. 4, also. It has improved characteristics with the broad rejection bandwidth at WLAN band and lower return losses over the whole UWB range, and has the second rejection band above the 12GHz area.

The return loss and the group delay are measured using Anritsu vector network analyzer 37397C. They agree pretty well with each other in spite of fabrication error. The radiation patterns of the proposed antenna are shown in Fig. 6 at 3.5 GHz, 5.5 GHz, and 10.5 GHz, respectively. The 3.5 GHz and 10.5 GHz are on the radiation band and the 5.5 GHz is on the rejection band. The group delay variations are within 1.0 ns except rejection band.

![Fig. 4. The return loss according to the types of SIR](image)

Fig. 6. The radiation pattern of the simulated and the measured one

REFERENCES