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A NOVEL TRIPLE-BAND SEMI-CIRCULAR SLOT ANTENNA FOR WLAN/WIMAX APPLICATIONS

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Introduction

Owing to the rapid developments in WLAN/WIMAX communications in the recently years, multi-band operations in the 2.4 GHz (2.4 ~ 2.484 GHz), 3.5 GHz (3.4 ~ 3.6 GHz) and 5 GHz (5.15 ~ 5.95 GHz) bands are becoming demanding in practical applications. The dual-band slot antenna designs have been presented by using single slot ring antenna with a narrow rectangular slot [2], parasitic element [3], stair-shaped slot antenna [4] and rectangular slot antenna embedded with a U-shaped strip [5] or two rectangular strips [6]. However, the triple-band slot antenna applied for WLAN/WIMAX applications is very scant in the literature. Therefore, in this article, we propose a novel semi-circular slot antenna inset with dual arc-shaped strips for triple-broadband operation in WLAN/Wimax communication. Owing to the inset unsymmetrical arc-shaped strips along the circle edge of the semi-circular slot antenna, a new resonant mode can be excited closely to 3.5 GHz for WIMAX communication. And, with the excited 2.4 and 5 GHz band of the proposed semi-circular slot antenna for WLAN applications, the triple-band operation can be easily achieved. It is also found that, by properly adjusting the directional angle, ϕ, between the x-axis and the center line of the subtended angle of dual arc-shaped strips to be 2^o, the obtained bandwidths for 2.4/3.5/5 GHz bands are 310/250/600 MHz, respectively, which is enough for WLAN/WIMAX communication. Details of the proposed slot antenna designs are described, and experimental results for the obtained dual-broadband performance are presented and discussed.

Antenna Design and Results

As shown in Fig. 1, dual arc-shaped narrow strips with the width of S and subtended angle of θ is unsymmetrically inset along the circle edge of the semi-circular slot antenna with the radius of R1. The proposed semi-circular slot antenna with the radius of R is etched on a substrate of thickness h and relative permittivity ε_r. The directional angle between the x-axis and the center line of the subtended angle of dual arc-shaped strips is set to be ϕ. Due to the presence of the embedded unsymmetrical arc-shaped strips, a new resonant mode can be excited closely to 3.5 GHz for WIMAX communication. However, the fundamental resonant modes of the proposed semi-circular slot antenna operating at 2.4 and 5 GHz band for WLAN applications are slightly perturbed with the operating frequency less varied. Fig. 2 shows the related experimental results of the return loss for the proposed semi-circular slot antenna design of Fig. 1. Results show the satisfactory agreement for the proposed slot antenna design operating at the 2.4, 3.5 and 5 GHz bands. From the experimental results, the measured bandwidth can reach about 13.2% (310 MHz) for 2.4 GHz band, 7.0% (250 MHz) for 3.5 GHz and 10.8% (600 MHz) for 5 GHz band for the condition of the proposed arc-shaped strip with S = 2 mm and $\phi = 2^o$. The proposed slot antenna provides much greater impedance bandwidths for triple operating bands to meet the bandwidth specifications of WLAN and WIMAX communication system. The radiation patterns at triple operating modes of the proposed slot

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antenna are measured and plotted in Fig. 3. These three resonant modes are seen to be of same polarization planes and similar radiation characteristics. Peak antenna gains for triple operating bands are measured to be, respectively, 4.5, 4.2 and 5.1 dBi and the gain variations for triple bands are within 0.5 dBi.

Conclusions

A novel triple-band semi-circular slot antenna for WLAN/WIMAX communication has been proposed and experimentally studied. With the use of dual arc-shaped strips, the impedance bandwidths for triple operating bands can reach about 13.2% (310 MHz) for 2.4 GHz band, 7.0% (250 MHz) for 3.5 GHz and 10.8% (600 MHz) for 5 GHz band, which is enough for the WLAN/WIMAX specifications.

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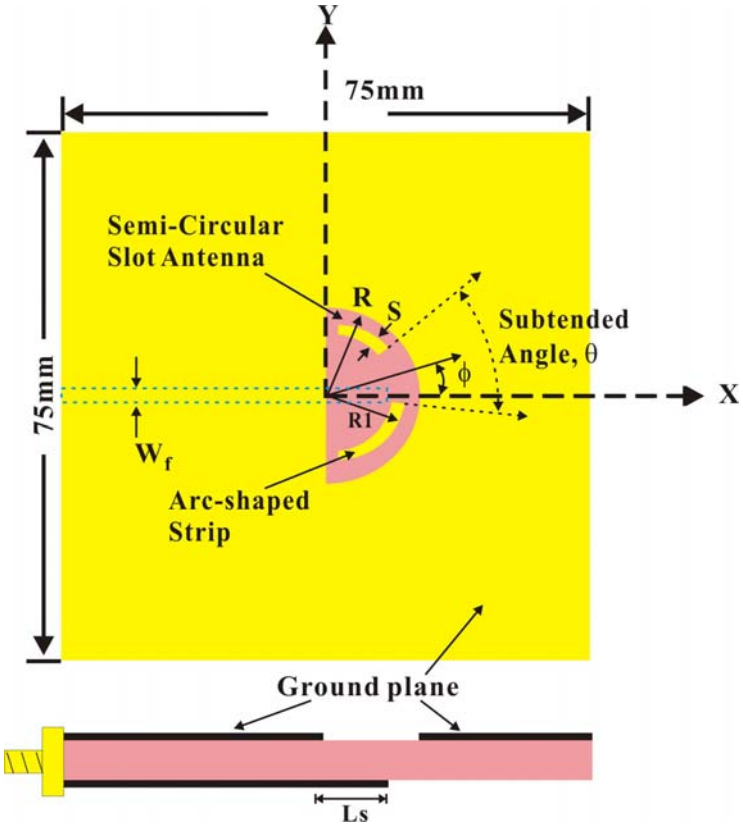

Fig. 1 Geometry of the proposed semi-circular slot antenna for triple-band operation.

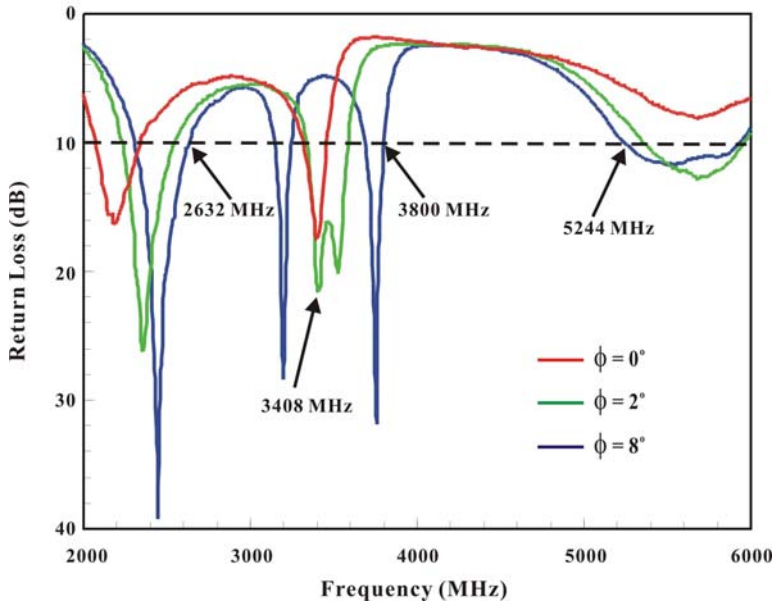

Fig. 2 Measured return loss for the multi-band semi-circular slot antenna; ε_r = 4.7, h = 1.6 mm, R = 19.4 mm**,** Ls = 12.5 mm, S = 2 mm, θ = 90°, R1 = 18.4 mm, ground plane size = 75 × 75 mm^2.

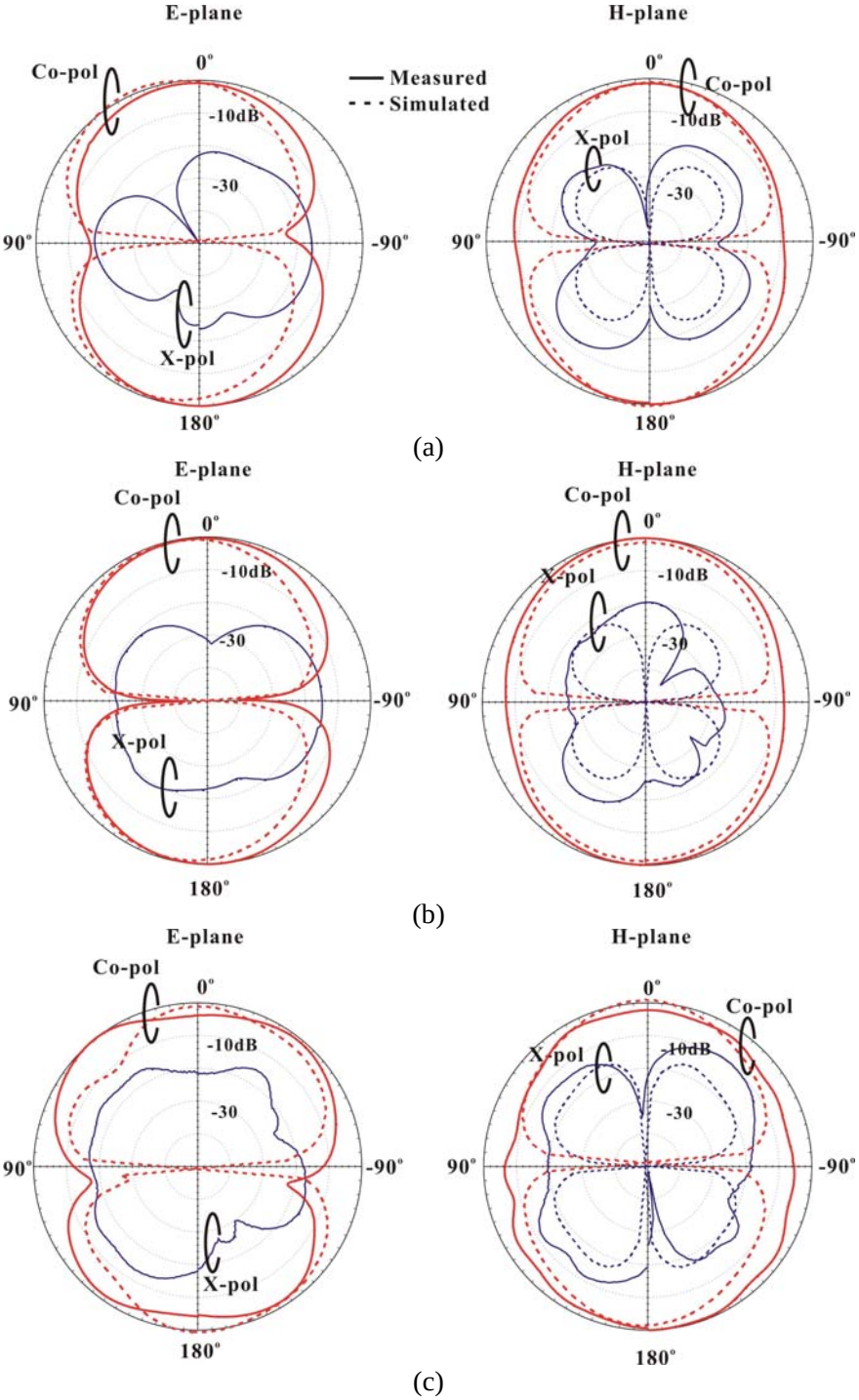

Fig. 3 E-plane (*x*-*z* plane) and H-plane (*y*-*z* plane) radiation patterns for the proposed slot antenna given in Fig. 2. (a) 2.4 GHz band. (b) 3.5 GHz band. (c) 5 GHz band.