U-Shaped Strip-Slot Antenna for a mobile device

Wen-Shan Chen and #Wen-Yen Chang
Department of Electronic Engineering, Southern Taiwan University
Yung-Kang city, Tainan County, Taiwan 710, R.O.C.
chenws@eecs.stut.edu.tw, m9530256@mail.stut.edu.tw

1. Introduction

Internal antenna is the current trend since the thickness of mobile phone sets has been reduced day by day. As the demands for covering bands are increasing, however, designing of antenna for thin mobile phones is intending toward to small size and compact with multi-band operation. Some internal antennas are mounted at the top portion of the ground plane have been demonstrated [1]-[2] for application in mobile devices. Recently, several types of printed complementary antennas have been developed. Antenna consists of spiral shaped metal strips and slots on a coplanar ground plane as small size and wideband performance was devised [3]. In reference [4], I-shaped self-complementary antenna (SCA) has been demonstrated by adding a resistance load at the opposite of the feed for improving wide bandwidth. Moreover, to improve of I-shaped self-complementary antenna, the L-shaped antenna [5] has been proposed which has wider bandwidth and well radiation efficiency then that shown in [4]. In this study, we present a U-shaped strip-slot antenna for triple band operation. Both simulation and experimental, and radiation pattern characteristics, are also shown and discussed.

2. Antenna Design

The proposed antenna geometries are illustrated in Figure 1. The overall dimension of the proposed antenna is $60 \times 120\,\mathrm{mm}^2$. The total length of the U-shaped radiation strip is 66mm, which corresponds to about 0.53 wavelength at 2.4GHz. Other detailed parameters are tabulated in table 1. Note that the gap(G) is to adjust the impedance matching, the bandwidth enhancement was achieved when G was chosen to be 1mm. Note that the open-end of the U-shaped arm is the location of the feed point, and the other side of the feed point is at the adjacent corner of the antenna’s ground plane. A 50Ω coaxial cable is used as the feed structure. The antenna was first designed as U-shaped structure to operating at 2.4GHz for WLAN (IEEE 802.11b Band: 2.4-2.5GHz). Furthermore, by inserting a symmetric slot on the ground plane, triple-band operations in the 0.9GHz (GSM Band: 890-960MHz), 1.8GHz (DCS Band: 1710-1880MHz) and 2.4GHz (WLAN) can also be obtained. Note the symmetric slot geometry has the same dimension as that of the U-shaped radiation strip.

3. Experimental Results and Discussion

By using Ansoft simulation software HFSS and Agilent 8720ES vector network analyzer, the impedance characteristics of the proposed antenna are successfully simulated and measured. Figure2 shows the simulated and measured return losses of the proposed antenna and good agreement between the simulated and measured result is obtained. Base on the definition of 2.5:1 VSWR (about 7.3dB return loss), the measured impedance bandwidth is about 320MHz (0.88-1.2GHz), 170MHz (1.71-1.88GHz) and 250MHz (2.25-2.5GHz) which cover GSM900 band, DCS band and WLAN IEEE 802.11b band respectively. As the geometry shown in Fig.1, it’s clearly seen that the antenna with symmetric structure was similar to SCA (self-complementary antenna). Because of the finite ground plane, the proposed antenna is not the nominal SCA [6]. The measured far-field radiation characteristics of the proposed antenna were measured and calibrated in our anechoic chamber. Figure 3 shows the measured antenna gain of the proposed antenna at three application frequencies. Figure 4 shows the radiation patterns in the X-Y, X-Z and Y-Z plane at 0.9GHz and 1.8GHz.

4. Conclusion

The novel design of triple band antenna has been proposed and experimentally investigated. The proposed antenna is easy to fabricated, low-profile and easy to combine circuits. The main radiation element size of the proposed antenna is only $30 \times 30\text{mm}^2$ which is occupied 9.4% area of total size and small enough to be located internal area of actual handsets. From experiment results, it was shown the measured return loss, far field radiation patterns and antenna gain are agreed well with the definition of wireless communication handsets.

Acknowledgments

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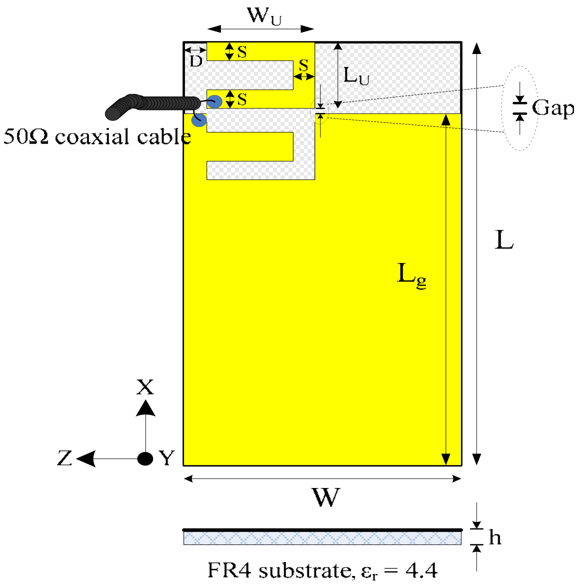

Figure 1: Geometry of the proposed antenna

Antenna parameters (unit: mm)	
W	60
L	120
Lu	14
Wu	26
S	3
D	4
Gap(G)	1
h	0.8
Lg	105

TABLE 1: Antenna parameters

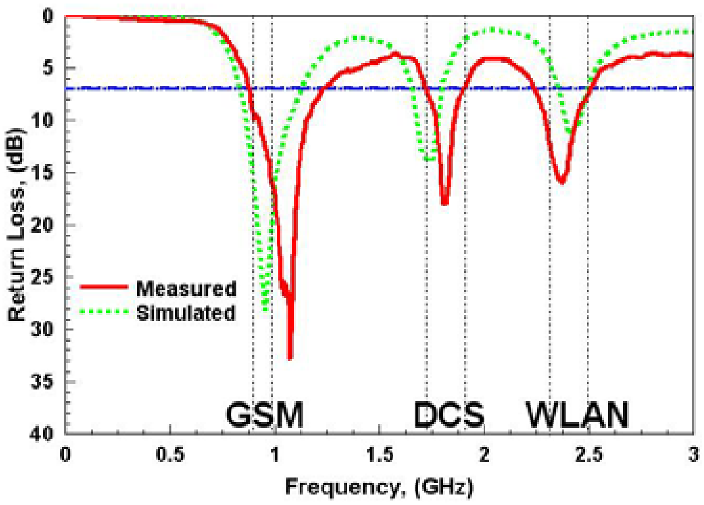

Figure 2: Measured and simulated return loss of the proposed antenna

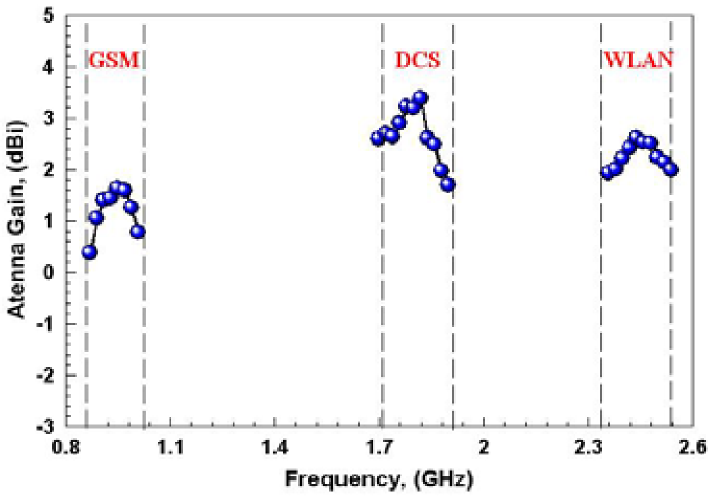

Figure 3: Measured antenna gain of the proposed antenna

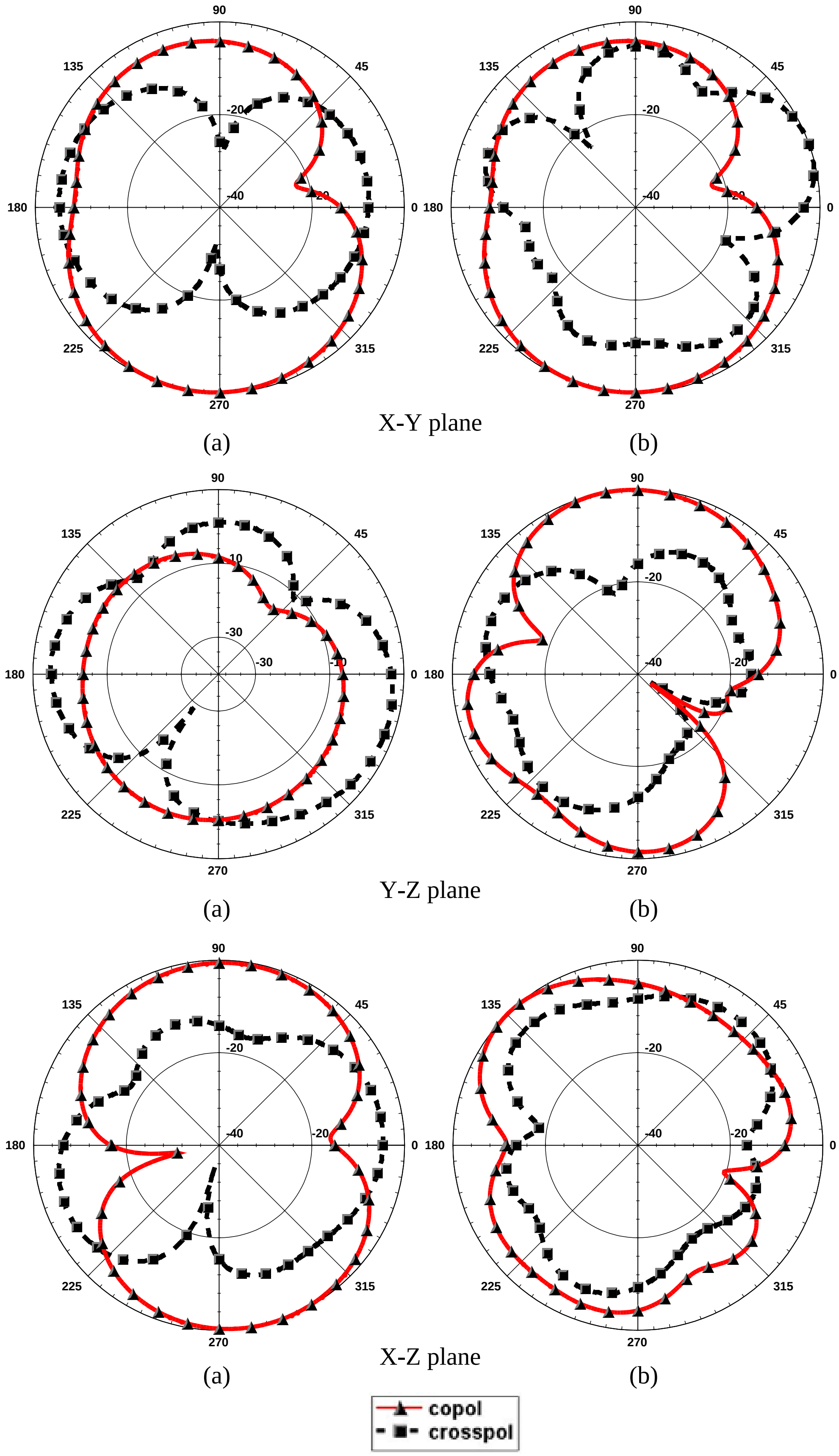

Figure 4: Measured far-field radiation patterns of Antenna in the X-Y plane, Y-Z pane and X-Z plane at (a) 900MHz and (b) 1800MHz