Dual-band Printed Antenna for WLAN Applications

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Abstract— A compact dual-band printed antenna is presented and discussed for wireless local area networks (WLAN) applications in this paper. The proposed antenna is printed on a FR4 substrate with a dielectric constant of 4.3 and an overall size of $40 \times 40 \times 1.6\,\mathrm{mm}^3$. The antenna consists of two mendering strips which locate at the top and bottom sides of the substrate, respectively. The top strip aims to generate a resonance frequency operating at 5.8 GHz WLAN band, while the bottom strip can provide another resonance for 2.4 GHz WLAN applications. Simulated results show that the proposed antenna can provide two resonance frequencies and good omnidirectional radiation patterns, making it suitable for lower and upper WLAN applications.

1. INTRODUCTION

Nowadays, wireless communication systems have attracted much more attention in home and abroad. Since WLAN communication can work in both 2.4 GHz and 5.8 GHz bands, an antenna is required to operate in dual frequency bands simultaneously. However, it is a great challenge to design dual-band or multi-band antennas integrated into the inside of modem compact wireless devices.

Consequently, a great number of methods have been proposed to implement dual-band or multi-band antennas. Fractal geometries such as Koch snowflake, Minkowski-like pre-fractal patch and Peano fractal curve have been presented and investigated in detail [1–4]. However, these antennas are complex in structures. Several dual-band or multi-band antennas have been designed by using multi-branches [5–10]. Among these well designed antennas, each branch can produce a resonance frequency for multi-band applications. However, they are large in size, which limits their applications in practical engineering. Another effective method to design multi-band antenna is realized by using various slots such as U-shaped slot [11–13], which can control the current path and, hence, control the resonance frequency.

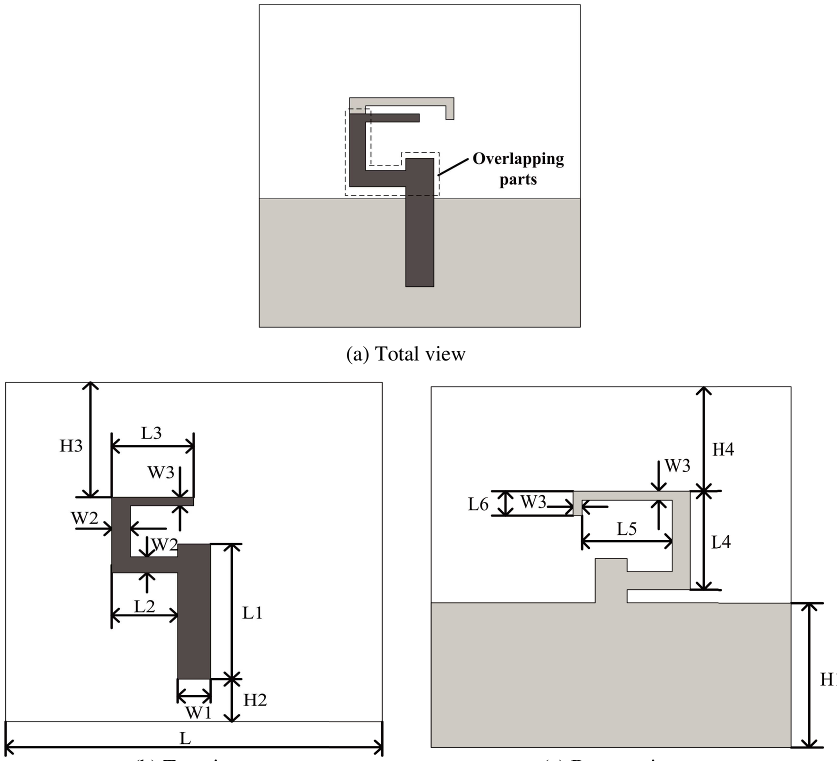
In this paper, a dual-band antenna with small size and simple structure is presented for lower and upper WLAN applications. The proposed antenna has two strips located at the top and bottom sides of a FR4 substrate whose dielectric constant is 4.3. The antenna with a small size of $40 \times 40 \times 1.6\,\mathrm{mm}^3$ can operate in both 2.4 GHz and 5.8 GHz bands. Also, the proposed antenna can provide an omnidirectional radiation patterns, rendering it promising for portable WLAN terminals.

2. ANTENNA DESIGN

The configuration of the proposed dual-band antenna is shown in Fig. 1. The proposed antenna consists of a FR4 substrate with the dielectric constant of 4.3, a ground plane, two meandering strips which are printed on the top and bottom sides of the substrate, respectively. The top meandering strip is connected with a 50-Ohm coaxial line, while the bottom meandering strip is set under the top one. By using this structure, the impedance matching can be highly improved. The detailed configuration of the antenna is depicts in Figs. 1(b) and 1(c). The proposed antenna is optimized by using CST and the optimal parameters are listed in Table 1.

Table 1: Optimal parameters of the proposed antenna.

Parameters	$H1$	$H2$	$H3$	$H4$	L	$L1$	$L2$
Unit (mm)	16	5	14	12	40	16	7
Parameters	$L3$	$L4$	$L5$	$L6$	$W1$	$W2$	$W3$
Unit (mm)	8.7	11	10	2.7	3.5	2	1



(a) Total view

(b) Top view

(c) Bottom view

Figure 1: The configuration of the proposed antenna.

3. RESULTS AND DISCUSSION

In order to better understand the performance of the proposed antenna, the effects of the key parameters $L3$ and $L6$ are investigated and illustrated in Fig. 2 and Fig. 3. Fig. 2 shows the return loss of the proposed antenna with varying $L3$. It can be seen that the center frequency of the upper band shifts from 6 GHz to 5.6 GHz with an increase of $L3$ ranging from 8.3 mm to 9.1 mm, while the center frequency of the lower band moves from 2.5 GHz to 2.3 GHz with an increase of $L6$ ranging from 1.7 mm to 3.7 mm. The simulated result with varying $L6$ is given in Fig. 3. Thus, the upper and lower bands can be tuned by adjusting the dimensions of the top and bottom strips, respectively. The proposed antenna has been optimized by the use of CST and the optimal return loss of the antenna is demonstrated in Fig. 4. It can be seen that the antenna covers the bandwidths of WLAN 2.4 GHz (2.4–2.484 GHz) and WLAN 5.8 GHz (5.725–5.825 GHz) with respect to S_{11} less than -10 dB.

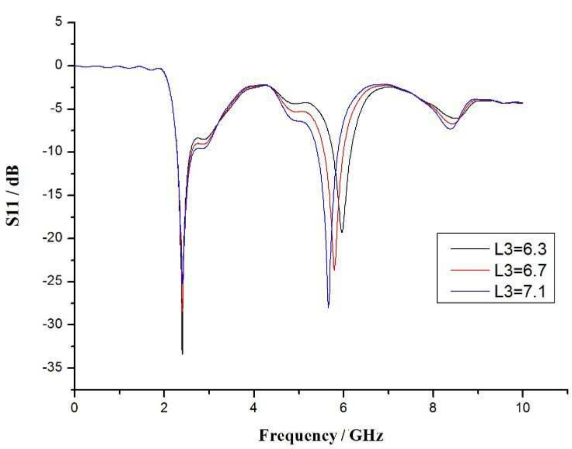


Figure 2: The return loss of the proposed antenna with varying $L3$.

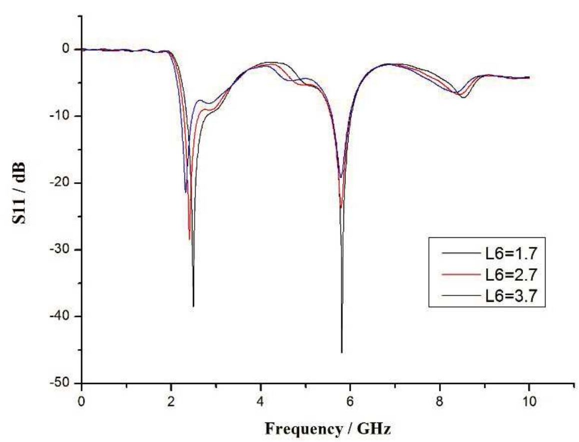


Figure 3: The return loss of the proposed antenna with varying $L6$.

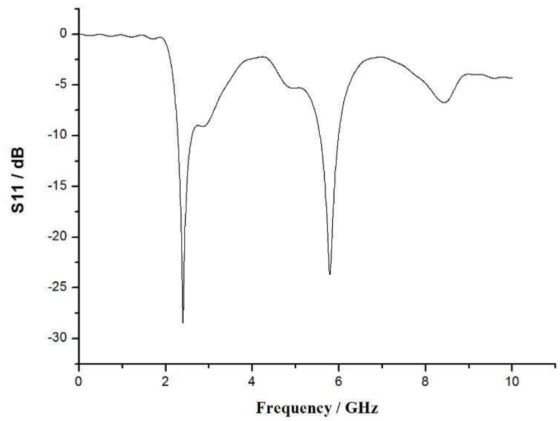
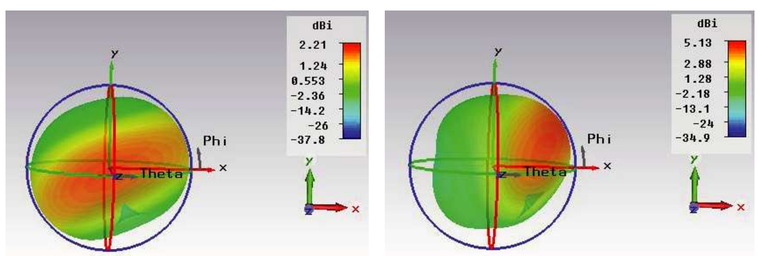


Figure 4: Optimal return loss of the proposed antenna.

The 3-D radiation patterns of the proposed antenna at 2.4 GHz and 5.8 GHz are displayed in Fig. 5. It is found that the proposed antenna has nearly omnidirectional radiation characteristics in the operating bands.



(a) 2.4 GHz (b) 5.8 GHz

Figure 5: The 3-D radiation patterns of the proposed antenna at 2.4 GHz and 5.8 GHz.

4. CONCLUSION

A dual-band antenna has been proposed and well investigated for WLAN applications, which is small in size. By using an overlapping strip structure, the proposed antenna can achieve a good impedance bandwidth within the dual operating bands. Also, the proposed antenna has a tunable dual-band function at both 2.4 GHz and 5.8 GHz bands, and can provide nearly omnidirectional radiation patterns, which make it suitable for miniaturized WLAN devices.

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