

Circularly polarized square slot antenna for navigation system

Yixing Zeng#, Yuan Yao#, Junsheng Yu#, Xiaodong Chen*, Youbo Zhang#

School of Electronic Engineering, Beijing University of Posts and Telecommunications, No.10 Xitucheng Road, Beijing, China

* School of Electronic Engineering and Computer Science, Queen Mary, University of London, London, UK
yixing_zeng@163.com

Abstract-This letter presents a circularly polarized square slot antenna used for navigation system. A tuning stub protruded into the slot from the narrowed stripe at the end of the signal strip of the CPW is used to obtain good impedance matching. A measurement showed that the bandwidth below -10dB of the antenna varied from 1.15GHz to 1.71GHz, and the Axial Ratio below 3dB is from 1.14 GHz to 1.75GHz. The radiation pattern is bi-directional.

I. INTRODUCTION

For generating circular polarization(CP) radiation, many solutions have been reported[1]. The CP antennas have lost of different types and structures including dielectric resonator antennas, reconfigurable patch antennas, monopole antennas and the most prevalent microstrip antennas. Now days CPW-fed square slot antenna has got much attentions due to their simple structure, wide bandwidth and easy to fabricated.

In [2], Jia-Yi Sze has designed the antenna by protruding a T-shaped metallic stripe from the ground plane toward the slot center and feeding the square slot antenna using a 50Ω CPW with a protruded signal stripe at 90 to the T shaped stripe. In [3], he designed the antenna with two inverted-L grounded stripes around two opposite corners of the slot and a widened tuning stub protruded into the slot from a signal stripe of CPW. In [4], Yue-Ying Chen designed the antenna with two opposite corners of the square slot. This paper presents a wideband circularly antenna which is printed on a square board. The antenna is fed by a coaxial cable through SMA. The bandwidth of return loss of the antenna varied from 1.15GHz to 1.71GHz. The bandwidth AR of the antenna varied from 1.15GHz to 1.75GHz.

II. ANTENNA DESIGN

The structure of the proposed circularly polarized antenna design for automobile is illustrated in fig 1. The proposed CPW-fed antenna is printed on a square substrate with a side size of $G=90\text{mm}$, a height of $h=0.8\text{mm}$, a dielectric constant of 2.3, Etched at the center of the top-side ground plane is a $75\text{mm} \times 75\text{mm}$ square slot, which is fed by a CPW line. the resistance of the CPW line is 50Ω . The signal tripe of the CPW is protruded into the slot by a line. The CP operation of

the proposed antenna is mainly attributed to the two grounded inverted-L stripe.

The CPW-fed square slot antenna is shown in fig 2.. Notice that the x-axis is horizontal and z-axis is vertical.

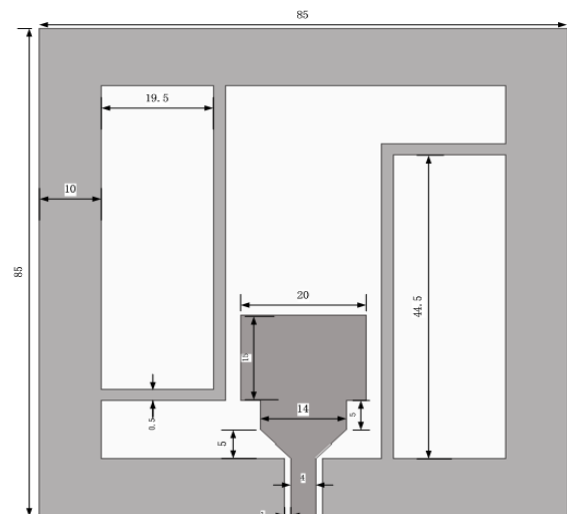


Figure 1. A structure of antenna configuration

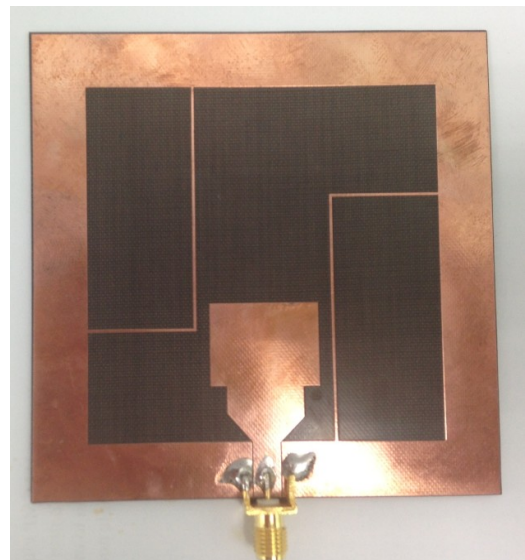


Figure 2. Fabricated CPW-fed Square slot antenna

III. SIMULATED AND MEASURED RESULT

The performance of this CPW-fed slot antenna is very sensitive to many parameters, which would affect the performance of the antenna, such as the size of the L-stripe. The simulation results of the antenna was carried out via HFSS, which is a full wavelength numeric electromagnetic simulation tool. A comparison between simulated and measured return loss is illustrated in fig 3. The measurement was carried out in chamber. It is evident that the antenna has a good match and good accuracy between measurement and simulated results is observed. The -10dB bandwidth is from 1.1GHz to 1.7GHz, which is broad enough to cover several frequency bands for the navigation system.

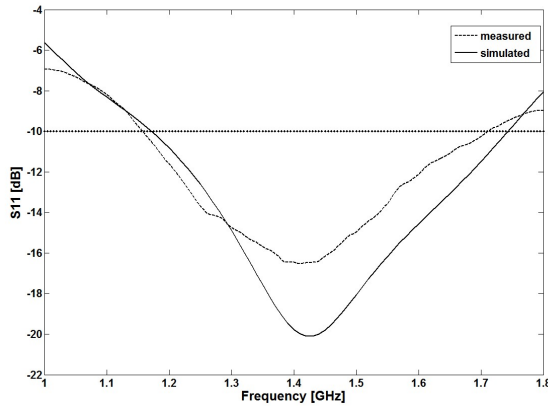


Figure 3. Measured and simulated return loss(S11) of the CPW-fed square slot antenna

Fig.4 compare the measured and simulated axial ratio(AR). We can see the AR is below -3dB from 1.14GHz to 1.75GHz, which means that the antenna has a good CP performance.

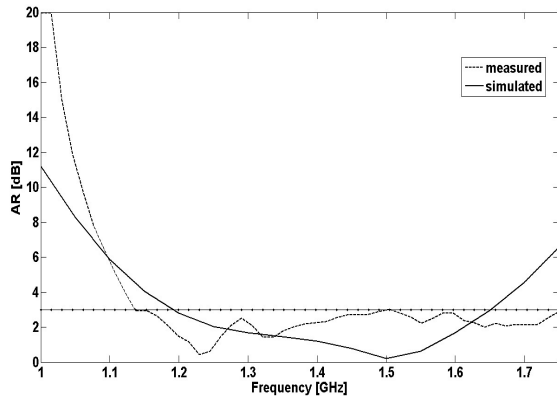


Figure 4. Measured and simulated Axial Ratio of the CPW-fed square slot antenna

Fig 5 and fig 6 shows the 2-D radiation pattern at 1.227GHz and 1.575GHz. The maximum gain is about 4dBi, which is found in the y and -y direction. It can be seen that the antenna radiates RHCP from the top of the antenna and LHCP from the bottom of the antenna. The measured result has good

match with simulated result. Fig 7 is the simulated gain of the antenna at 1.227GHz and 1.575GHz.

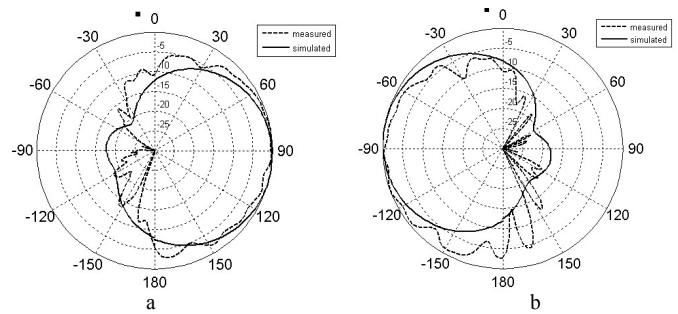


Figure 5. Measured and simulated 2-D radiation pattern of y-z plane at 1.227GHz (a) RHCP (b) LHCP

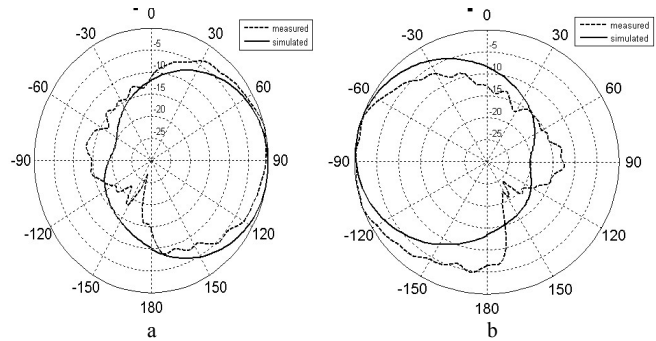


Figure 6. Measured and simulated 2-D radiation pattern of y-z plane at 1.575GHz (a) RHCP (b) LHCP

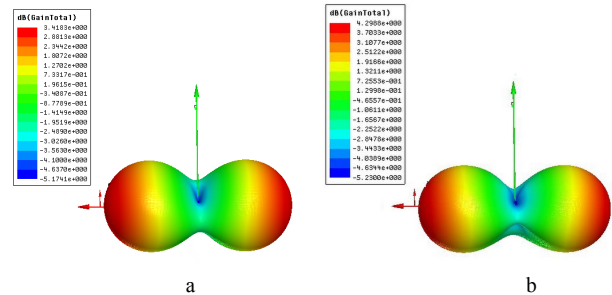


Figure 7. Simulated 3-D radiation pattern of the proposed antenna (a) at 1.227GHz (b) at 1.575GHz

CONCLUSION

A CPW-fed slot antenna for GPS, GNSS, Compass and Galileo was designed using CPW-fed square slot structure. The simulation result obtained by HFSS show good agreement with the measured results. The measured radiation patterns of the proposed antenna are bi-directional.

ACKNOWLEDGMENT

This work is supported by the Fundamental Research Funds for the Central Universities, the National Natural Science Foundation of China under Grant No.61201026, and Beijing Natural Science Foundation (4133091).

REFERENCES

- [1] Zainud-Deen S H, El-Azem Malhat H A, Awadalla K H. A single-feed cylindrical superquadric dielectric resonator antenna for circular polarization[J]. Progress In Electromagnetics Research, 2008, 85: 409-424.
- [2] Sze, Jia-Yi, Kin-Lu Wong, and Chieh-Chin Huang. "Coplanar waveguide-fed square slot antenna for broadband circularly polarized radiation." Antennas and Propagation, IEEE Transactions on 51.8 (2003): 2141-2144..
- [3] Sze, Jia-Yi, and Chi-Chaan Chang. "Circularly polarized square slot antenna with a pair of inverted-L grounded strips." Antennas and Wireless Propagation Letters, IEEE 7 (2008): 149-151.
- [4] Chen Y Y, Jiao Y C, Zhao G, et al. A novel compact slot antenna for broadband circularly polarized radiation[C]//Antennas Propagation and EM Theory (ISAPE), 2010 9th International Symposium on. IEEE, 2010: 201-204