

Dr G Kalyani, J. Nonlinear Anal. Optim. Vol. 11(10) (2020), October 2020

Journal of Nonlinear Analysis and Optimization

Vol. 11(10) (2020), October 2020

<https://ph03.tci-thaijjo.org/>

ISSN : 1906-9685



J.Nonlinear Anal. Optim

A Defected Ground Microstrip Patch Antenna for Wireless Communications

Dr G Kalyani

Associate Professor, Department of CSE

Sri Sai Institute of Technology and Science, Rayachoti

Email: kalyaniphd@gmail.com

Abstract- Wireless communication has always been a vast field for the experts and as the technology is rising day by day the advancements have always arose to such an extent that the communication network has slowly started depended on the wireless mode. For the implementation of wireless network many forms of antenna are used. In this paper, a printed slot wide band antenna fed by a microstrip line with heptagonal slots for bandwidth enhancement is proposed and experimentally studied. From experimental results, the measured impedance bandwidth, defined by 10-dB return loss, can reach two different bands operating at different frequencies from approximately 1.9- 2.5 GHz, 7.8-9.8 GHz.

Keywords- Microstrip Antenna, Bandwidth, Hexagonal slots, HFSS, Printed slot antennas.

I. INTRODUCTION

Printed slot antennas are attractive because their operating bands usually have wide bandwidths. In addition, they are easily integrated with active devices or MMICs. A wide-slot is a slot with an aspect-ratio significantly smaller than that of the usual narrow slots, sometimes quite close to 1. Characteristics of printed wide-slot antenna fed by a microstrip line have also been widely studied In the reported literature, a printed wide-slot antenna fed by a microstrip line with a fork-like tuning stub is good for bandwidth enhancement. However, it makes the configuration of the wide-slot antenna more complicated in the design on the feed line. In this paper, a new design of microstrip-line-fed printed wide-slot antenna with simply small slots for bandwidth enhancement is proposed and investigated. The small slots are placed at each corner of polygon. By choosing proper small slots, it can be expected that the other resonant mode operating near one of the conventional wide-slot antenna can be obtained. Hence within the operating bandwidth, four resonant modes having similar slot radiation patterns and the same polarization planes makes significant bandwidth enhancement of the proposed wide-slot antenna possible.

II. ANTENNA IN WIRELESS COMMUNICATIONS

Patch antennas are very popular because of their low profile nature, light weight and low costs. They have many advantages over conventional antennas. Because of these advantages these antennas are widely used in wireless applications. Some of applications are as listed below:

Applications	Ranges
Global positioning satellite (GPS)	1575 MHz and 1227 MHz
Wireless local area network (WLAN)	2.40- 2.48 GHz and 5.4 GHz

Direct broadcast satellite (DBS)	11.7- 12.5 GHz
Automatic toll collection	5-6 GHz
DCS (base station)	1710–1880 MHz

Table 1. Wireless Applications with operating ranges

III. ANTENNA CONFIGURATION

The configuration of the proposed antenna is 7H shown in Fig.1. The shape of the slot antenna 7H is assumed and the drawing method of this polygon is shown in Fig. 2. The b' is the radius of main heptagon and a' is the radius of small heptagon. The polygonal slot antenna is fed by a 50Ω microstrip line, printed on the opposite side of the substrate and placed on the centerline (Y-axis) of the polygonal slot. The width of the tuning line is equal to that of the 50Ω microstrip line ($w = 3\text{mm}$). The substrate is made of FR4 material.

According to Fig. 1 (or Fig. 2), the parameters in the structure of all the antennas studied are b (or b'), a (or a') and c , where c is negative or positive value. By selecting the proper dimensions for these parameters, the proposed antennas show a good impedance matching across a very broad band.

The ground plane is also chosen to be square with a side length of 50mm. The correct values can be obtained using a simulation tool such as HFSS.

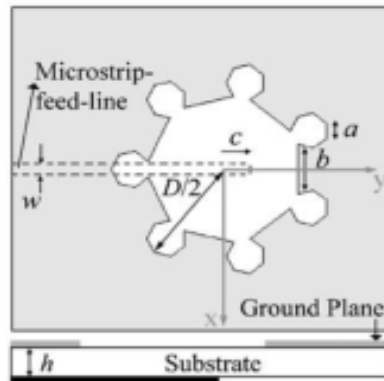


Fig 1. Geometry of 7H antenna

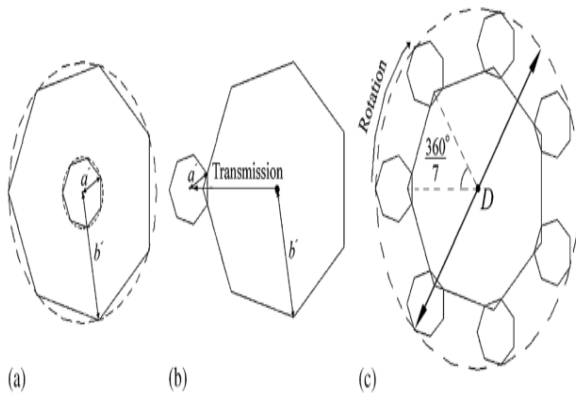


Fig 2. a) shape drawing b) drawing small heptagon c) rotating small heptagons.

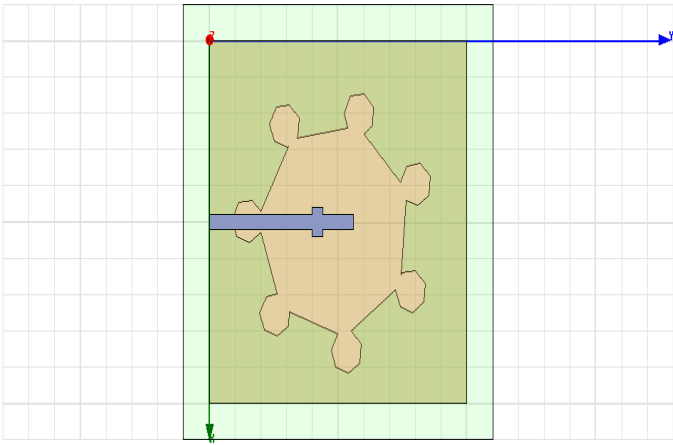


Fig 3. Structure of 7H printed slot antenna

Figure3 shows the structure of 7H printed slot microstrip antenna implemented by using HFSS tool.

	Freq [GHz]	dB(S(LumpPort1,LumpPort1)) Setup1 : Sweep1
1	1.000000	-0.766249
2	1.009505	-0.786455
3	1.019010	-0.807258
4	1.028514	-0.828695
5	1.038019	-0.850803
6	1.047524	-0.873621
7	1.057029	-0.897192
8	1.066533	-0.921558
9	1.076038	-0.946765
10	1.085543	-0.972860
11	1.095048	-0.999891
12	1.104552	-1.027909
13	1.114057	-1.056966
14	1.123562	-1.087117
15	1.133067	-1.118418
16	1.142571	-1.150927
17	1.152076	-1.184704
18	1.161581	-1.219811
19	1.171086	-1.256311

Table 2. Data Table

IV. RESULTS & DISCUSSIONS

In this paper the simulated return loss of the 7H antenna is measured & presented. The bandwidth of these antennas can be widened by small slots that are placed at each corner of polygon appropriately. A printed wide-slot antenna fed by a 50 Ω microstrip line with small slots for bandwidth enhancement has been demonstrated. Figure 4 shows the return loss pattern of 7H antenna.. Fig 5. Shows the 3D polar plot of this printed slot wide band antenna.

V. CONCLUSIONS

Experimental results show that the impedance bandwidth of a printed wide-slot antenna can significantly be improved by suitable small slots. The results of measurement, obtained in this study, show that the bandwidth for the proposed antenna 7H can reach two different bands operating at different frequencies from approximately 1.9-2.5 GHz, 7.8-9.8 GHz. In addition, the proposed antenna also shows less parameter, reasonable bandwidth and a simple feeding structure, compared to a conventional printed wide-slot antenna. The resonating frequency of antenna is 8.9 Ghz. It is observed that these antennas can be used for different applications. These antennas are suitable for GSM (1900–1990MHz), PCS (1900–1990MHz), IMT-2000 (1920–2170MHz), Bluetooth (2400–2484MHz), IEEE802. (2400–2484MHz), PHS (1905–1915MHz), PACS(1930–1990MHz), UMTS

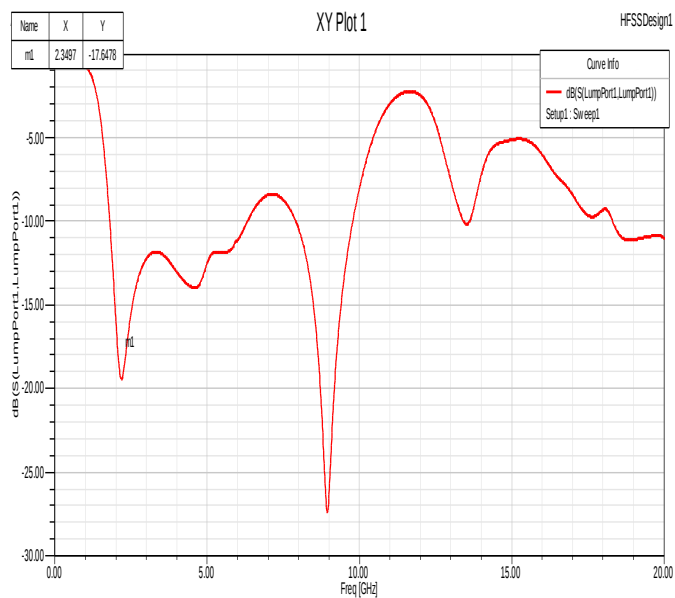


Fig 4 . Shows the return loss pattern of 7H antenna.

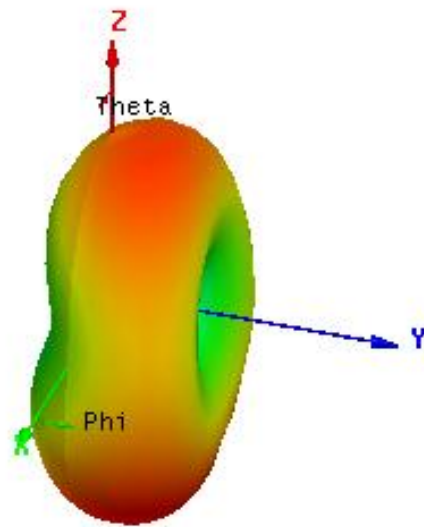


Fig 5. Shows the 3D polar plot of 7H antenna .

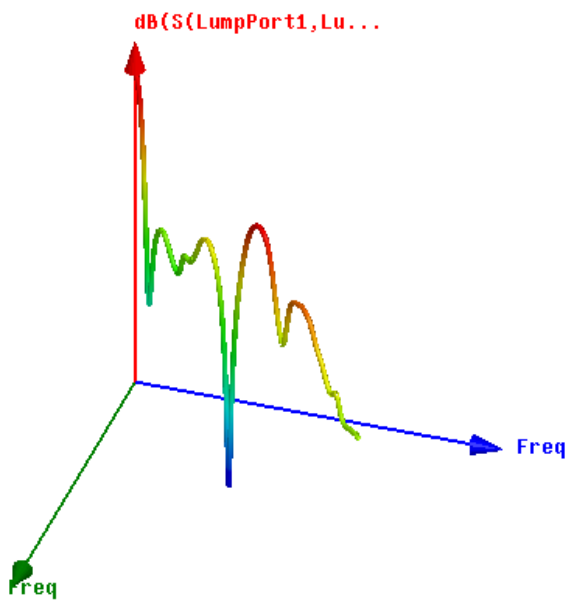


Fig 6. 3-D Rectangular Plot

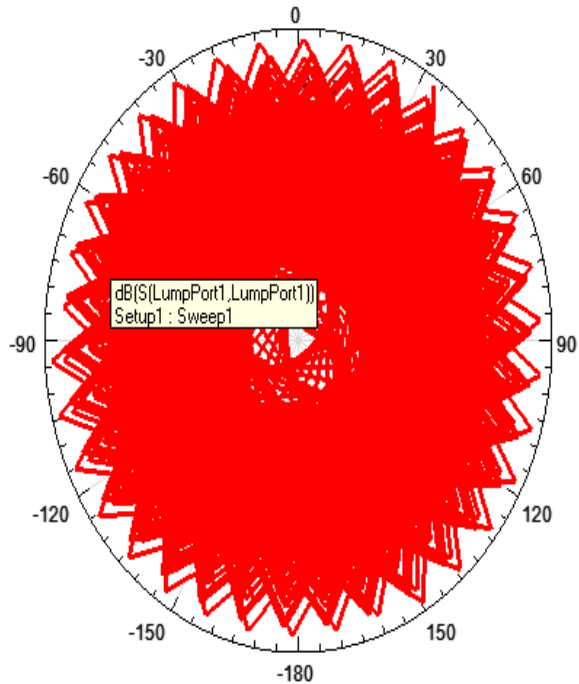


Fig 7. Radiation pattern

VI. REFERENCES

- [1] Hossein Eskandari, Mohammad Naghi Azarmanesh "Bandwidth enhancement of a printed wide slot antenna with small slots" AEU Int. J. Electron. Commun. (AEÜ) 63 (2009) 896–900.
- [2] Chen WS. "A novel broadband design of a printed rectangular slot antenna for wireless applications." Microwave J 2006;49:122–30.
- [3] Yao FW, Zhong SS, Wang W. et al." Wideband slot antenna with a novel microstrip feed. Microwave Opt Tech Lett" 2005;46:276–8
- [4] Jan JY, Su JW. "Bandwidth enhancement of a printed wide-slot antenna with a rotated slot." IEEE Trans Antennas Propag AP 2005;53:2111–4.
- [5] Liu YF, Lan KL, Xue Q. et al. "Experimental studies of printed wide-slot antenna for wide-band applications" IEEE, Antenna.Wireless Propag Lett 2004;3:273–5.
- [6] Sze JY, Wong KL." Bandwidth enhancement of a microstrip line-fed printed wide-slot antenna". IEEE Trans Antennas Propag AP 2001;49:1020–4.
- [7] Jang YW. "Experimental study of large bandwidth three-offset microstripline-fed slot antenna." IEEE Microwave Wireless Components Lett 2001;11:425–7.
- [8] Jang YW. " Broadband cross-shaped microstrip-fed slot antenna". Electron Lett 2000;36:2056–7.
- [9] Lee HL, Lee HJ, Yook JG, Park HK." Broadband planar antenna having round corner rectangular wide slot" IEEE Antennas and Propag Int Symp Digest 2000;2:460–3