

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/268150100>

Design of H-slot Patch Antenna for Ultra Wideband

Article in *European Journal of Scientific Research* · July 2013

CITATIONS

6

READS

1,589

3 authors:



Soufian Lakrit

Université Mohammed Premier

26 PUBLICATIONS 99 CITATIONS

[SEE PROFILE](#)



Hassan Ammor

Mohammadia School of Engineers

50 PUBLICATIONS 210 CITATIONS

[SEE PROFILE](#)



Jaouad Terhzaz

Centre Régional des Métiers de l'Education et de la Formation (CRMEF), Grand Casab...

51 PUBLICATIONS 145 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Microwave circuits development for antenna feed [View project](#)



Application of the FDTD method to determine complex permittivity of dielectric materials at microwave frequencies using a rectangular waveguide [View project](#)

Design of H-slot Patch Antenna for Ultra Wideband

Soufian Lakrit

*Electronic and Communication Laboratory, EMI
Mohammed V University, Agdal, Rabat-Morocco
E-mail: lakritsoufian@gmail.com*

Hassan Ammor

*Electronic and Communication Laboratory, EMI
Mohammed V University, Agdal, Rabat-Morocco
E-mail: ammor@emi.ac.ma*

Jaouad Terhzaz

*Electronic and Communication Laboratory, EMI, Mohammed V University
Agdal, Rabat-Morocco, Centre Régional des Métiers de L'éducation et de la
Formation (CRMEF), Casablanca-Morocco
E-mail: terhzazj@yahoo.fr*

Abstract

The printed antenna is one of the best antenna structures, due to its low cost and compact design. In this paper, we studied a new approach to improve the effectiveness of radiation and performance antennas with the miniaturization of its size. Indeed, we propose a miniature rectangular printed antenna with three slots in the form of H and which satisfies the multilayer UWB characteristics in terms of bandwidth and reflection coefficient. This antenna is for a system for detecting malignancy the microwave imaging. We use some techniques of miniaturization and expansion of bandwidth in order to achieve our goal. The study was made for the band of UWB frequency range from 3GHz to 10GHz.

Keywords: Patch antenna, Ultra wideband, H-shape slot, multilayer.

1. Introduction

In recent years, the developments in wireless communication systems Ultra Wide Band (UWB) have generated significant research activity dedicated to antennas for broadband (Christophe, 2009). Originally used in military applications, UWB technology is nowadays exploited by various applications, since the U.S. Federal Communications Commission (FCC) has authorized in February 2002. The commission has established some regulations regarding the frequency bands and transmission power limits allocated to different UWB applications. Any radio technology which has a bandwidth greater than 500 MHz or higher than 20% of its center frequency can be regarded as a UWB transmitter (Z.N.Chen; Sibille et al, 2004; FCC, 2002; Liang et al, 2005; Sharma et al, 2012). Around this enormous bandwidth there are several narrow band systems preexists and UWB communication potentially cause interference to the narrow band systems. The mostly commonly used narrow band systems affected by UWB systems are WiMAX band (3.4-3.69 GHz), IEEE 802.11a wireless local area network bands (5.15-5.35 GHz and 5.725-5.825 GHz) and HIPERLAN/2 band (5.450-5.725 GHz). Therefore, a band stop filter in this band would be required to reduce the inference between

UWB systems and these systems. To avoid adding new circuits to the communication system, band-notching technique can be applied directly to various UWB planar antennas by loading the UWB antenna with a resonant slot at the center frequency of the stop band. Different configurations of this slot are introduced for this purpose such as a U-shaped slot (Su et al, 2005), a V-shaped slot (Kim et al, 2006), I-shape (Yoon et al, 2005), an arc-shaped slot (Abbosh et al, 2006), square-slot (Hu et al, 2007), C-shaped slot (Nikolaou1 et al, 2006; William et al, 2010). These configurations are based on adding the slot on the radiating patch. However, Su and Wong (Yoon et al, 2005), introduced another technique by adding these slots on the ground plane of the antenna structure.

In this paper, we propose a printed antenna consists of a rectangular patch fed by a microstrip line over the substrate lower 50Ω impedance. This antenna has several advantages, first a small and simple to manufacture structure. The antenna design was performed using the Ansoft High Frequency Structure Simulator (HFSS). The following sections describe the configuration, design and implementation of the proposed antenna.

2. Antenna Design

Figure 1 shows the geometry of the proposed antenna, with an inverted H-slot on the radiating patch. The two substrates have been combined so as to include the quality of both high and low dielectric (i.e. high bandwidth and low patch size respectively). The first layer used for the patch is RT/Duroid5880 with the relative dielectric constant of 2.2 and thickness of $h_1=1.58\text{mm}$. The second layer used for feed line is the FR4-epoxy substrate with the relative dielectric constant of 4.4 and thickness of $h_2=3.16\text{mm}$. This antenna is fed by a microstrip line normalized at 50Ω as shown in Figure 1. The H-shaped slot on the patch is used to produce the second resonance in order to widen the UWB. All parameters of the proposed antenna are shown in Table 1.

Figure 1: Geometry of the proposed antenna.

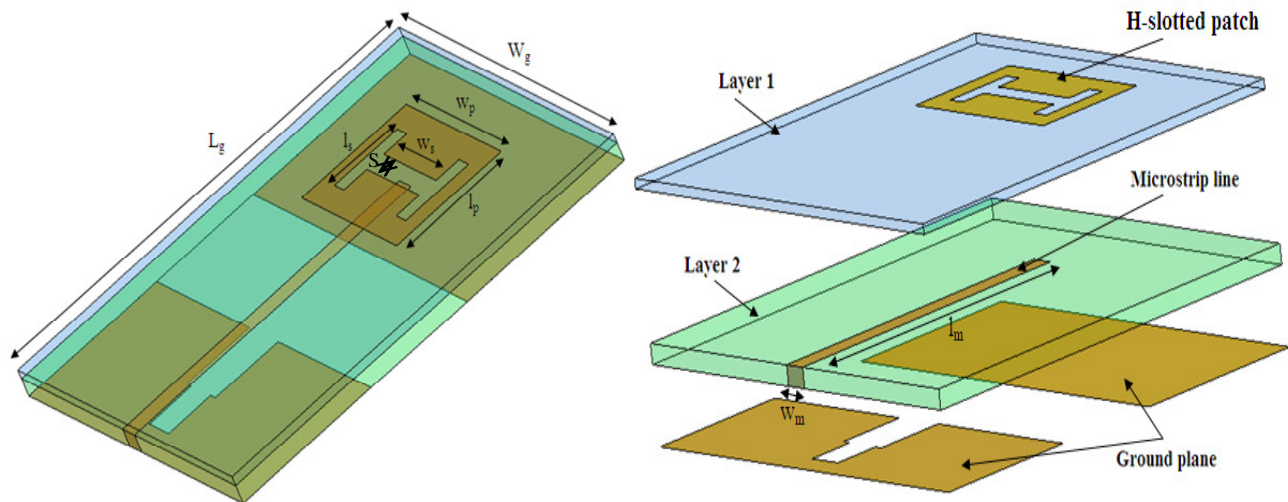


Table 1: Specifications of the proposed antenna

Width	Length
$W_g = 90\text{mm}$	$L_g = 91\text{mm}$
$w_p = 40\text{mm}$	$l_p = 25\text{mm}$
$w_s = 24\text{mm}$	$l_s = 15\text{mm}$
$w_m = 5\text{mm}$	$l_m = 2.45\text{mm}$

3. Results and Discussion

All of the simulations are performed by software HFSS. Figure 2 shows the reflection coefficient of the H-slot patch antenna. The obtained result shows that the bandwidth at -10dB of this antenna is in the frequency range from 3.08 to 10 GHz, which covers the bandwidth of the WiMAX and WLAN2.

Figure 2: Reflection Coefficient Of The H-slot Patch Antenna.

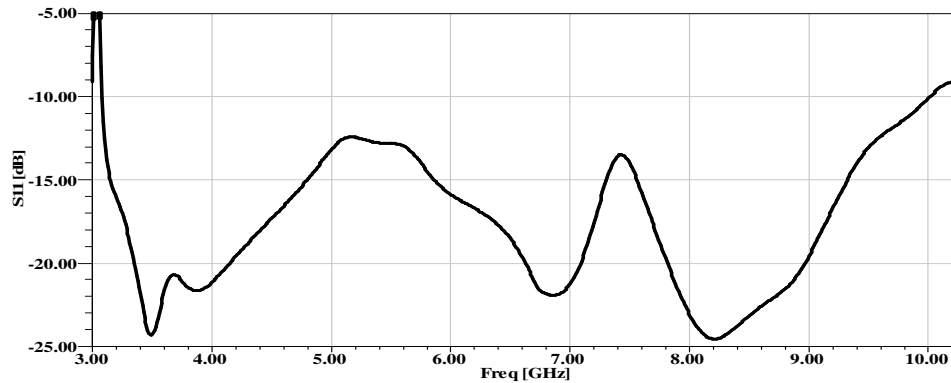


Figure 3: The VSWR Of the H-slot Patch Antenna.

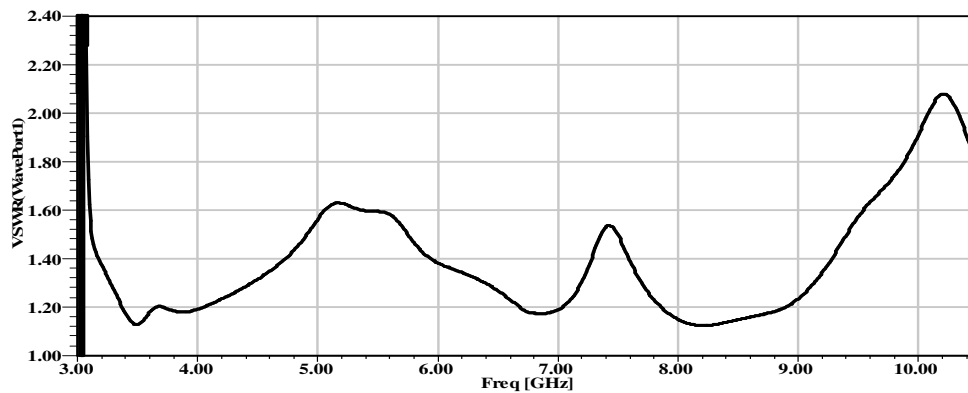
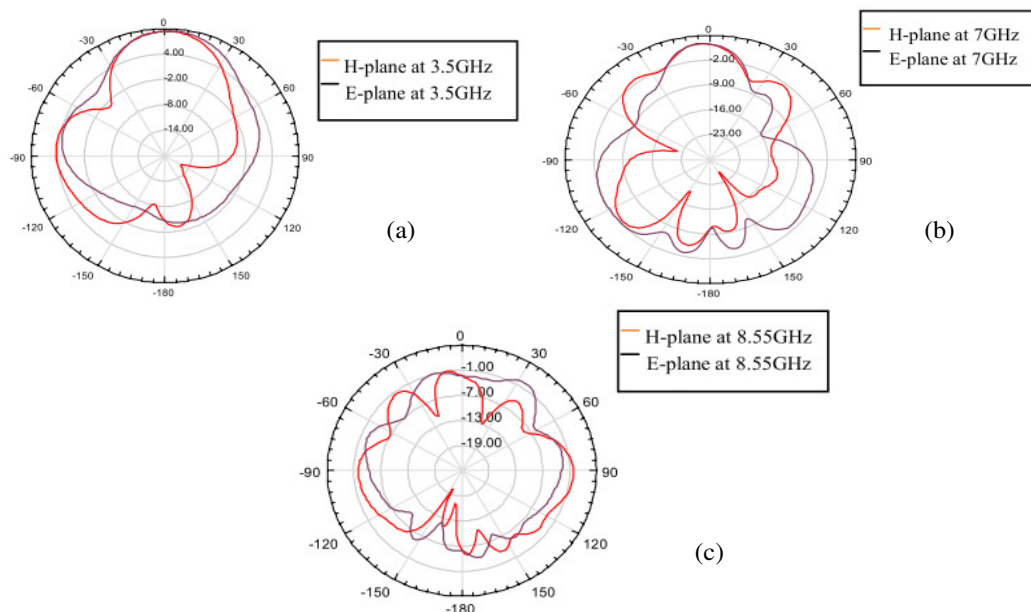


Figure 4: Radiation Patterns Of the H-slot Patch Antenna. (a) 3.5GHz, (b) 7GHz and (c) 8.55GHz



The simulated radiation patterns at 3.5GHz, 7GHz and 8.55GHz are shown in Figures 4(a), 4(b) and 4(c), respectively. From the simulated results, the antenna presents a radiation above 9dB in a band from 3 to 3.5GHz of the operating band in H plane and E plane. The asymmetry in E-plane and H-plane is caused by the asymmetrical feed stub and the H-slot patch. For the symmetrical structure of the antenna along XZ plane, the symmetrical radiation in H plane is produced. The H-slot patch antenna shows a front-to-back ratio of 20dB and a simulated maximum gain in the broadside direction of 11dB at 3GHz.

Figure 5: 3D Gain Total Of The H-slot Patch Antenna.

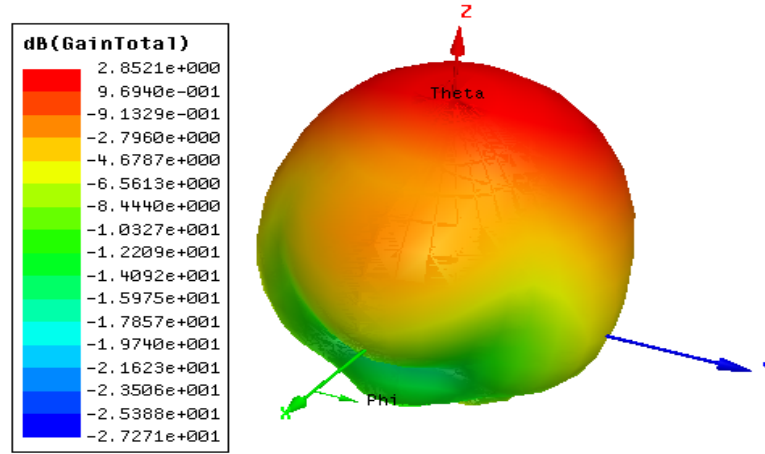


Figure 5 shows that the radiation patterns of the antenna are almost omni-directional.

Figure 6: (a) E-field Distribution.(b) H-field Distribution

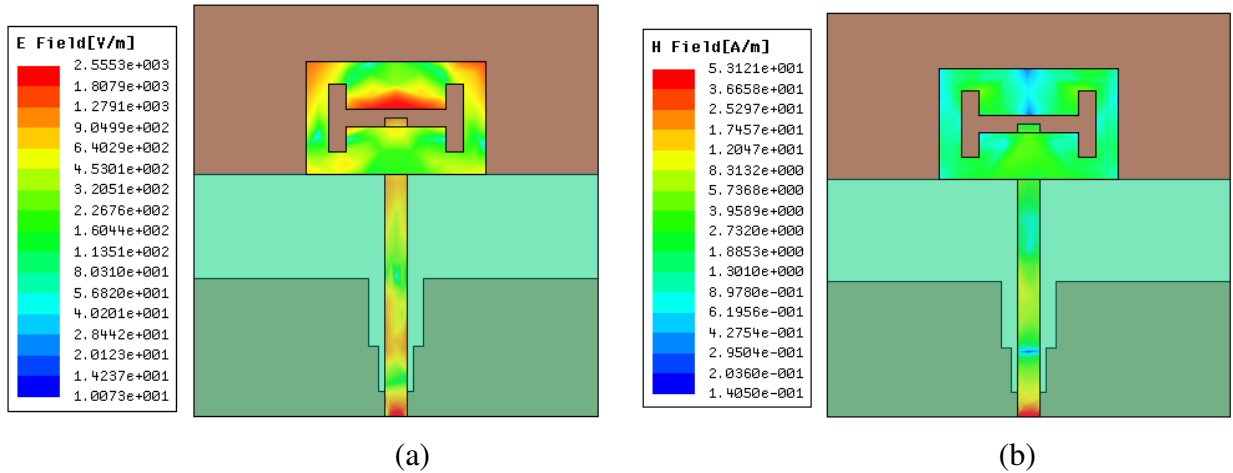


Figure 6(a) shows the electric field distribution. The maximum value of the E-field obtained is 2.55 103 V/m. The simulated intensity of a magnetic field in the patch is shown in figure 6(b). The maximum value of the H-field obtained is 53.12 A/m.

4. Conclusion

In this paper, a rectangular H-slot patch antenna has been proposed and simulated. The proposed antenna shows appropriate UWB performance and band notching suitable to avoid interference with WiMAX and WLAN2. This antenna provides low VSWR in the frequency band from 3.08 to 10GHz.

The antenna satisfactorily meets the requirements and has an UWB behavior. Indeed, the simulations in HFSS led to a reflection coefficient of -10dB between 3.08GHz and 10 GHz. The good performances make it suitable for applications in medical imaging which is the detection of breast cancer.

References

- [1] Christophe, DELAVEAUD 2009. "Compact antennas for communication systems Ultra Wide Band", Thursday, February 26.
- [2] Z.N.Chen, Antennas for Portable Devices, John Wiley & Sons Ltd, England, ISBN 978-0-470-03073-8.
- [3] Sibille, A., Roblin, C., Bories, S., Lepage, A.C., and Begaud, X., 2004 "Conception et caractérisation d'antennes ULB pour communications multimedia haut débit", *Revue de l'Electricité et de l'Electronique* 4, pp. 73-80.
- [4] New Public Safety Applications and Broadband Internet Access among Uses Envisioned by FCC Authorization of Ultra-Wideband Technology-FCC News Release 2002.
- [5] Liang, J., Guo, L., Chiau, C. C., Chen, X., and Parini, C. G., 2005 "Study of CPW-fed circular disc monopole antenna for ultra wideband applications", *IEE Proc.-Microw. Antennas Propag* 152, pp. 520-526.
- [6] Sharma, M. M., Ashok, K., Sanjeev, Y., and Ranga, Y., 2012 "An Ultra-wideband Printed Monopole Antenna with Dual Band-Notched Characteristics Using DGS and SRR", 2nd International Conference on Communication, Computing & Security.
- [7] Su, S. W., Wong, K. L., and Chang, F. S., 2005 "Compact printed band-notched ultra-wideband slot antenna", *IEEE International Symposium on Antennas and Propagation Society* 2B, pp. 572-575.
- [8] Kim, J., Cho, C.S., and Lee, J.W., 2006 "5.2 GHz notched ultra-wideband antenna using slot-type SRR", *Electronics Letters* 42, pp. 315-316.
- [9] Yoon, I.J., Kim, H., Yoon, H.K., Yoon, Y.J., and Kim, Y.H., 2005 "Ultra-wideband tapered slot antenna with band cutoff characteristic", *Electron Lett* 41, pp. 629-630.
- [10] Abbosh, AM., Bialkowski, ME., Mazierska, J., and Jacob, MV., A 2006 "planar UWB antenna with signal rejection capability in the 4-6 GHz band". *IEEE Microw Wireless Comp Lett* 16, pp. 278-80.
- [11] Hu, S., Chen, H., Law, CL., Shen, Z., Zui, L., Zhang, W., and Dou, W., 2007 " Backscattering cross-section of ultrawideband antennas". *IEEE Trans Wireless Propag Lett* 6 , pp.70-73.
- [12] Nikolaou1, S., Kim, B., Kim, YS., Papapolymerou, J., and Tentzeris, M., 2006 "CPW-fed ultra wide-band (UWB) monopoles with band rejection characteristic on ultra thin organic substrate", In: Presented at the Micro Conf, Asia-Pacific , p. 2010-13.
- [13] William, J., and Nakkeeran R., 2010 "Investigation on CPW-fed UWB slot antenna with notched design", *Int.J. Ultra Wideband Communications and Systems* 1, pp.173-180.