RESEARCH ARTICLE OPEN ACCESS

Antenna Design for Biomedical Application

Mr. Powar Sharad V.[1] Dr. Bombale U. L.[2]
Department of Electronics Technology Department of Technology Shivaji University, Kolhapur, Maharashtra, India

ABSTRACT
A wideband antenna is designed for tumor detection at ultra-high frequency (UHF) and super-high frequency (UHF) band. The antenna is designed to have a wideband and unidirectional performance. The antenna design is simple micro-strip patch antenna with dimensions of 60 × 60× 1.6 (mm). The tested antenna achieves a fractional bandwidth 8GHz (2–10 GHz) at 10-dB return-loss reference. The antenna in addition to a microwave transceiver type and an adjustable platform are then used to brain tumor detection system. The wide operating bandwidth, unidirectional radiation and detection viability are merits of the presented antenna.
Keywords: Microstrip patch antenna, ultra-high frequency (UHF), super-high frequency(UHF).

Date of Submission: 25-10-2017 Date of acceptance: 28-11-2017

I. INTRODUCTION

Now a day's use of microwave frequencies is increased in various wireless, communication, biomedical, etc. applications. High microwave frequencies also can use in biomedical applications. In microwave imaging technique. In that technique antenna is used and antenna play important role. Using antenna we can make or build portable medical diagnostic tools at low cost and use easily. In microwave imaging techniques electrical properties between healthy and unhealthy tissues are compared. Microwave image can be understood as "seeing" an object's internal structure by means of electromagnetic fields at microwave (300MHz-30GHz), millimeter wave (30GHz-300GHz) and THz frequencies (300 GHz-

3THz). Microwave based tumor detection systems require antennas operating within the wide super-high frequency (SHF) band (0.5– 40 GHz) for the required penetration in the human body. However, the physical size of antennas operating in this frequency range will be large. So, the designed antenna should provide directional radiation for the efficient use of the allowed microwave power and to minimize the interference from nearby systems and objects. There are several types of antennas proposed for SHF medical applications. However, those antennas either have omnidirectional radiation or wide operating bandwidths.

In this, a simple microstrip patch antenna is designed that has a wide operating bandwidth. To increase the bandwidth circular patch is used. The antenna is then tested to ensure its wide operating bandwidth and unidirectional radiation. The antenna is then connected with a compact microwave transceiver and an adjustable platform to build a microwave system for tumor detection. The antenna radiation firstly tested on an artificial phantom of the human torso. We can see the changes in the electrical properties of tissue affected by diseases such as cancer compared with the same type of healthy tissue. Different studies show that tumors can have a 10-20% greater permittivity than the surrounding healthy tissue. The final design achieves a wide operating bandwidth in the range of 2-9 GHz and moderate unidirectional radiation.

II. ANTENNA DESIGN PROCESS

The evolution process of the antenna begins with Antenna shown in Fig. 1, which designing a simple circular microstrip patch structure with dimension of 60×60×1.6 (mm)($l \times w \times h$). The antenna uses a square FR4 substrate with dielectric constant of 4.4, thickness of 1.6 mm. Ground plane and circular patch is on the top layer. Two squares on top layer are ground planes. The resonant frequency of the structure can be roughly estimated from $f_r = C / [2\sqrt{2}(\varepsilon_r+1)]$, where C is the speed of light and ε_r is the relative permittivity of the substrate. The antenna is fed by a microstrip line and width of the feeder is 2.38 mm for 50Ω impedance. Antenna is transceiver type. Signal transmitted and received by same antenna.

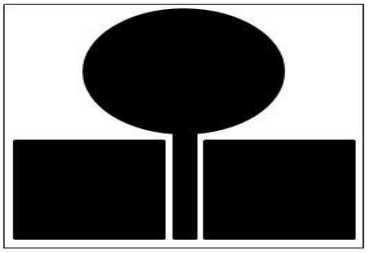
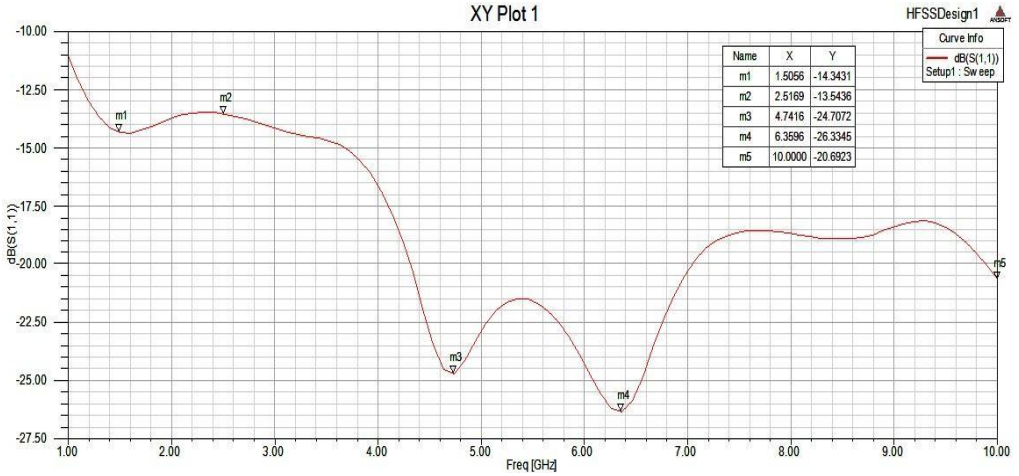
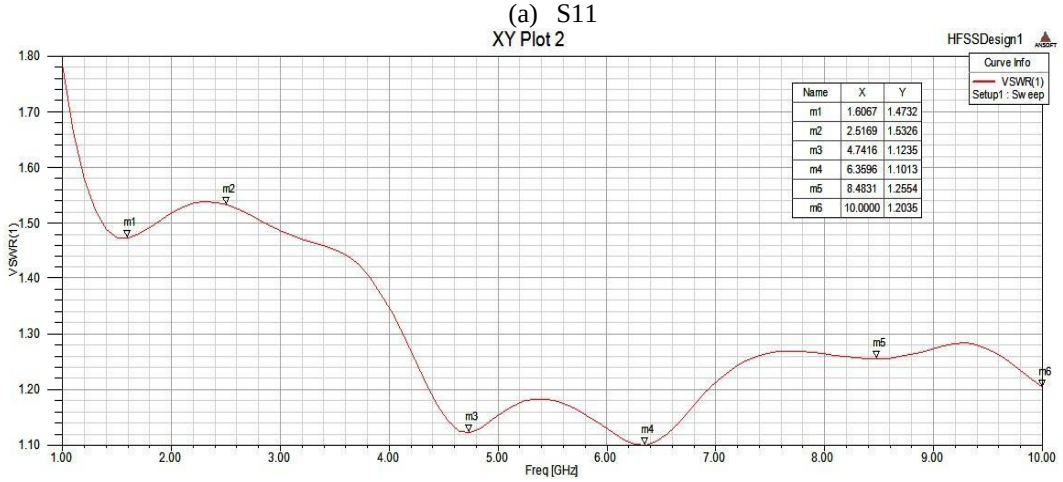


Fig.1 Antenna Geometry

Antenna designed using the HFSS software in 1-10 GHz frequency after designed we check the simulated result. S11, VSWR performance of the antenna is shown in fig. 2. The antenna operates across the band 1- 10 GHz and above with VSWR less than 2. After software design and checking simulated result antenna is fabricated. The result of fabricated antenna checked using vector network analyzer (VNA).We get the VNA result is near about simulated result are shown in fig.3. Measured S11 get 7 GHz bandwidth 2 – 9 GHz and VSWR is in between 1 to 2 in that frequency band.

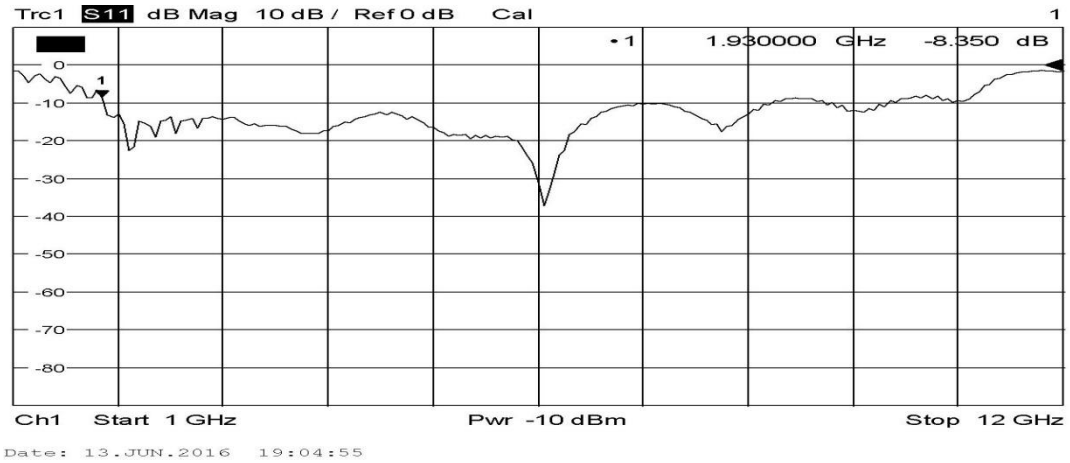


(a) S11

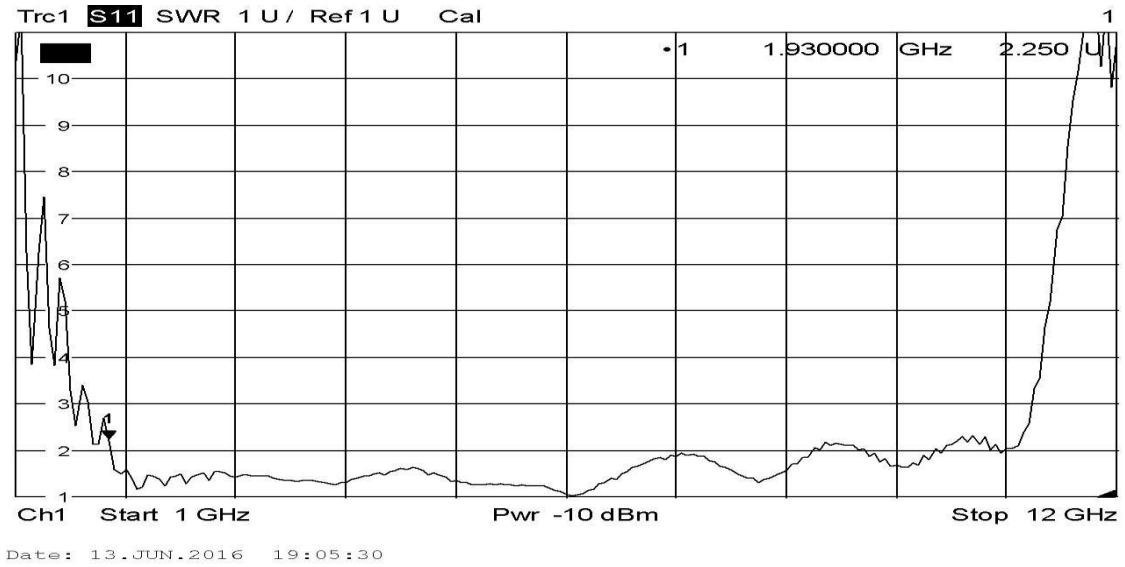


(b)VSWR

Figure-2. Simulated Result- (a) S11 and (b) VSWR



(a) S11



(b) SWR

Figure-3. Measured VNA Result- (a) S11 and (b) SWR

So, by checking the simulated and measured result of designed antenna. This antenna can use in biomedical applications such as tumor detections and other diseases. Because 1-10 GHz frequency band is used in tissue detection application. Tumor detection is cancer tissue or tumor tissue compared with the same type of healthy tissue. Using antenna we can detect the problems or diseases in human body in minimum time at low cost. Antenna plays important role in detection system. So, unidirectional and wide bandwidths antenna is required for detection.

III. CONCLUSION

A circular patch antenna that has a wide operational band and unidirectional radiation has been presented. It includes parasitic patch structures and is designed to operate within the UHF and SHF band as needed for tumor detection. A prototyped antenna with the size of 60×60×1.6 (mm) shows a -10dB operating bandwidth of 7 GHz (2 – 9 GHz). The antenna can used to build a tumor detection system by including a transceiver and an adjustable platform. Using this antenna we can test on an artificial human torso emulating the cases of healthy and tumor tissues. The obtaining results indicate the feasibility of the system in detecting early tumor.

REFERENCES

[1]. "Three Dimensional Wideband Antenna for Head Imaging System with Performance Verification in Brain Tumor Detection", S. Ahdi Rezaeieh, *Student Memebr, IEEE,* A. Zamani, *Student Memebr, IEEE,* A.M. Abbosh, *Senior Member, IEEE.*2014

[2]. "Novel Preprocessing Techniques for Accurate Microwave Imaging of Human Brain", A.S. Mustafa, B. Mohammed, and A. Abbosh, *Senior Member, IEEE.*2013

[3]. "Microwave System to Detect Traumatic Brain Injuries Using Compact Unidirectional Antenna and Wideband Transceiver With Verificationon Realistic Head Phantom", Ahmed Toaha Mobashsher, *Student Member, IEEE,* Amin M. Abbosh, *Senior Member, IEEE,* and YifanWang . 2014

[4]. "Dual-Polarized, Broadside, Thin Dielectric Resonator Antenna for Microwave Imaging", Abas Sabouni, *Member, IEEE,* and Ahmed A. Kishk, *Fellow, IEEE, Member*. 2013

[5]. "Recent Advances in Thermal Treatment Techniques and Thermally Induced Immune Responses against Cancer", J. F. Bai, *Member, IEEE,* P. Liu, and L. X. Xu, *Senior Member, IEEE.*2014

[6]. "Wideband and Unidirectional Folded Antenna for Heart Failure Detection System", S. Ahdi Rezaeieh, *Student Member, IEEE,* and A. M. Abbosh, *Senior Member, IEEE.*2014

[7]. "On the use of HF Techniques for Biological Tissue Detection", Paula Mediavilla, David Vegas, Antonio Taz6n, Tomas Fernandez and Angel Mediavilla, Jose Luis Gutierrez Banos.2014

[8]. "Miniaturized Circularly Polarized loop Antenna for Biomedical Applications", Li-Jie

Xu, Yong-Xin Guo, *Senior Member, IEEE,* and Wen Wu, *Senior Member, IEEE.*2014

[9]. "Confocal Microwave Imaging for Breast Cancer Detection: Localization of Tumors in Three Dimensions", Elise C. Fear, *Member, IEEE,* Xu Li, *Student Member, IEEE,* Susan C. Hagness, *Member, IEEE,* and Maria A. Stuchly, *Fellow, IEEE.*2002

[10]. "Microwave Detection of Breast Cancer", E. C. Fear, *Student Member, IEEE,* and M. A. Stuchly, *Fellow, IEEE.*

[11]. "Temperature-dependent dielectric properties of liver tissue measured during thermal ablation: Toward an improved numerical model", Christopher L. Brace, *Member, IEEE.*2008

[12]. "Biological Effects of Radio-Frequency/Microwave Radiation", Eleanor R. Adair, *Fellow, IEEE,* and Ronald C. Petersen, *Fellow, IEEE.*2002

[13]. "A New IEEE Standard for Safety Levels with Respect to Human Exposure to Radio-Frequency Radiation", James C. Lin. 2006

[14]. "Lung cancer detection using frequency domain microwave imaging", A. Zamani , S.A. Rezaeieh and A.M. Abbosh.2015

[15]. "Compact Wideband Antenna Immersed in Optimum Coupling Liquid For Microwave Imaging Of Brain Stroke", B. J. Mohammed, A. M. Abbosh, D. Ireland, and M. E. Bialkowski.2012

[16]. "Microwave Tomography for Brain Imaging: Feasibility Assessment for Stroke Detection", Serguei Y. Semenov and Douglas R. Corfield.2008

[17]. "Radiofrequency Functions (RF) Effects on Blood Cells, Cardiac, Endocrine, and Immunological", David R. Black, and Louis N. Heynick. 2003

[18]. "Beamspace time-reversal microwave imaging for breast cancer detection", M.D. Hossain, A.S. Mohan, M.J. Abedin, *IEEE Antennas Wireless Propag.*2013.

[19]. "Microwave imaging for stroke detection", D. Ireland and M. Bialkowski 2011.

[20]. "Wideband antenna for microwave imaging of brain", B. J. Mohammed, A. M. Abbosh, D. Ireland, and M. E. Bialkowski. 2011.

[21]. "Microwave system for head imaging", B. J. Mohammed, A. M. Abbosh, S. Mustafa, and D. Ireland, *IEEE Trans Instrum.*2014.

[22]. "Ultra wideband antenna for portable brain stroke diagnostic system", A. T. Mobashsher, B. J. Mohammed, S. Mustafa, and A. Abbosh.2013.

[23]. "New wideband printed antennas for medical applications", A.Sabban, *IEEE Trans. Antennas Propag.*, 2013

[24]. "A New Compact Multiband Antenna for Stroke Diagnosis System Over 0.5 to 3GHz", Shirin Abtahi, Jian Yang, And Stefan Kidborg.2012

International Journal of Engineering Research and Applications (IJERA) is **UGC approved** Journal with Sl. No. 4525, Journal no. 47088. Indexed in Cross Ref, Index Copernicus (ICV 80.82), NASA, Ads, Researcher Id Thomson Reuters, DOAJ.

Mr. Powar Sharad V Antenna Design for Biomedical Application." International Journal of Engineering Research and Applications (IJERA) , vol. 7, no. 11, 2017, pp. 57-60.