R. Satheesh Kumar et al. International Journal of Recent Research Aspects ISSN: 2349-7688, Vol. 4, Issue 4, Dec 2017, pp.233-237

Detection of Brain Tumor Using Ring Antenna

R. Satheesh Kumar[1], Keerthana I[2], Jayashree P[3], Kaushick Easwar J[4], Manikandan S[5]
[12345] ECE Dept, K.S. Rangasamy College of Technology, Tiruchengode, Namakkal, India

Abstract: - In worldwide, stroke is the leading cause of adult disability, the brain tumor is the third cause of death, ranking only behind heart disease and cancers. It is fabricated in FR4 with relative permittivity 4.4 and thickness 1.5mm. It is operating at a band from 3.3568-12.604 GHz in free space and from 3.818 to 9.16 GHz on the normal head model. The antenna has dimensions of 44x30mm2. The antenna is simulated on the HFSS software and measured using the network analyzer. The measured and simulated result of the return loss of the antenna on human's head and head phantom has good results.

Keywords--- UWB pentagon antenna, Brain tumor.

I. INTRODUCTION

The brain is a most important part of Central Nervous System (CNS) which locates inside the skull. Under normal condition, brain uses glucose to supply its energy requirements. The brain's glycogen stores are negligible and depends on the continuous blood supply of oxygen and glucose. In fact, the decreasing of blood supply results most common problem of damage in the brain region. When lack of nutrition and oxygen occurred and neurons in the region confront lack of blood supply for even a few minutes, they stop functioning and die. This neuronal death results from vascular disease calls stroke. Since stroke treatment is depends on the type, the source of stroke and the location of injury stroke diagnosis in progress is critical. The stroke and Transient Ischemic Attack (TIA) have similar symptoms with other general medical conditions such as seizures, fainting, migraine and heart problems. Therefore, it is important to not diagnose as stroke. The stroke treatments are different according to type and play important role in medical diagnosis. Ischemic stroke, caused by blocked artery in brain and it may be treated with a clot-busting drug called tPA (tissue Plasminogen activator). If medical doctor diagnoses ischemic stroke, it is important to receive drug treatment tPA within 4.5 hours of the onset symptoms. tPA cannot be given if more than three hours passes. The hemorrhagic stroke is result of a ruptured blood vessel or a week area of blood vessel that bulges. The difference between ischemic and hemorrhogic stroke is depicted.

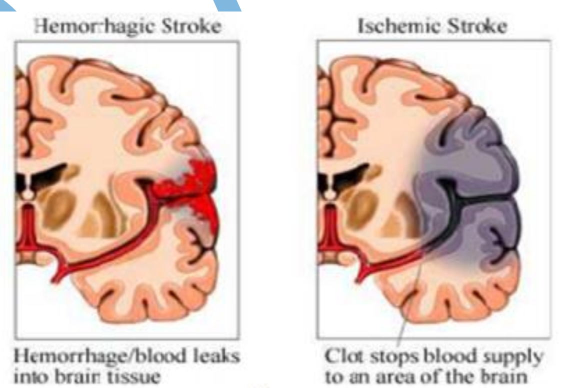


FIGURE 1.1: Ischemic and hemorrhagic stroke (Illustration copyright 2000 by Nucleus Communications, Inc)

There are several diagnostic exams that can perform to know if someone has a stroke or is at risk of having it:

• Computed Tomography (CT) is the first test which generate detailed picture of brain to conform the stroke diagnosis and tell whether the stroke is hemorrhage or ischemic.

• Magnetic Resonance Imaging (MRI) performs to identify the site and source of the stroke. It may identify the place deprived of sufficient blood flow.

• Angiography is an X-ray to highlight the blood vessels by injecting the contrast agent into a vein. In this exam the radiologist can understand the exact place of blocking or bleeding in the brain. It also uses to lead catheters to the site of problem and do treatments.

• Microwave Tomography which is under development exam that can be done in early stage of stroke even in ambulance to further treatment. The longer the brain cells are deprived of oxygen, the more damage they will suffer. Therefore, an early treatment after a stroke is extremely important. Over the past 2 decades, many microwave imaging systems have been designed for biomedical applications, and particularly for breast cancer imaging. However, designing a clinical imaging system that employs microwave to image the human tissues is a challenging task for a number of reasons:

II. ANTENNA CHARACTERIZATION

2.1 Radiation Pattern

The radiation pattern is an important concept which can easily indicate the application of antenna. For instance, cell phones needs nearly omnidirectional antenna because of the unknown user's location. In the other hand, for satellite applications a high directive antenna is desired. According to antenna theory an antenna radiation pattern is defined as follows: "An antenna radiation pattern is a mathematical function or graphical representation of the radiation properties of an antenna as a function of space coordinates. The radiation properties include radiation intensity, field strength, directivity, power flux density, phase or polarization." the two or three dimensional spatial distribution of radiated energy as a function of observer's position along a path is one of the most desired radiation properties.

2.2 Radiation density

Electromagnetic waves are used to transport information through a wireless medium or a guiding structure, from one point to the other. It is, then, natural to assume that power and energy are associated with electromagnetic fields. The scatter parameter or S-parameter describe the input-output relationship between terminals. For instance, S12 represent the power I from port1 to port2. The voltage reflection coefficient at the terminals of antenna (Γ) shows how much power is reflected form the antenna and also is called S11. If S11 = 0 dB, all the power is reflected from the antenna and nothing is radiated. This also means that the voltage reflection coefficient (Γ) equals to one.

2.6 Bandwidth

The bandwidth of an antenna is defined as the range of frequencies which the antenna is performed due to some characteristic and it can be considered as a range of frequencies on either side of the center frequency. The bandwidth in broadband antennas is expressed as the ratio of upper to lower frequencies of acceptable region and in narrow-band antennas, it is expressed as a percentage of the upper frequency minus lower frequency over the center frequency of the bandwidth. Ultra Wide-Band (UWB) have very large bandwidth, typically more than 500MHz. The UWB antennas are widely in attention in communication systems because of very high bandwidth and low power requirement.

2.3 Radiation Intensity

Radiation intensity is defined as "the power radiated from an antenna per unit solid angle". It is a far-field parameter and it can be achieved by multiplying the radiation density by the square of the distance.

$U = r^2 W_{rad}$

2.4 Directivity

The antenna directivity is defined as "the ratio of the radiation intensity in a given direction from the antenna to the radiation intensity averaged over all directions". It can be written as

$D = 4\pi U / P_{rad}$

Where

D = directivity

U = radiation intensity (W/unit solid angle)

Prad = total radiated power (W)

2.5 Antenna Efficiency

Losses at the input antenna terminals and within the antenna structure is the total antenna efficiency e0. Such losses are due to reflection because of mismatch between the antenna and the transmission line and I 2R losses from conduction and dielectric.[8] The overall efficiency can be written as

$e_0 = e_r e_c e_d$

where

e_0 = total efficiency

e_r = reflection (mismatch) efficiency = $(1 - |\Gamma| 2)$

e_c = conduction efficiency

e_d = dielectric efficiency

e_0 = total efficiency

Γ = voltage reflection coefficient at the input terminals of the antenna

III. EXISTING SYSTEM

3.1 Computed tomography (CT)

Computed tomography (CT) of the head uses special x-ray equipment to help assess head injuries, severe headaches, dizziness, and other symptoms of aneurysm, bleeding, stroke and brain tumors. It also helps your doctor to evaluate your face, sinuses, and skull or to plan radiation therapy for brain cancer. In emergency cases, it can reveal internal injuries and bleeding quickly enough to help save lives. In standard X-rays, a beam of energy is aimed at the body part being studied. A plate behind the body part captures the variations of the energy beam after it passes through skin, bone, muscle, and other tissue. While much information can be obtained from a standard X-ray, a lot of detail about internal organs and other structures is not available. In computed tomography, the X-ray beam moves in a circle around the body. This allows many different views of the same organ or structure. The X-ray information is sent to a computer that interprets the X-ray data and displays it in a two-dimensional (2D) form on a monitor. CT scans of the brain can provide more detailed information about brain tissue and brain structures than standard X-rays of the head, thus providing more information related to injuries and/or diseases of the brain. A CT scan of the brain may also be used to evaluate the effects of treatment on brain tumors and to detect clots in the brain that may be responsible for strokes. Another use of brain CT is to provide guidance for brain surgery or biopsies of brain tissue. CT scanning is also performed

3.2 Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging (MRI) is a test that uses a magnetic field and pulses of radio wave energy to make pictures of organs and structures inside the body. In many cases, MRI gives different information about structures in the body than can be seen with an X-ray, ultrasound, or computed tomography (CT) scan. MRI also may show problems that cannot be seen with other imaging methods. For an MRI test, the area of the body being studied is placed inside a special machine that contains a strong magnet. Pictures from an MRI scan are digital images that can be saved and stored on a computer for more study. The images also can be reviewed remotely, such as in a clinic or an operating room.

Magnetic resonance imaging (MRI) is done for many reasons. It is used to find problems such as tumors, bleeding, injury, blood vessel diseases, or infection. MRI also may be done to provide more information about a problem seen on an X-ray, ultrasound scan, or CT scan. Contrast material may be used during MRI to show abnormal tissue more clearly.

IV. ANTENNA PARAMETER DESIGN

4.1 EFFICIENCY

• The total efficiency of the antenna is affected by the resistively of the patch, loss tangent, height, width and the feed matching network.
• To get the most radiation efficiency out of your antenna you want the lowest loss tangent and the lowest receptivity that is available in materials.
• The over-all efficiency of your antenna is very much depending on the feed matching network. In fact most of the efficiency in micro strip antennas is lost in the feed network.

4.2 RADIATION INTENSITY:

• Radiation intensity in a given direction, instead, is defined as the power radiated from an antenna per unit solid angle.
• The radiation intensity is a far field parameter, and can be obtained multiplying the radiation density by the square of the distance.

4.3 DIRECTIVITY:

• Directivity of an antenna is defined as the ratio of the radiation intensity in a given direction from the antenna to the radiation intensity averaged over all directions.
• The average radiation intensity is equal to the total power radiated by the antenna divided by 4Π. If the direction is not specified, the direction of maximum radiation intensity is implied.

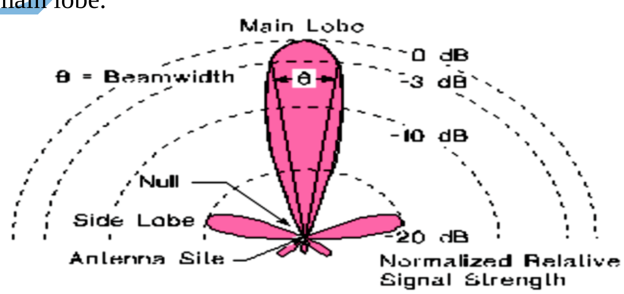
4.4 ANTENNA GAIN:

• Antenna gain is defined as the ratio of the intensity, in a given direction, to the radiation intensity that would be obtained if the power accepted by the antenna were radiated isotropic ally.

• The radiation intensity corresponding to the isotropic ally radiated power is equal to the power accepted (input) by the antenna divided by 4Π.

4.5 FIELD REGIONS

• Various parts of a radiation pattern are referred to as lobes, which may be sub-classified into major or main, minor, side and back lobes.
• A radiation lobe is a portion of the radiation pattern bounded by regions of relatively weak radiation intensity.
• A major lobe (also called main beam) is defined as the radiation lobe containing the direction of maximum radiation.
• A minor lobe is any lobe except the major lobe. Minor lobes usually represent radiation in undesired directions and they should be minimized.
• The beam width is the angle, expressed in degrees, between the half power (-3 dB) points of the main lobe, when referenced to the peak effective radiated power of the main lobe.



4.6 RETURN LOSS:

• The return loss indicates how much of the incident power is not reflected or doesn't return from a load.
• It is the square of the magnitude of the reflection coefficient, usually expressed in logarithmical form as:

V. ABOUT USAGE OF HFSS SOFTWARE

Here we have proposed a ring shaped UWB antenna for the detection of brain stroke and brain tumor using HFSS (High Frequency Structural Simulator) software. HFSS is a commercial finite element method solver for electromagnetic structures from Ansys. The acronym originally stood for high frequency structural simulator. It is one of several commercial tools used for antenna design, and the design of complex RF electronic circuit elements including filters, transmission lines, and packaging. HFSS benefits from multiple state-of-the-art solver technologies, allowing users to match the appropriate solver to any simulation need. Each solver is a powerful, automated solution process in which the user specifies geometry, material properties and the desired range of solution frequencies. Based on this input, HFSS automatically generates the most appropriate, efficient and accurate mesh for the simulation, thereby leading to the highest-fidelity solution possible. HFSS results yield information critical to your engineering designs. Typical results include scattering parameters (S, Y, Z), visualization of 3-D electromagnetic fields (transient or steady-state), transmission-path losses, reflection losses due to impedance mismatches, parasitic coupling, and near- and far-field antenna patterns.

VI. DESIGN OF ANTENNA

6.1 DESIGN OF ANTENNA WITHOUT TUMOR IN HFSS

First ring antenna is created on a substrate of Rogers RT/ duroid 5880(tm) with a position (-50,-45,0) and x= 100, y=90, z=3.2. Then ring shaped antenna is created by first drawing a circle shaped sheet then circle is converted into a ring shaped antenna by subtracting a half sized circle of the first drawn circle from its centre point. Another rectangle shaped antenna is subtracted in one edge of the ring. Thus the ring shaped antenna is created as like the below figure6.1.1

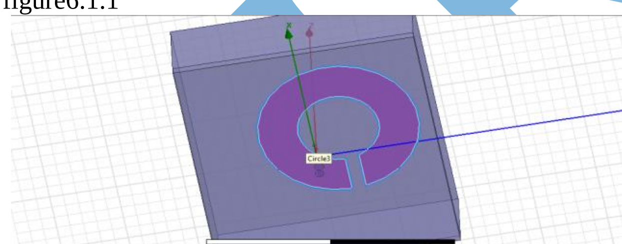


FIGURE 6.1.1 Ring shaped antenna

After creating ring shaped antenna a solid box is created to indicate it as a human head. This human head is created by using the solid materials like air, brain, csf, dura, fat, skin and skull in box shape. Then the connecting cylinder is created by using the pec material from antenna to substrate and within the substrate and then the vaccum is created in cylinder shape as like the figure 6.1.2

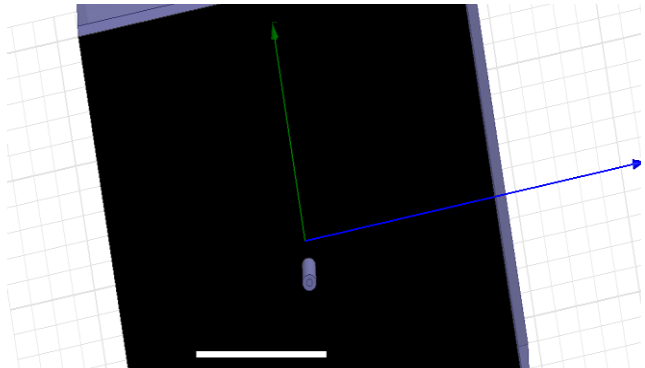


FIGURE 6.1.2 cylinder shaped vacuum

After finishing all these steps a ring shaped antenna is created and it is kept on a substrate and then human head is formed as like the below figure 6.1.3

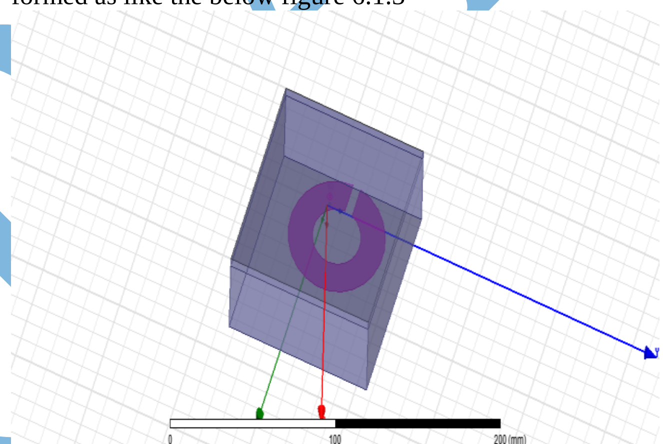


FIGURE 6.1.3 Antenna on human head

6.2 DESIGN OF ANTENNA WITH TUMOR IN HFSS

Here the ring shaped antenna is created as like before but here we have created a sphere inside a human head to indicate as a tumor inside the head with a material 'tu-s' as like the below figure 6.2.1

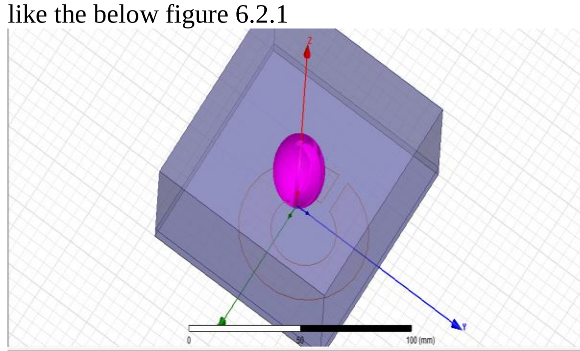


FIGURE 6.2.1 Antenna on human head with tumor

VII. EFFECTS OF ANTENNA

7.1 EFFECTS OF ANTENNA IN NORMAL HUMAN HEAD

Here the designed antenna on normal human head is simulated and measured the return loss of the antenna. In our project, because of the use of ring shaped antenna major noises are avoided and thus it is useful than pentagon shaped antenna. We have measured the return loss as like the below figure 7.1.1

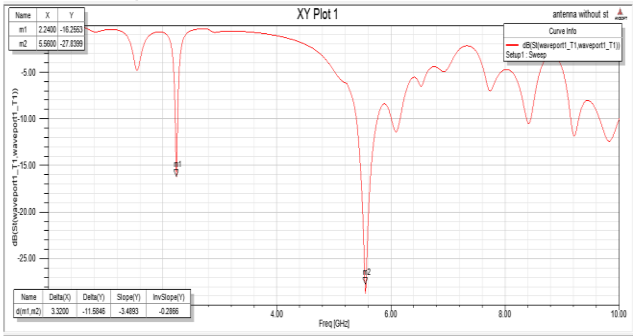


FIGURE 7.1.1 Return loss on normal human head.

By this figure 7.1.1 we have got a return loss for the frequency 2 to 5 GHz is -16 and -27 db.

7.2 EFFECT OF ANTENNA ON TUMOR

Here the designed antenna on human head with tumor is simulated and measured the return loss of the antenna. The return loss is shown in the below figure 7.2.1

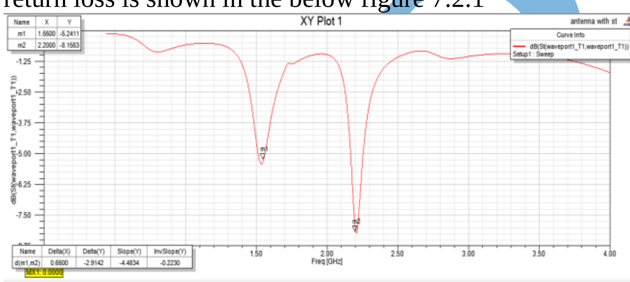


FIGURE 7.2.1 Return loss on human head with tumor

The return loss of the antenna measured and stimulated on the normal human head and tumor head is shown in the figures and it is clear that there is a good agreement between the measurement and the simulated results.

VIII. CONCLUSION

The paper delineates the plan and usage of a pentagon receiving wire for mind growth and tumor location, situated straightforwardly on human's head. It is reproduced utilizing HFSS microwave studio and created on FR-4 substrate with relative permittivity 4.4 and thickness 1.5mm. It is called attention to that there is a recurrence move of frequency shift between the ordinary head show and the one recreated with tumour and stroke when re-enacted on head model. The pentagon receiving wire is additionally measured on a normal head apparition. The various parameters are measured for the proposed structure and the design is fabricated on FR-4 substrate.

REFERENCES

[1] M. Garcia and A. Jemal, “Global Cancer Facts and Figures 2011,”Atlanta, GA: American Cancer Society, 2011.

[2] D.Ireland and M.Bialkowski, “microwave head imaging for stroke Detection,” School of ITEE, University of Queensland St.Lucia, Brisbane, Australia, 2011.

[3] E.Widmaier, H. Raff, K Strang, and A. Vander, “Human physiology: the mechanisms of body function,” Mcgraw Hill, 2008.

[4] Ma, H., J. Ly, and G. A. Donnan, “ TIA and stroke: A management guide for GPs,” Medicine Today, Vol. 7, No. 5, May 2006.

[5] World Stroke Academy, “Let’s talk about a stroke diagnosis,” vol. 2011, no. 20 May, 2007.

[6] Y.Rahmat-Samii and J.Kim, “Implanted Antennas in Medical Wireless Communication”, University of California at los Angeles, Morgan & Claypool, 2006.

[7] F.Balsiger, “Brain Tumor Volume Calculation”, Linkoping university, July 2012.

[8] Y.Done-Sik, K.Boneg-Seok, C.Hyung-Do, L.Aekyoung,P.Jeoy.Ki, “The Dielectric properties of cancerious”, Chungnam National University, Daejeon 305-764, Korea.

[9] D.Ireland and M.Bialkowski, “microwave head imaging for stroke Detection,” School of ITEE, University of Queensland St. Lucia", Brisbane, Australia, 2011.

[10] M.A.Shokry, A.M.M.A.Allam, “Planar Spiral Antenna for Brain strike
detection,” EuCAP, Lisbon, 2015.

[11] B.Mohammed, a.Abbosh, B.Henin, P.Sharpe, “Head Phantom for Testing Microwave System for Head Imaging,” CIBEC, Cairo, 2012.

[12] “Novel image reconstruction algorithm for a UWB cylindrical microwave imaging system”, M. E. Bialkowski ,Y. Wang, A. Abu Bakar, W. Khor University of Queensland, Brisbane, Australia., July 2010.

