International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 6, June - 2014

Diffused Optical Imaging of Phantom Using CCD Camera

Samson Nivins S, Reetoja Nag
(Department of Biomedical Engineering, VIT University, Vellore)

Abstract**—Electromagnetic radiation in the range of near infrared light is widely used in the study of anatomical and the physiological research of the deep biological tissues. In Our proposed system we use Diffused optical tomography (DOT) which involves tomographic reconstruction of the isotropic diffusion of the near infrared light in the living tissues. This helps in determining the properties of the tissues like scattering, absorption while the light is propagating in the forward direction. It is non-ionizing and non-invasive when compared to other imaging systems. It is also superior to OCT which is only meant for imaging superficial tissues in spite of the high resolution imaging. In this method we used Near infrared light LED as a source and CCD camera as detector. The light passing through the tissue is captured and obtained by the IR detector. From this cross sectional image of the phantom was obtained using cone beam reconstruction process.**

IndexTerms: Diffused optical tomography (DOT),NearinfraredLight(NIR),cone beam geometry.

I. INTRODUCTION

Diffuse optical tomography (DOT) is an emerging science and advanced field of Medical imaging. This technique has found its application wider in the field of neuroscience, medicine, wound monitoring,and also in the detection of cancer. Diffused Optical Tomography system uses near infrared (NIR) that helps to measure absorption as well as scattering properties which changes with tissue properties [1]. The near infrared uses 700-900nm range of wavelength.All oxygenated and deoxygenated haemoglobin of blood are strong absorbers of near infrared in the range from 700-900nm. Under this range near infrared light is absorbed very less and mostly it is scattered in the biological tissue which penetrates through the deep tissue layers and provide

a required analysis for the study and imaging of the tissue.There are different methods followed in optical measurement techniques they are continuous wave (CW), frequency domain (FD) and time domain (TD). In CW imaging absorption and scattering of tissue can be obtained by making source as constant with respect to time and it attenuates as it pass through the tissue. In FD imaging uses source which is time dependent and gets attenuated and phase shiftedas it pass through the tissue. TD imaging is also time dependent but the light gets broadened as it enters and attenuated by the tissue. Diffused optical imaging (DOI) is a non-invasive technique which implements non-ionizing method for obtaining soft tissue images [2]. The method when reconstructed to obtain 2-D image it is called as diffuse optical topography while when used to create 3-D model it is called as diffuse optical tomography. The difference between the optical properties helps in identifying the abnormalities which are present in the tissues. Thus this analysis helps in performing 2-D and 3-D operation. Thisnear Infrared has relatively higher accuracy when determining the geometrical properties of the tissue [3].

In this work we used infrared source which act as a non-invasive source to obtain the image of the tissue using the infrared camera to obtain the cross sectional image of the internal structure and also helps in the study of properties of the tissues. The slice of the image which is obtained through cone beam projection was reconstructed using FDK algorithm [4].This technique has employed in the brain mapping and also in the diagnosis of the cancer [2].
The projection which is obtained through cone beam is called as multi slice reconstruction algorithm. This algorithm technique is used in 2-D reconstruction in objects. From this technique we could able to determine only the slice of the measured object but if we want to determine the volume of the slice [5], the object has to be rotated with a small motion or the source and detector has to be moved in the same manner with both placed exactly opposite to each other in a parallel manner.

II. MATERIALS AND METHODS

1. Experimental setup:

The system set up is shown in Fig. 1. The illumination source is a high speed, high radiant power and high radiant intensity Gallium aluminium arsenide 830nm infrared emitting diode. The maximum radiant power of a source is 60mW and it has an operating voltage ranges from 1.7-2.1v and the maximum forward current is 200mA. The light from a LED is made to pass through the tissue which is kept in a few distances away from a source. As source hits the tissue few lights are scattered, emitted and few lights are diffused through the tissue. The diffused light from the tissue is captured by a CCD camera which is 600 x 800 resolutions and has a flame rate of 31 frames per sec. The CCD camera and source are kept exactly opposite to each other in a pole. The tissue is made to rotate with the help of a unipolar stepper motor. The cone beam projection obtained by a CCD is made into slice and reconstructed using an FDK algorithm for analysing the tissue.

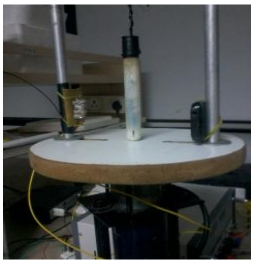

Fig-1: Illumination of a source

2. Phantom: The practical phantom is shown in Fig.2. A phantom is developed with a beaker of radius 2.5cm, thickness of 0.2cm and height of 7cm. The beaker is made up of glass material. The beaker was filled with milk up to 6cm which acts as phantom. The 10ml of milk is mixed with 90ml of water is taken as a test solution. The parameters of milk are known. To model the abnormality copper wire is placed inside the milk so that it would be visible in the reconstructed image.

Fig-2: Phantom containing milk

3. IR source Circuit Design:

The circuit designed is shown in Fig. 3. It consists of a power supply and a LED driver circuit. The power supply circuit converts 230V AC to 2 to 12V DCby using LM 338.The circuit of the LED design consist of a resistor with a Light emitting diode shown in Fig. 4.

Fig-3: Power supply design

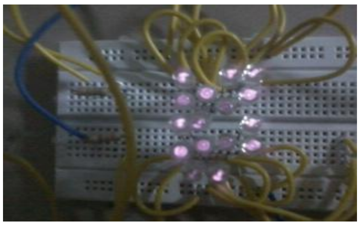

Fig-4: LED circuit design

The LED set up consists of volt which ranges from 1.7-2.1v and supplied by a 200mA current arranged in 4 rows and 2 columns. The measurement of power each LED is measured as 10.6 mw as shown in fig. 5.

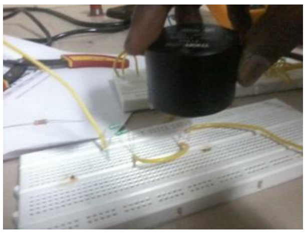

Fig-5: Power measurement using power metre

The rotation of the object is made by a stepper motor. The stepper motor rotates each step by 1.8 degree. The stepper motor is energized using four MOSFET which is shown in fig.6. For each rotation each MOSFET is energized. When one MOSFET is energized the stepper motor rotates an angle of 1.8 degree. When next MOSFET has to be energized first MOSFET will become zero with respect to ground and other would get energized. This process is repeated again and again until the stepper motor rotates through an angle of 360 degree.

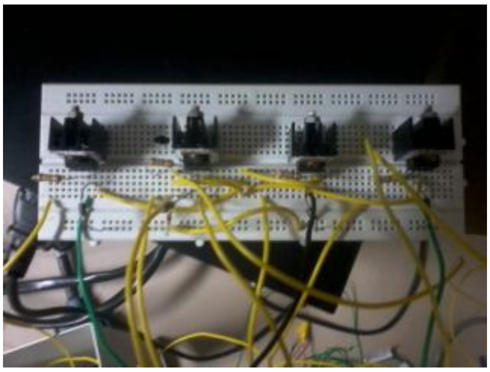

Fig-6: MOSFET energizing stepper motor

4. Image Reconstruction:

The cone beam projection which is obtained through CCD is reconstructed into slice using FDK algorithm. The cone beam projection is shown in Fig. 7.

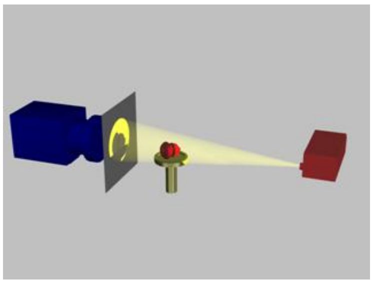

Fig-7: Cone beam projection

Feld Kamp, Davis, and Kress proposed about an approximate reconstruction algorithm for circular cone-beam tomography and this method is called as FDK method. As the FDK algorithm can handle data truncated in the longitudinal direction and it is very simple it's quite widely implemented in all sort of cone beam reconstruction [5]. The result of reconstruction will wide slightly when compared to the measured objects but there won't any changes with respect to the measurement of resolution [5]

III. RESULTS AND DISCUSSION

The image of the phantom is captured by a camera at various projections from 0 degree to 360 degree. The projection of 180 degree is shown in Fig. 8 and projection at 360 degree is shown is fig. 9. By using the images obtained at various angles the reconstruction of image is done and made into slice for analysis.

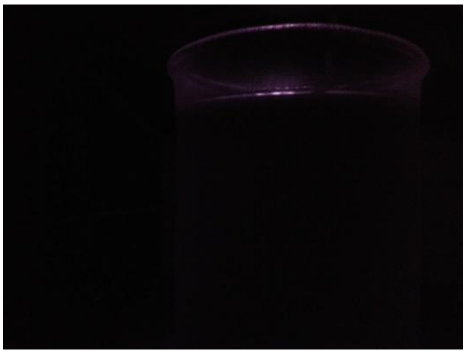

Fig-8: Projection of image at 0 degree

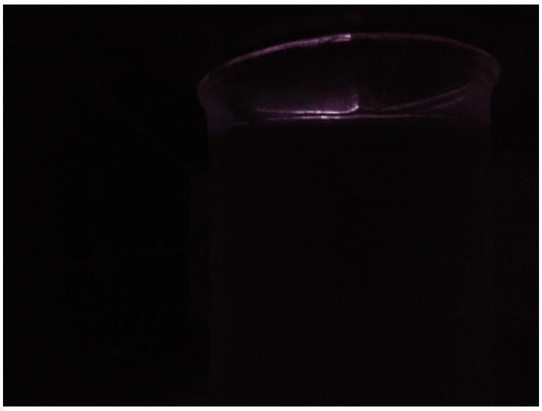

Fig-9: Projection of image at 360 degree

ACKNOWLEDGEMENTS

We thank Dr.D.DevaKumar Christian Medical College, Vellore for his suggestion in completing our project.

REFERENCES

[1]. Yogh and D. Boas, "Functional imaging with diffusing light," Biomedical photonics handbook, vol. 21, pp. 21-45, 2003.
[2]. Erickson, Godavarty, A ; Martinez, S. L.; Gonzalez J. ; Romero, A. ; Roman, M; Nunez, A. ; Ge, J ; Regalado, S ; Kiszonas, R ; Lopez-Penalver," Hand-Held Optical Devices For Breast Cancer: Spectroscopy And 3-D Tomographic Imaging" Quantum Electronics, IEEE Journal of Volume:18 , Issue: 4 ,pp. 1298 – 1312, 2012.
[3]. Chang, Wenhui; Fang, Bin "3-D surface registration based on line light scanning"Control Conference (CCC), pp. 3923 – 3926,2013
[4]. Deepak Bharkhada[1], Hengyong Yu[2], Kai Zeng[3], Er-Wei Bai[4], Ge Wang[1,2,] "A comparative study on interpolation methods for controlled cardiac CT "Volume 17 Issue 2, pages 91–98, 2007
[5]. HenrikTurbell"Cone-Beam Reconstruction Using Filtered Back projection" February 2001.