International Journal of Mathematics and Physical Sciences Research ISSN 2348-5736 (Online)
Vol. 5, Issue 1, pp: (136-140), Month: April - September 2017, Available at: www.researchpublish.com

Analysis of the Algorithm and Radiation of the Computed Axial Tomography

UCHEGBU, MS.C.

DEPARTMENT OF PHYSICS, UNIVERSITY OF JOS, NIGERIA

Abstract: **The Computed Tomography (CT) imaging also known as Computerized Axial Tomography, provides a different form of imaging known as cross-sectional imaging. We were able to view the cross-sectional images, describing the voxels by showing an algorithm of the voxel numbers which represents the attenuation values in the voxels along the path of the rays. In addition, further discussion was made on the radiation of the Computed Axial Tomography.**

Keywords: **CT scan, Algorithm.**

1. INTRODUCTION

The visible light being reflected by the majority of the objects which surrounds us, we can apprehend our environment only by the properties of the surface of the objects which compose it. To exceed this limit and to explore the intimacy of the matter, a dedicated imaging technique and instruments, which uses penetrating radiations like X rays, neutrons, gamma or certain electromagnetic or acoustic rays to explore internal structure, are developed. The tomography is one of these developed techniques that allow 2D and 3D interior object examination. By combination of a set of measures and thanks to computational and images reconstruction methods, it provides cartography of attenuation parameters characteristic of the radiation/object interaction, according to one or more transversal plans.

It thus makes possible to see on TV monitor, the interior of bodies and objects, whereas before one had access either by pure imagination, by interpreting indirect measurement, or by cutting out the objects materially. In the case of the medical imaging, for example, this direct observation requires a surgical operation. This formidable invention thus enable us to discover the interior of human bodies and different objects which surround us and their organization in space and time, without destroying them. The tomography thus constitute an instrument privileged to analyze and characterize matter that is inert or alive, static or dynamic, of microscopic or macroscopic scale. While giving access to the structure and the shape of the components, it makes possible the apprehension of the complexity of the objects studied.

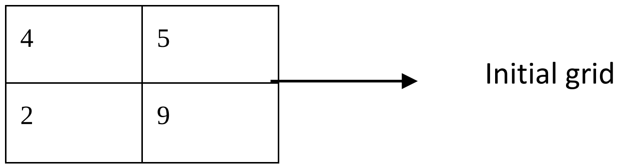
The computed tomography is a technique of acquisition of digital images. It generates a computer coding of interest through a patient, a structure or an object. The tomography thus provides a virtual representation of reality, in the intimacy of its composition. This numerical coding then will facilitate the exploitation, the exchanges and the information storage associated. It becomes thus appropriate processing to detect the presence of defects, to identify the internal structures and to study their form and their position, to quantify the variations of density, to model the internal components and to guide the instruments of intervention in medicine. Finally, the user will be able to take benefit from a large variety of existent software and algorithms for the tomography digital images processing, analysis and visualization. A CT system gathers several technological components. Its development requires the participation of the end users-as the doctors, the physicists or the biologist-to specify the needs, of the engineers and researchers to develop the novel methods and finally, of the industrial teams to develop, produce and market these systems. In this work, we were interested in the algorithm related to the main phases of the computed tomography; an algebraic approach for image reconstruction in tomography.

2. RESULTS AND DISCUSSION

Algorithm:

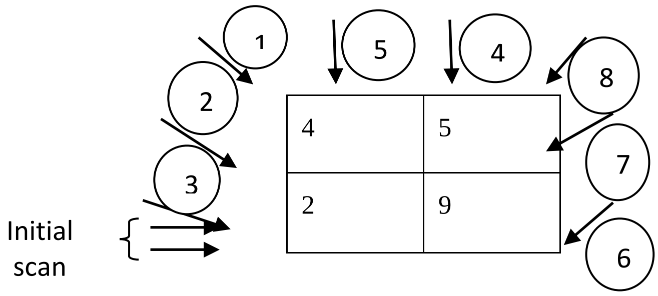
The raw data from a CT scan is not an image, and therefore is not readable by a human, the data needs to be processed to reconstruct and produce cross-sectional images clinicians can view. Image reconstruction in CT is a mathematical process that generates tomographic images from X-ray projection data acquired at many different angles around the patient. Image reconstruction has fundamental impacts on image quality and therefore on radiation dose for a given radiation dose, is desirable to reconstruct images without sacrificing image accuracy and spatial resolution. Reconstructions that improve image quality can be translated into a reduction of radiation dose because images of the same quality can be reconstructed at lower dose. The CT scan uses x-ray to produce a three dimensional picture of what is going inside the body. Since the computer performs an algorithm consisting of millions of voxels, a simple algorithm of what the computer does, is shown below;

Considering a grid containing four voxels



Now each of this voxels, have a number, indicating the amount of x-rays that will be attenuated. Bones would have a higher number than soft tissues because they tend to attenuate x-ray, meaning that the intensity of x-ray passing through the bone would be high. In the grid above, number 2, means that the attenuation of x-ray would be very small, and this is exact for soft tissue.

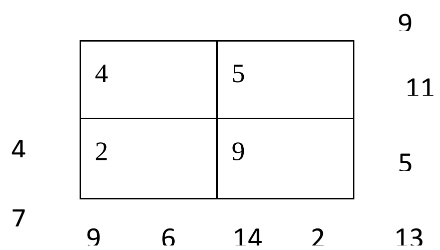
Now assuming that the above grid of voxels represents a body part, the CT scan transmits x-rays through different angle as shown below



The arrows signify the transmission of x-rays since the CT interpretation is not clearly understood at first, the computer applies an algorithm or formula for working out what the individuals paths of the voxels represents.

Again from the grid above, we add up the numbers representing the attenuation of x-rays, from the direction of the arrows. These arrows represents the transmission of x-rays. Hence the grid becomes

First Grid



The patient or subject on the motorized bed, is titled at several degrees. Interpreting the above, the numbers of the initial scan we have is;

$$\begin{cases} 4 + 5 = 9 \\ 2 + 9 = 11 \end{cases}$$

Again from arrow (1), the sum of the number is 5 due to the x-ray passing through that voxel number only. Arrow (2) gives the sum of the voxel numbers as 4 + 9 = 13. Arrow (3) gives only 2 since the x-rays passes through that voxel number only. Proceeding as before, from arrow (4) the total voxel number becomes 5 + 9 = 14. Arrow (5) also becomes 4 + 2 = 6. Again the x-ray represented by arrow (6) gives the voxel number as 9, because it passes through the voxel number 9. Arrow (7) gives 5 + 2 = 7, while arrow (8) gives 4 only. All these figures are represented in the first grid. This is what the computer does. From the 1st grid, picking up the numbers 9 and 11 obtained from the initial scan, to form a new grid represented as

→ 5
→ 13
→ 2

Second Grid

9	9
11	11

5, 13 and 2 are the next voxel numbers obtained from the passage of x-rays. Working this out as before to have.

Third Grid

22	14
13	24

This is because calculating or summing up, to have 5 + 9 = 14, the x-ray of voxel 13, passing through voxel 9 and 11 in the grid, is given as 13+9 = 22, and 13 + 11 = 14. While the x-ray passing through voxel number 11 becomes 2 + 11 = 13. The computer continues the process which we called "iteration" to give another grid as

6 14

22	14
13	24

6 and 14 are the next voxels numbers taking a look at the first grid. Again adding or summing up to have 6 + 22 = 28, 6 + 13 = 19, 4 + 14 = 28, and 14 + 24 = 38. And they are represented in a new grid as

Fourth grid

28	28
19	38

Again proceeding as before, we have another new grid as

4 7 9

28	28
19	38

It is worthy of note that the position of the voxel numbers attached to the grid, is as a result of the arrows which represents the transmission of the x-rays when the patient is titled on the motorized bed. From the above, we have a grid given as

Fifth Grid

32	35
26	47

This is because 28 + 4 = 32, 28 + 7 = 35, 19 + 7 = 26 and 38 + 9 = 47

Again going back to the first grid, it is quite clear that the value of the combined total of the initial x-ray scan is 20. That is 9+11 = 20.

Now subtracting 20 from each of the voxel numbers in the fifth grid to have a newer grid as

Sixth grid (final grid)

12	15
6	27

Also since we did not first do the initial scan only but 3 more which are represented by the arrows in the first grid, we divide the voxel numbers in the final grid by 3, to have

4	5
2	9

This is exactly the voxel numbers we started with, that is the initial grid. The above is a simple algorithm of what the computer does when information as a result of the scan is sent to it. The information sent to the computer, is raw data, and the computer interprets this information, using basic algorithm to confirm what was done, and which body part was examined. The final result, can then be displayed in the form of a 3D-image on the screen of the computer, which can be interpreted easily by the radiologist. Millions of voxels like this can be analyzed in matter of seconds by the computer. Bones appear as grey, while softer tissues would appear as whitish in colour. It is also worthy of note that no voxel would carry a number zero. This is because no matter how soft a tissue might be it must absorb x-rays. Also using this method or simple algorithm for any grid of voxel numbers would still give us the same result that is the final grid would be the same as the initial grid and the voxel numbers would not be interchanged. Alternatively, the computer uses basic Fourier transform, but this is cumbersome to analyze.

3. DANGER OF THE RADIATION OF A CT SCAN

In this research, we have demonstrated the slicing of several parts of the body by the CT machine into voxels. Computed tomography scans helps doctor detect everything from cancer to kidney stones. But alarm have been raised about the safety of such procedures most notably an increase in cancer risk. Due to the fact that CT scan divides the body into several slices (Tomos-Greek), it packs a mega-dose of radiation-as much as 500times that of a conventional x-ray. In the western world, the frequent use of the CT machine by physicians or radiologist to ascertain problems in patients, is alarming. As discussed earlier radiation doses are extremely dangerous and will not just cause cancer, but other harmful diseases. Carrying out this research at DC pharmaceuticals, we observed that 70% of people or patients who were exposed to higher doses of radiation (war veterans, and war victims) suffered from Parkinson disease, mania, or acute depression in later years. The vast majority of these patients were in need of anti-depressant and muscle-relaxant drugs. Since one cannot measure accurately the doses of radiation absorbed by the body the risks are also not overly measured. The risk of getting cancer is as dangerous as others too. This is true because high pack or doses of radiation, can also alter genetic trait. This is exact, as in the case of Hishorima and Nagazaki, which were war zones in the World War II. Diseases or problems caused by high doses of radiation that occurs gradually with time. Which means that the rate at which a risk caused by radiation would occur in a patient, is directly proportional to the age of the patient. Physicians at hospitals in Florida and Washington DC, evaluated the medical-imaging records of 1,234 randomly selected patients had sustained in the past five years. Although CT scans were the biggest source of radiation, other offenders included x-rays and mammograms. The results of the study, presented at the annual conference of the society for Academic Emergency medicine, were disturbing; the average patient had received 45 millisieverts (msv) of radiation. (The typical chest x-ray dispatches 0.02msv of radiation). From this it is quite clear that people in the Western world and not in third world countries, are getting large doses of radiation from a CT scan and it is not innocuous.

4. CONCLUSION

Since advances in Computed Tomography (CT) have increased dramatically during the last ten years, offering a non-invasive technique for examining patients as an alternative for exploratory surgeries that were once routine clinical practice, we obtained an algorithm of the attenuation values in the voxels along the path of the ray. The ultimate goal in the CT, of course, is to provide clinicians with the highest quality images as fast as possible, maximizing diagnostic accuracy and speed. Hence we were able to show an algorithm of image reconstruction, by interpreting what the computer does when images obtained from the CT machine is sent to it, represented by voxel numbers.

ACKNOWLEDGEMENTS

The author acknowledges support from D.C Pharmaceuticals, and Jos University Teaching Hospital radiation Unit.

Conflicts Of Interest: The author declares no conflict of interest.

REFERENCES

[1] Buvat, I. Reconstruction Tomographic: www.guillemment.org/irene accessed 7/07/17

[2] Herman, G.T. (2009). Fundamentals of Computerized Tomography: Image Reconstruction from Projections. Springer.

[3] How dangerous are CT scans: http://content.time.com/time/health/article/0,8599,1818520,00.html accessed 8/07/17.

[4] Kak, A.C. and Slaney, M. (1999). Principles of Computerized Tomographic Imaging. N.Y: IEEE Ed.

[5] Shimizu, Y., Kato, H. and Schull, W.J. (1990). Studies of the mortality of A-bomb survivors: 9 mortality, 1950-1985. Part 8. Cancer mortality based on the recently revised doses (D586). Radiat Res.