SMU
Sikkim Manipal University
Manipal INSPIRED BY LIFE
SMU Medical Journal
ISSN : 2349 – 1604 (Volume – 2, No. 2, July 2015) Research article
Indexed in SIS (USA), ASI (Germany), I2OR (India) and SJIF (Morocco) databases
Impact Factor: 3.835 (SJIF)

Improvement of Nuclear Cardiology Images for Ischemic Patients using Image Processing Techniques

Yousif Mohamed Y. Abdallah[1]*, Eltayeb Wagiallah[2,3], Mohamed M. Yousef[4]
[1]College of Applied Medical Science, Majmaah University, Saudi Arabia
[2]Nuclear Medicine Department, Radiation and Isotopes Center of Khartoum, Khartoum, Sudan
[3]Nuclear Medicine Department' Elnileen Medical Center, Khartoum, Sudan
[4]College of Medical Radiological Science, Sudan University of Science and Technology, Sudan

*Corresponding author: Tel 00966501427451
Email: yousifmohamed@outlook.com , y.yousif@mu.edu.sa

Manuscript received : 29.05.2015
Manuscript accepted: 25.06.2015

Abstract

This study was performed Nuclear Medicine Department of Fadil Specialist Center and Elnileen Medical Center in Khartoum for 25 Ischemic heart disease patients associated with CAO. This paper presented an appropriate approach for the robust estimation of noise statistic in nuclear cardiology images. The main objective of this study was to Improve of Nuclear Cardiology Images for Ischemic Patients using Image Processing Techniques. For the Single Photon Emission Computed Tomography machine (SPECT) each imaged had been taken for each single case with guidance of ECG trigger by injected patients with (20 mci) of Tc99m-MIBI, then patient wait for 45 min to 1 hour. The scanned image saved as TIFF format images in computer for reservation of image quality. The data analyzed using

MatLab program to enhance the cardiac images and adenosine them. To achieve maximum image quality after denoising, a new, low order, local adaptive Gaussian Scale Mixture model is presented, which accomplishes nonlinearities from scattering. State of art methods use multi scale filtering of images to reduce the irrelevant part of information, based on generic estimation of noise. In this, paper, prominent constraints are firstly preservation of image's overall look; secondly, preservation of the diagnostic content in the image and thirdly detection of small low contrast details in diagnostic content of the image.

Keywords: Nuclear medicine, cardiac images, ischemic heart disease, MatLab.

Introduction

The cardio-vascular system composed of the heart and blood vessels. The heart is hollow muscular organ consists of four chamfers two a train and two ventricle, and four valves. The function of the heart is to provide blood to the body tissue and more important is to vary the amount of blood pumped according to the metabolic status of the tissues, when the heart fails to provide blood to tissues or fails to regulate the amount pumped according to needs of the tissues, we say that "this case is heart failure". Each of these two divisions or types actually has its specific characteristics throw, which the heart maintains, its function appropriately [1]. Like any muscle, the cardiac muscle is formed from separate muscle fibers anatomically, but physiologically these fibers act or function as one unit so all of them contract at same time, while the skeletal muscles whose fibers can contract each one by itself. This property of contraction, at the same time is called functional syncytium [2,3]. This mechanical excitation (contraction) is initiated or preceded by action potential, so when we say that all cardiac muscle fibers contract at the same time this means that the action potential reaches all the cells or fibers at the same time and for this to exist there is very low electrical resistance. Action potential travels along the cell membranes and distributes through the junction between the cells, the junctions between these cells, cardiac muscle fibers are gap junction and intercalated discs [4,5]. The action potential travels very fast on the intercalated discs because they have a very low electrical resistance if this property functional syncytium is not available, that is not all the fibers contract at the same time the ventricle wont contract properly and fail to pump the bloods, and this is very series. Most of the nutrient (about 70%) for tissues is from carbohydrates in the cardiac muscle it is reversed (70%) of the energy provided is from free fatty acids, and this is very essential because the carbohydrate diminish quickly during exercise fasting and its storage is not much while fats are stored in massive quantities [6-8]. As this muscle contract, it pumps the blood to the tissues, so the main blood flow or a supply to the organs is due to systole that is ventricle contraction. Nevertheless, the cardiac muscles get its blood supplies mainly during diastole that is ventricles relaxation, through the coronary arteries. As the ventricle contraction grows stronger, it requires more blood, and this blood flow to the cardiac muscle is not guarded or controlled by the autonomic nervous system but it is controlled by the metabolites, mainly adenosine, these metabolites make the coronary arteries contract pushing more blood to the cardiac muscle. All cardiac muscles cells contract at the same time. In case of skeletal muscle the force of contraction increase by involving more fibers into contraction (not all the skeletal muscles contract as same time) in what we called requirement, but in the case of the cardiac muscle all fiber are contract already and their no relax it fiber to contract, so the force of contraction in not by requirement but by increasing the force of each fiber [9]. The cardiac muscle does not work under un-aerobic conditions (only 1% of the activity is anaerobic and 99% is aerobic) so it must get its sufficient O2 always. This is a reason for myocardial ischemia so any disease in the coronary artery or anemia or any cause of O2 deficiency lead to this case, and that is why when someone makes a lot of activity, he has any of these diseases from this kind he fails to continue, and feels ache in the heart [10,11].

Materials and Methods:

For panoramic images each film scanned using digitizer scanner then treat by using image processing program (MatLab), where the enhancement and contrast of the image was determined. The scanned image was saved in a TIFF file format to preserve the quality of the image. The data analyzed used to enhance the contrast within the soft tissues, the gray levels, which can be, redistributed both linearly and nonlinearly using the gray level frequencies and noise estimation of the original panoramic images. Researchers used in this study a method for image preprocessing of cardiac scintography images step-by-step process. Collecting the nuclear medicine images from Hospitals and converting this image RGB into Gray color. Two different filtering algorithms filtered cardiac images. The filtering algorithms used were Block Processing Large Images.

Block Processing Large Images Technique

When working with large images, normal image processing techniques can sometimes break down. The images can either be too large to load into memory, or else they can be loaded into memory but then be too large to process. To avoid these problems, one can process large images incrementally: reading, processing, and finally writing the results back to disk, one region at a time. The blockproc function helps you with this process. Using blockproc, specify an image, a block size, and a function handle. Blockproc then divides the input image into blocks of the specified size, processes them using the function handle one block at a time, and then assembles the results into an output image. Blockproc returns the output to memory or to a new file on disk.
First, consider the results of performing edge detection without block processing. This example uses a small image, cameraman.tif, to illustrate the concepts, but block processing is often more useful for large images [12-16].

Results

When working with large images, normal image processing techniques can sometimes break down. The images can either be too large to load into memory, or else they can be loaded into memory but then be too large to process. To avoid these problems, large images can process incrementally: reading, processing, and finally writing the results back to disk, one region at a time. The blockproc function helps in this process. Using blockproc, specify an image, a block size, and a function handle. Blockproc then divides the input image into blocks of the specified size, processes them using the function handle one block at a time, and then assembles the results into an output image. Blockproc returns the output to memory or to a new file on disk figure 2 and figure3.

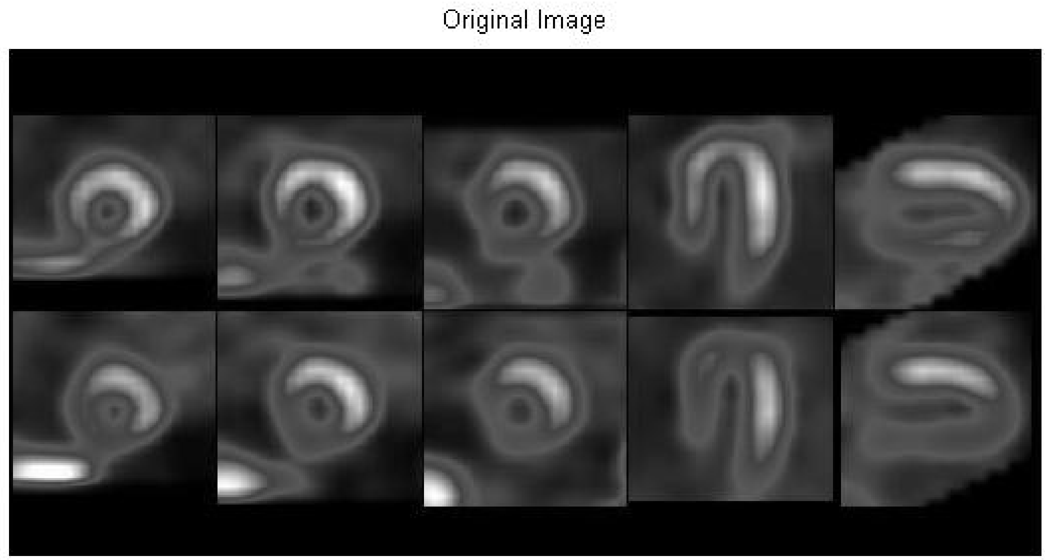

Figure No.1 Original Cardiac Images

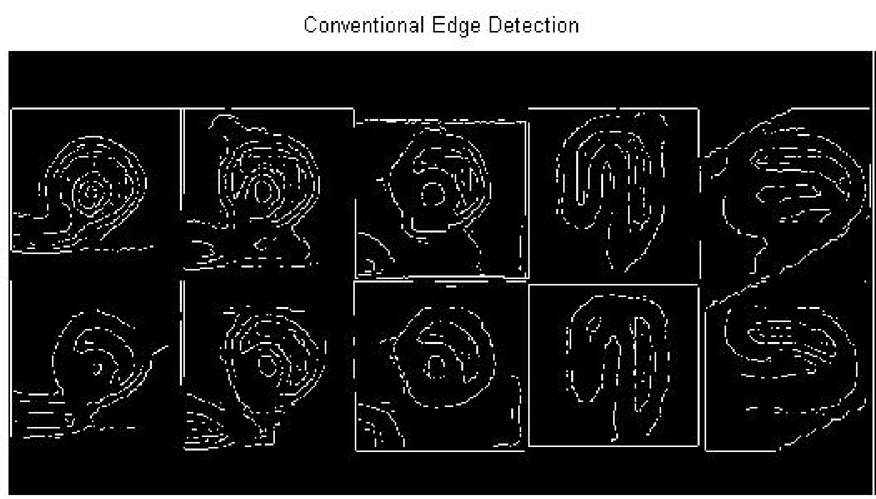

Figure No.2. Conventional Edge Detection

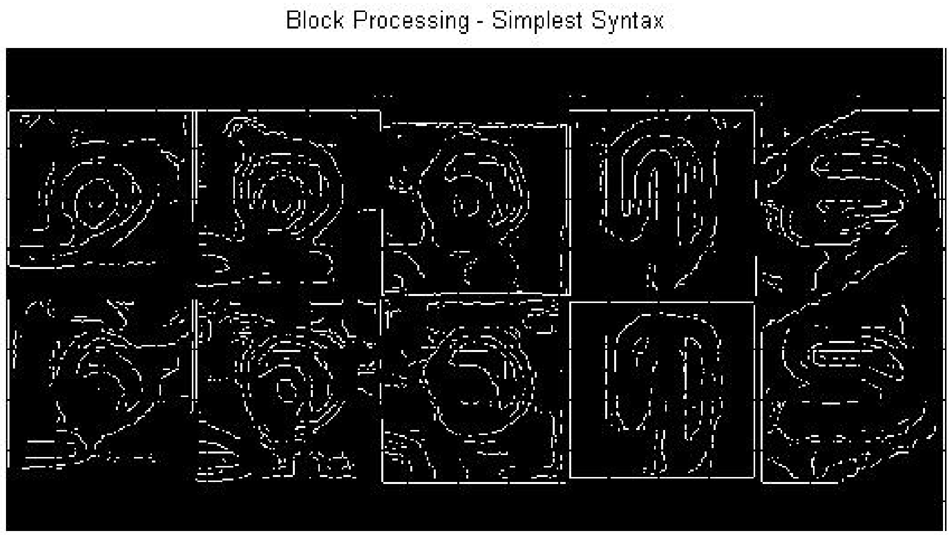

Figure No.3 Block Processing

Discussion

When working with large images will often use the 'Destination' parameter to specify a file into which blockproc will write the output image. This example uses a block size of (50 50) as in nuclear medicine images. In general, choosing larger block sizes yields better performance for blockproc. This is particularly true for file-to-file workflows where accessing the disk will incur a significant performance cost. Appropriate block sizes vary based on the machine resources available, but should likely be in the range of thousands of pixels per dimension. The significant artifacts from the block processing. Determining whether a pixel is an edge pixel or not requires information from the neighboring pixels. This means that each block cannot be processed completely separately from its surrounding pixels. To remedy this, use the blockproc parameter 'BorderSize' to specify vertical and horizontal borders around each block. The necessary 'BorderSize' varies depending on the task is being performed. The blocks are now being processed with an additional 10 pixels of image data on each side. This looks better, but the result is still significantly different from the original in-memory result. The reason for this is that the Canny edge detector uses a threshold that is computed based on the complete image histogram. Since the blockproc function calls the edge function for each block, the Canny algorithm is working with incomplete histograms and therefore using varying thresholds across the image.

When block processing images, it is important to understand these types of algorithm constraints. Some functions will not directly translate to block processing for all syntaxes. In this case, the edge function allows you to pass in a fixed threshold as an input argument instead of computing it. The function is modified to handle to use the three-argument syntax of edge, and thus remove one of the “global” constraints of the function. Some trial and error finds that a threshold of 0.09 gives good results [17-18].

The result closely matches the original in-memory result. Some additional artifacts could see along the boundaries. These are due to the different methods of padding used by the Canny edge detector. Currently, blockproc only supports zero-padding along the image boundaries.

References

1. Adam MJ, Wilbur DS (2005) Radiohalogens for imaging and therapy. Chem Soc Rev 34:153–63

2. Alauddin MM, Conti PS (1998) Synthesis and preliminary evaluation of 9-(4-[18F]-fluoro-3-hydroxymethylbutyl) guanine ([18F] FHBG): a new potential imaging agent for viral infection and gene therapy using PET.Nucl Med Biol 25: 175–180

3. Alberto R, Schibli R, Egli A, Schubiger AP, Abram U, Kaden TA (1998) A novel organometallic aqua complex of technetium for the labeling of biomolecules: synthesis of [99mTc(OH2)3(CO)3]+ from [99mTcO4]– in aqueous solution and its reaction with a bifunctional ligand. J Am Chem Soc 120(31):7987–798

4. Alrabiah FA, Sacks SL (1996) New anti-herpes virus agents: their targets and therapeutic potential. Drugs 52:17–32

5. Anderson C (1933) The positive electron. Phys Rev 43(6): 491–494

6. Anderson CJ, Dehdashti F, Cutler PD, et al. (2001) Copper-64- TETA-octreotide as a PET imaging agent for patients with neuroendocrine tumors. J Nucl Med 42:213–221

7. Antoni G, Langstrom B (2005) Progress in 11C radiochemistry. In: Bailey DL, Townsend DW, Valk PE,MaiseyMN(eds) Positron emission tomography – basic sciences. Springer-Verlag, London, pp 223–236

8. Baeken C, D'haenen H, Flamen P, Mertens J, Terriere D, Chavatte K, Boumon R, Bossuyt A (1998) 123I-5-I-R91150, anew single-photon emission tomography ligand for 5-HT2 A receptors: influence of age and gender in healthy subjects. Eur J Nucl Med 25(12):1617–22

9. Banati RB, Goerres GW, Myers R, et al. (1999) [11C](R)- PK11195 positron emission tomography imaging of activatedmicroglia in vivo in Rasmussen's encephalitis.Neurology 53:2199–2203

10. Bangard M, Behe M, Guhlke S, Otte R, Bender H, Maecke HR, Biersack HJ (2000) Detection of somatostatin receptor-positive tumours using the new 99mTc-tricine-HYNIC-D-Phe1- Tyr3-octreotide: first results in patients and comparison with 111In-DTPA-D-Phe1-octreotide. Eur J NuclMed 27(6): 628–37

11. Barrio JR, Huang S-C, Cole G, et al. (1997) PET imaging of tangles and plaques in Alzheimer's disease with a highly hydrophobic probe. J Label Compd Radiopharm 42:S194–S195

12. Bass LA,Wang M,Welch MJ, Anderson CJ (2000) In vivo transchelation of copper-64 from TETA-octreotide to superoxide dismutase in rat liver. Bioconjugate Chem 11:527–532

13. Bergmann SR, Fox KA, Rand AL, et al. (1984) Quantification of regional myocardial blood flow in vivo with [15O]water. Circulation 70:724–733

14. Bjurling P,Watanabe Y, Tokushige M, et al. (1989) Synthesis of q -11C-labeled L-tryptophan and 5-hydroxy-L-tryptophan using a multi-enzymatic reaction route. J Chem Soc Perkin Trans 1:1331–1334

15. BlockD, CoenenHH, Stocklin G, et al. (1987) TheNCA nucleophilic 18F-fluorination of I,N-disubstituted alkanes as fluoralkylation agents. J Label Compd Radiopharm 24:1029–42

16. Blower PJ, Kettle AG, O'Doherty MJ, Coakley AJ, Knapp FF, Jr (2000) 99mTc(V)DMSA quantitatively predicts 188Re(V)- DMSA distribution in patients with prostate cancer

metastatic to bone. Eur J Nucl Med 27(9):1405–9 72 2 Radiochemistry and Radiopharmacy

17. Blower PJ, Lewis JS, Zweit J (1996) Copper radionuclides and radiopharmaceuticals in nuclear medicine. Nucl Med Biol 23(8):957–980

18. Boswell CA, Sun X, NiuW, et al. (2004) Comparative in vivo stability of copper-64 labeled cross-bridged and conventional tetraazamacrocyclic complexes. J Med Chem 47:1465–1474

Authors Column

Dr. Yousif Mohamed Y. Abdallah received the B.S., M.Sc. and PhD degrees and M.Sc. in nuclear medicine and Radiotherapy Technology from College of Medical radiological Science, Sudan University of Science and Technology, National Cancer Institute, University of Gazira in 2005, 2009 and 2013, 2014, respectively. During 2006 up to date, he is staying in College of Medical Radiological Science, Sudan University of Science and Technology. He has eight published books and more than forty published papers. He is now assistant professor in College of Applied Medial Sciences, Majmaah University.