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Biomedical Signal and Image Processing in Matlab

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Abstract: *Nowadays, the techniques for the analysis and image processing are usually can be found use widespread in the medicals industry. The techniques use in the medical applications by using the image data. The image data will be used to obtain the process details in imaging patient. All the information obtained from the medical images has become a vital part of nowadays patient. The images generate are complex. Matlab is one of the mathematical models for the biomedical signal and processing. The image processing nowadays has become a mainstream wave. The image processing tools in the Mathlab provides a set of reference which is include the graphical tool, standard algorithms, analysis visualization for image processing. By using mathlab, user can create and perform the image processing process such as image debluring, noise reduction, feature detection and image enhancement.*
Keywords: *Biomedical Imaging, Matlab, , Signal Processing.*

1. INTRODUCTION

One of the rising issue of technology is Digital signal processing (DSP). DSP is a branch of information science and technology, specifically on the methods and techniques for processing digital signals. The signals processed in two ways which in time and in magnitude, and therefore fit for computer manipulations. Sensor is a device that responds to a physical stimulus and transmits a resulting impulse. Sensor can be in different type such as heat, light, sound, pressure, magnetism, or a particular motion.

The biomedical imaging nowadays is more focuses on the capture the images process for the therapeutic and diagnostic. The biomedical imaging technology is rarely used to utilize the patient organ such as ultrasound, MRI, CT scan, and light endoscopy. Biomedical imaging used to access the organ condition in the body or the issues in the body. It easier to monitor the patient for treatment and diagnostic evolution. [1, 2, 3] Today the software that used to perform biomedical imaging re-inverted since the x-ray was inverted on year 1895. The modem x-ray nowadays just need milliseconds of exposure time and used the solids state electronics to produce a high quality images and resolution. Today, the digital x-ray is enabling all the images to be more easily shared and compared. Matlab is one of high-level technical software that used to develop the algorithm and computing languages. Matlab is easy to be modify and easy to use when it deals with large matrices. Math lab also use only the language script to ensure all the statistical test and the matrix are easy manipulation. The required initial data will be taken and be customized to scanner and develop by the Matlab code to filter the optimized results. [6] After obtained the output, the Matlab will slice the information and construct the 3D image processing.

2. BIOMEDICAL IMAGE PROCESSING AND SIGNAL PROCESSING

The biomedical image processing is also similar to the biomedical image processing in a multiple dimensions. It includes all the enhancement and display of images that captured by the x-ray, ultrasound, MRI, nuclear medicine and optical imaging technologies.[2] The biomedical image processing techniques can reconstruction and modelling the 2D signals and create 3D images. Image processing and analysis also can be used to determine the volume, diameter and vasculature of tumours. [4,5]

Biomedical signal processing is the analysis which is involve s the analysis of measurement that provides useful information to make decisions. The engineers are discovering the new method or process to variety these signals by using the mathematical formula and algorithms.

3. IMAGE ENHANCEMENT

The fast developments of information technology nowadays have given impact on the image processing techniques. The development of image processing has been modify from the mainframe system to the computer platform.

Currently people might perform the processing and all type of the techniques ranging from the small to a large statistical operation. [3] Image enhancement is refers to the sharpening images features such as contrast, edges to make the graphic display more useful.

The image enhancement process will not affect the ordinary information data. It will include only the grey level, contrast manipulation, noise reduction, and magnification and so on [7]. Image enhancement is information to interpret the human viewer's image and provides better images. The main goals of

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image enhancement are to ensure the images be more modify attributes to be a better for given task and specific observation. For the images enhancement process, one or more attributes for an image will be modify [6].

4. MATLAB IMAGE PROCESSING

Matlab image processing technique is an effective method that can use for problem solving in image processing. It used algorithms and mathematical process operations. The matlab image processing use algorithms process number to represent the tissues information and the radiological density of the MRI and CT scan images. This new creation will be customize visual representations by applying the mathematical algorithms by using the matlab. The matlab will construct the data by extract the simplest single parametric and produce 2D reconstructions.[6] Figures 1 illustrates example of images that been slices to a volume data.
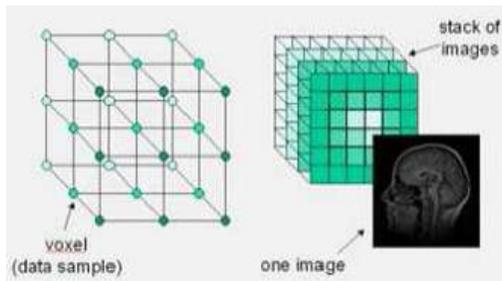

Figure 1: Images That Been Slices To A Volume Data.

The Image processing techniques in the matlab include all the possible tools that help to change or analyse an image[8]-[9].

5. DIGITAL IMAGES IN MATLAB

Matlab is one of the software that offers simple instructions that help to read images from variety of file formats [10]. Matlab also support a number of colours and depends to the file type or colour space either in 2D matrix or 3D matrix. [10]

The images type that support from the image processing in the matlab tool box are listed below:

(i).   Binary images : only can take pixels 0 or 1 value and black or white images

(ii).   Intensity images and grayscale : the images data are in grayscale an represent the brightness or intensity. For the typical greyscale images, it can be represented by 8bits value.

(iii). RGB or true color : the images can be display by using the three matrices. The matrices will correspond to each red, green and blue colour. For the RGB images, for each component is 8 bits and the required pixel is 3 to 8

(iv).   Indexed images: it consists of 2D matrices. Each row specified the red, green and blue components of single colour.

6. MATLAB IMAGE TOOL

In the matlab, image tools is one of the simplest toolkit that help to contribute a quick image processing by using matlab language and without need to writing a code. This tool is very useful in quick processing the images to get better view desirable images.

The image tools in the matlab will opens by writtng the "im tool" command in the main window [10]. A new window will be open and the images will be load. In this menu also contains many instructions that can be used for an image processing. The tool contains image information, panning adjustment, image zooming, contrast adjustment, distance measurement, cropping, colour map choices, conversion of images to a pixel matrix, and so on. This common function can be used to performed an 3D or 2D image plotting to obtain an pixel images.

a. Image Filtering

One of factor that degrades the quality of images is using poor resolution. Its result by blurred and noisy images. This factor impacts the quality of image filtering. Image filtering is a mathematical processing which is used to noise removal and resolution recovery [10]. The filters suppressed noise by deburred and sharpened the images. As a result, it is greatly improve the image resolution.
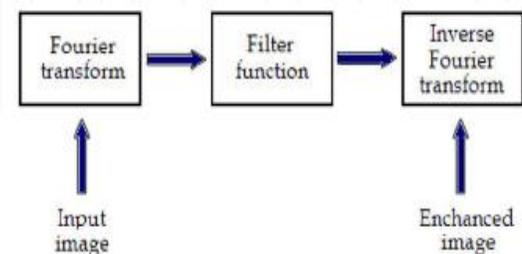

Figure 2: Frequency Domain Filtering Basic Step

Figure 2 Frequency domains filtering basic step. An image can be modify either in the spatial domain or in the frequency. The ordinary data will in form of fourier transform and will be multiplied with the appropriate filter, next the fourier transform will be inverse.

In the spatial domain, the filtering demands the filter mask. This filter mask is a matrix of an odd size which is directly will be applied to the original data of the image. The mask is centered for initial image pixels. The pixels value of an image for each position will multiplied with the position of the mask pixels and corresponding values mask. The products of these multiplications will be added and the value results of the central pixel of the original images will be replaced by the sum. This process need to be repeated for each pixels in the image. This procedure illustrates in figure 3 above. [10]

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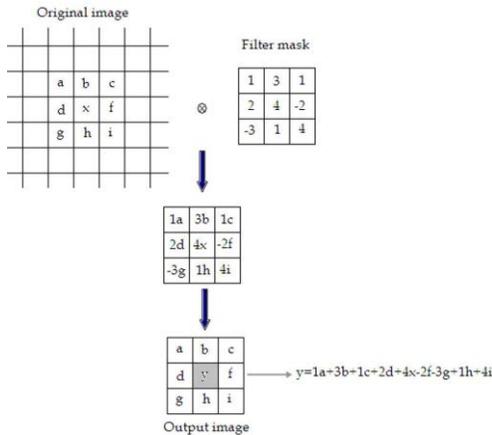
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Figure 3: Filtering Process In Spatial Domain

b. Gaussian Filter

Gaussian filter is known as a linear low pass filter. The Gaussian filter mask has a form of a bell shaped curved which is have a high point centre and symmetrically tapering sections. The application of Gaussian filter on image is produce a weighted average central on image and significantly results a pixels at the mask edge. The weights will be computed according to the Gaussian function below. The μ is a mean and the σ is the standard deviation

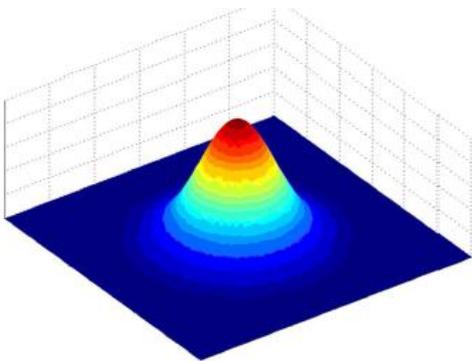$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2 / (2\sigma^2)}$$

(1)

Figure 4 Example of 2D Gaussian function

Figure 4 illustrates an example of 2D Gaussian functions. The standard deviation will determine the degree smoothing. The larger value of standard deviation, the smoother image will be obtained. The Gaussian filter is most effective filter to reducing the Gaussian and impulse [6].

7. IMAGE SEGMENTATION IN MATLAB

In matlab, thresholding is the basic type of segmentation. It is can be classified into two name which is single thresholding and multiple thresholding. In the single threshold, the image

will be divide into two homogeneous regions which is in form of black and white [10] (Figure 5).
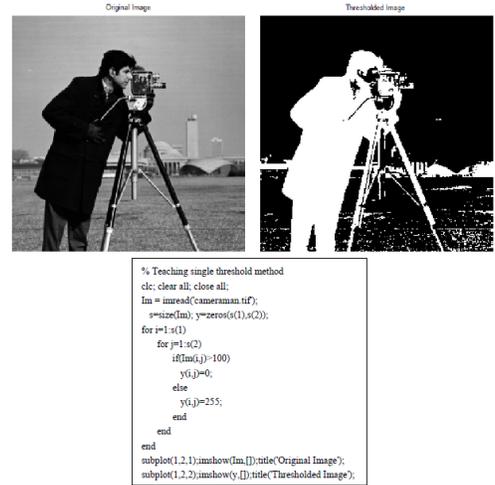

Figure 5: Simple Thresholding Based Segmentation

For the multiple thresholding, the image is segmented into three homogenous regions [10] (Figure 6).
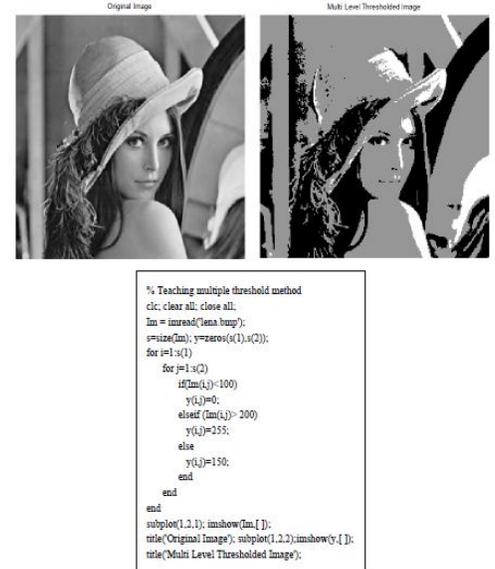

Figure 6: Multiple Thresholding Based Segmentation

8. CONCLUSION

From all the article that have been simplify and explain in literature review, we know that there are lot of methods to manipulate and process the image in the image processing field. The MATLAB software is the systematic tools to be used to apply any application in this field.

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