Selection of A Stopping Criterion For Anisotropic Diffusion Filtering In Ultrasound Images

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Abstract- *Ultrasound imaging is a safe and cost-effective diagnostic tool, but the quality of the images is affected by speckle noise and artifacts. Anisotropic diffusion filters can be used to reduce noise and preserve the edges in the image. However, this technique is very sensitive to the number of iterations selected. This paper proposes a stopping criterion for effective noise removal without blurring the edges, based on the relative variance between the estimated denoised image and the original one. Different quality metrics were evaluated in 25 test images.*

The results suggest that the proposed stopping criterion can be implemented efficiently and aids in the process of automation of the filter.

Keywords- Ultrasound image enhancement, speckle reduction, Anisotropic diffusion filtering, stopping criterion.

I. INTRODUCTION

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.

1.1Digital image processing

In this case, digital computers are used to process the image. The image will be converted to digital form using a scanner – digitiser and then process it. It is defined as the subjecting numerical representations of objects to a series of operations in order to obtain a desired result. It starts with one image and produces a modified version of the same. It is therefore a process that takes an image into another.

The term digital image processing generally refers to processing of a two-dimensional picture by a digital computer . In a broader context, it implies digital processing of any two-dimensional data. A digital image is an array of real numbers represented by a finite number of bits.

The principle advantage of Digital Image Processing methods is its versatility, repeatability and the preservation of original data precision.

1.2 Types of Digital Images

The images types we will consider are: 1) binary, 2) gray-scale, 3) colour, and 4) multispectral.

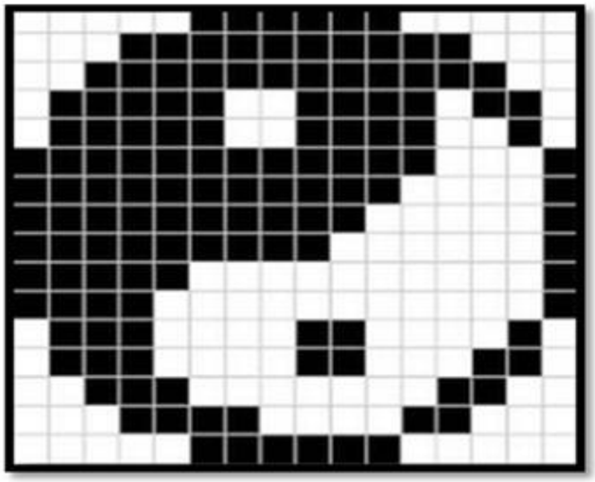


Fig. Binary image

Fig. Gray-scale image

1.2.1 Binary images:

Binary images are the simplest type of images and can take on two values, typically black and white, or 0 and 1. A binary image is referred to as a 1-bit image because it takes only 1 binary digit to represent each pixel. These types of images are frequently used in applications where the only information required is general shape or outline, for example optical character recognition (OCR).Binary images are often created from the gray-scale images via a threshold operation, where every pixel above the threshold value is turned white ('1'), and those below it are turned black ('0'). In the figure below, we see examples of binary images.

1.2.2 Gray-scale images:

Gray-scale images are referred to as monochrome images. They contain gray-level information, no colour information. The number of bits used for each pixel determines the number of different gray levels available. The typical gray-scale image contains 8bits/pixel data, which allows us to have 256 different gray levels. The figure below shows examples of gray-scale images.

In applications like medical imaging and astronomy, 12 or 16 bits/pixel images are used. These extra gray levels become useful when a small section of the image is made much larger to discern detail

1.2.3. Color images

Color images can be modeled as three-band monochrome image data, where each band of data corresponds to a different colour. The actual information stored in the digital image data is the gray-level information in each spectral band.

Typical colour images are represented as red, green, and blue (RGB images). Using the 8-bit monochrome standard as a model, the corresponding colour image would have 24-bits/pixel (8-bits for each of the three colour bands red, green, and blue). The figure below illustrates a representation of a typical RGB colour image.

1.3 MRI IMAGES

Magnetic resonance imaging (MRI) systems provide highly detailed images of tissue in the body. The systems detect and process the signals generated when hydrogen atoms, which are abundant in tissue, are placed in a strong magnetic field and excited by a resonant magnetic.

Excitation pulse. Hydrogen atoms have an inherent magnetic moment as a result of their nuclear spin. When placed in a strong magnetic field, the magnetic moments of these hydrogen nuclei tend to align. Simplistically, one can think of the hydrogen nuclei in a static magnetic field as a string under tension. The nuclei have a resonant or "Larmor" frequency determined by their localized magnetic field strength, just as a string has a resonant frequency determined by the tension on it. For hydrogen nuclei in a typical 1.5T MRI field, the resonant frequency is approximately 64MHz.

II. PROPOSED SYSTEM

INPUT IMAGE

The raw or original image which is to be processed in order to improve its clarity, sharpness and resolution is called as an input image. These input images are generally of four types, they are**:**

- Binary image
- Grey scale image
- RGB image
- Indexed image

In this project we mainly concentrate on grey scale images. These grey scale images mainly composed of multiple shades of blacks and whites ranging from 0 - 255 ,these grey scale images are easy to as they composed of less colours and wider spectral values compared to binary images and can be easiely processed.

PRE-PROCESSING

Pre-processing is a common name for operations with images at the lowest level of abstraction - both input and output are intensity images. These iconic images are of the same kind as the original data captured by the sensor, with an intensity image usually represented by a matrix of image function values (brightnesses). The aim of pre-processing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing, although geometric transformations of images (e.g. rotation, scaling, translation) are classified among pre-processing methods here since similar techniques are used. Image pre-processing methods are classified into four categories according to the size of the pixel neighbourhood that is used for the calculation of a new pixel brightness. Section deals with pixel brightness transformations, describes geometric transformations, Section considers preprocessing methods that use a local neighbourhood of the processed pixel and briefly characterizes image restoration that requires knowledge about the entire image. Some authors classify image pre-processing methods differently into image enhancement, covering pixel brightness transformations (local pre-processing in our sense), and image restoration. Image pre-processing methods use the considerable redundancy in images. Neighbouring pixels corresponding to one object in real images have essentially the same or similar brightness value, so if a distorted pixel can be picked out from the image, it can usually be restored as an average value of neighbouring pixels.

DISCRETE WAVELET TRANSFORM

A discrete wavelet transform (DWT) is a transform that decomposes a given signal into a number of sets, where each set is a time series of coefficients describing the time evolution of the signal in the corresponding frequency band.
In this discrete wavelet transform the input pre-processed image is decomposed into four frequency bands in order to map its horizontal, vertical, diagonal features. The four frequency bands are:

- Low low frequency band
- Low high frequency band
- High low frequency band
- High high frequency band

Low Low Frequency band:

In this frequency band the image is in low low frequency and this image is similar to that of an input image.

Low high frequency Band:

In this frequency band the image is decomposed in such a way that its horizontal attributes are taken in to consideration as the result of this process.

High Low Frequency Band:

In this frequency band the image is decomposed in such a way that, the vertical components of the are taken into consideration as the result of the process.

High High Frequency Band:

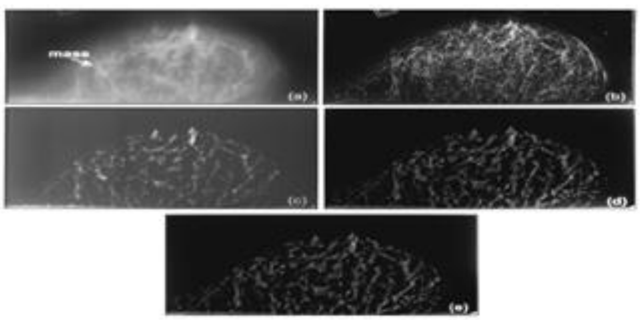
In this frequency band the image is decomposed in such way that, the diagonal components of the image are considered as the result of decomposition process.

GRADIENT PROCESS

Image gradients can be used to extract information from images. Gradient images are created from the original image (generally by convolving with a filter, one of the simplest being the Sobel filter) for this purpose. Each pixel of a gradient image measures the change in intensity of that same point in the original image, in a given direction. To get the full range of direction, gradient images in the x and y directions are computed.

One of the most common uses is in edge detection. After gradient images have been computed, pixels with large gradient values become possible edge pixels. The pixels with the largest gradient values in the direction of the gradient become edge pixels, and edges may be traced in the direction perpendicular to the gradient direction. One example of an edge detection algorithm that uses gradients is the Canny edge detector.Image gradients can also be used for robust feature and texture matching. Different lighting or camera properties can cause two images of the same scene to have drastically different pixel values. This can cause matching algorithms to fail to match very similar or identical features. One way to solve this is to compute texture or feature signatures based on gradient images computed from the original images. These gradients are less susceptible to lighting and camera changes, so matching errors are reduced.

WEIGHTED MATRIX OPTIMISATION



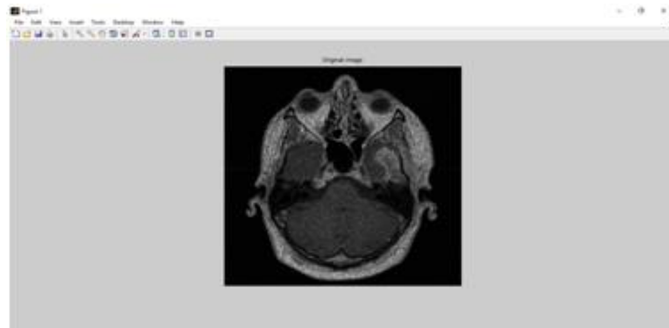
In matrix laboratory we consider all the input images in the form of a matrix in order further process them, in ever image there will be a certain key section in an image which will enhance the over all features of an image. Considering such section of image and processing the pixels that are present in that section of and image is called as weighted matrix optimisation.

These group of pixels impact the over all features of an image and its contents in a wider range as compared to the others parts of an image.

POST PROCESSING

In this step the image is re-configured and reconstructed which was decomposed initially and which had already been iterated and regularized in order to reduce noise and blurness in the image. Now all these processed images are recollected and arranged in such a way that each and every pixel is assigned to their most significant grey scale values so that it gives out the best possible grey scale image as an output with best image quality ,high resolution and least amount of noise.

III. RESULTS



IV. CONCLUSION

The main objective of this paper is to provide a comparative study of some existing techniques of contrast enhancement based on histogram equalization for MRI Glioblastoma brain tumour. For the evaluation process, we selected the most relevant slices where the tumour core appears clearly, then we computed the average value (with a standard deviation) of the quality evaluation metrics which makes the evaluation to be more precise. Through this study one could notice that, ADF technique provides efficient performances for MRI contrast enhancement compared to other studied techniques. For future works, we will focus on enhancing the AHE techniques by introducing filtering approaches that could improve the results in terms of accuracy and treatment efficiency.

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