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ANALYSIS OF CRANIAL ULTRASOUND IMAGES FOR NOISE REDUCTION USING WIENER FILTER

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ABSTRACT

In this paper we are describing Medical images are affected by the Mixed Noise, which is the combination of Speckle & Gaussian Noise. Mixed Noise is an inherent property of CRANIAL Ultrasound Imaging (CUS) & it is generally tends to deteriorate the image quality, thereby reducing the diagnostic value of this medical imaging modality. As a result the noise reduction filtering is considered to be an important & essential procedure to be used, whenever CUS image is used for brain tissue and the flow of blood to the brain. wiener filtering is used to reduce the mixed noise in CUS Image. This method reduces the noise & hence the quality of the image is enhanced. Experimental results show a significant improvement in removing the mixed noise present in the CUS Image by giving better PSNR, MSE & SNR values; the experimental results demonstrate the efficiency of Wiener Filtering Method.

Keywords: Mixed Noise, Speckle Noise, Gaussian Noise, Wiener Filter, PSNR, MSE and SNR.

INTRODUCTION

Image denoising is one of the most essential tasks in image processing. There are different techniques of image restoration can be used for image denoising. In this thesis we used Wiener filtering for denoising the image. Using some statistical parameter such as PSNR & MSE, we can calculate the amount of information retained in the denoising image compare to original image. The increasing reliance of modern medicine on diagnostic techniques such as computerized tomography, histopathology, magnetic resonance imaging, radiology and ultrasound imaging shows the importance of medical images. Ultrasound (US) imaging is an imaging technique that is far the least expensive and most portable comparing to other standard medical imaging modalities. US imaging is a safe technique, easy to use, noninvasive nature and provides real time imaging, hence it is used extensively. But on the downside, ultrasound imaging has a poor resolution of image compared with other medical imaging instrument like Magnetic Resonance Imaging (MRI). US has wide spread application as a primary diagnostic aid of obstetrics and gynecology, due to the lack of ionizing radiation or strong magnetic fields The US image produced has poor quality image which are affected by multiplicative speckle noise due to loss of proper contact or air gap between transducer and the body part. It also may occur all through beam forming progression or signal processing. Speckle has variation of gray level intensities, where ranging from hyper-echoic to hypo-echoic and the existence of this noise construct an analysis of this US images are more difficult.

NEED OF DENOISING

Thus, speckle & Gaussian are considered as the dominant source of noise in ultrasound imaging and should be processed without affecting important image features. The main purposes for varied noise reduction in medical ultrasound imaging are as follows.

1. To enhance the human analysis of ultrasound images – mixed noise reduction makes an ultrasound image cleaner with clearer boundaries.
2. Denoising is a preprocess step for many ultrasound image processing tasks such as segmentation and check noise reduction enhanced the speed and accuracy of automatic and semiautomatic segmentation & registration.

THE CONCEPT OF DENOISING FILTER

The idea behind of every denoising filter is unusual from other filters because each filter has its own function. To give simple clarification of the denoising filters window 3×3 is basically used for median, Gaussian and Wiener filter. Before the start of the discretion of denoising filters we have to know about the convolution.

Convolution:-

Convolution provides a way of `multiplying together' two arrays of numbers, usually they have different sizes, but of the same dimensionality, to create a third array of numbers of the same dimensionality. This can be used in image processing to implement operators whose output pixel values are simple linear combinations of certain input pixel values. Convolution is a easy mathematical operation which is fundamental for many general image processing operators. .In an image processing context, one of the input arrays is normally just a gray level image. The second array is typically much smaller, and is also two-dimensional (even though it may be just a single pixel thick), and is known as the kernel. Figure .1, shows an example image and kernel that we will use to illustrate convolution.

I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
I11	I12	I13	I14	I15	I16	I17	I18	I19	I20
I21	I22	I23	I24	I25	I26	I27	I28	I29	I30
I41	I42	I43	I44	I45	I46	I47	I48	I49	I50
I51	I52	I53	I54	I55	I56	I57	I58	I59	I60
I61	I62	I63	I64	I65	I66	I67	I68	I69	I70
I71	72	I73	I74	I75	I76	I77	I78	I79	I80
I81	I82	I83	I84	I85	I86	I87	I88	I89	I90
I91	I92	I93	I94	I95	I96	I97	I98	I99	I100

(a)

K11	K12	K13
K21	K22	K23
K31	K32	K33

(b)

Figure 1: (a) Pixels of image (b) Kernel of filter

The convolution is solved by sliding the kernel over the image, normally starting at the top left corner, so as to move the kernel during all the positions where the kernel fits completely within the boundaries of the image. Each kernel position corresponds to a single output pixel, the value of which is calculated by multiplying mutually the kernel value and the original image pixel value for each of the cells in the kernel, and then adding all these numbers together So, in our example, the value of the bottom right pixel in the output image will be given by Equation (1).

$O1 = I1\ K11 + I2\ K12 + I3\ K13 + I11\ K21 + I12\ K22 + I13\ K23 + I21\ K31 + I22\ K32 + I23\ K33$ …….(1)

If the image has M rows and N columns, and the kernel has m rows and n columns, then the size of the output image will have M - m + 1 rows, and N - n + 1 columns.

RESULT

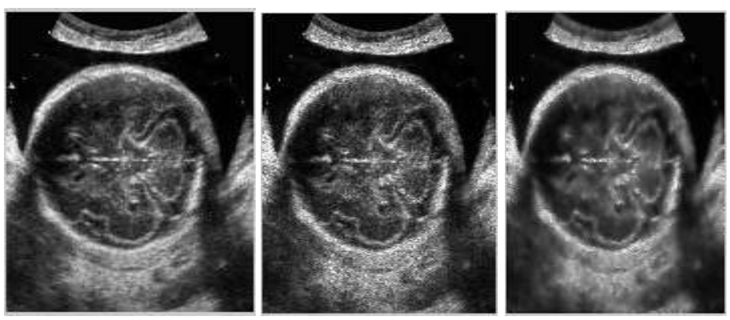
In this paper, result of image restoration technique is presented. The experimentation is carried out on CRANIAL Images using wiener filter. The statistical parameters are computed for original and restored as well as original and noisy images. A comparative result is presented.

The original noise free CRANIAL image, noisy image with speckle variance 0.01 and the denoised image by wiener filter are shown in Figure 2

(a)CRANIAL Image (b)Noisy Image (c)Denoised Image

Figure 2 : Filtering through wiener filter with speckle variance 0.01.

Apart from PSNR & MSE measures, visual quality of the denoised image is usually used for calculating the denoising results. In Figure 7.2 the original CRANIAL Image, noisy image with speckle variance 0.03 and the denoised image by wiener filter are shown.



(a)CRANIAL Image (b)Noisy Image c)Denoised Image

Figure 3: Filtering through wiener filter with speckle variance 0.03

CONCLUSION

The multiplicative noise is often found to model the real time noise in image like Cranial Ultrasound image. This thesis aims at developing a denoising method under multiplicative noise corruption. Wiener Filtering is used to denoising the CRANIAL image. The algorithm is applied to standard images and performance is evaluated using statistical indices like MSE, PSNR & SNR. Experimental result gives better PSNR & MSE values for enhanced image in comparison to degraded image.

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