APPLY DIFFERENT FILTERING TECHNIQUES TO REMOVE THE SPECKLE NOISE USING MEDICAL IMAGES

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ABSTRACT

In this experimental work, we taken different medical images like MRI, Cancer, X-ray, and Brain and we have calculated standard derivations and mean of all these medical images after finding Gaussian noise and then we have applied median filtering technique for removal of noise. After removing a noise by using median filtering techniques again standard derivations and mean are evaluated. This experimental analysis will improve the accuracy of MRI, Cancer, X-ray and Brain images for easy diagnosis. The results, which we have achieved, are more useful and they prove to be helpful for general medical practitioners to analyze the symptoms of the patient.

Keyword: MRI – Magnetic Resonance Imaging , ROI- Region Of Interest, Median filter, Adaptive filter and Average filter, Wiener filter.

INTRODUCTION:

Median Filtering:

Median filtering is similar to using an averaging filter, in that each pixel is set to an 'average' of the pixel values in the neighborhood of the corresponding input pixels. However with median filtering, the value of an output pixel is determined by the median of the neighborhood pixels, rather than the mean. The median is much less sensitive than the mean to extreme values. Median filtering is therefore better able to remove this outlier without reducing the sharpness of the image.

Max and Min filter:

The median filter is by far the order-statistics filter most used in image processing; it is by no mean the only one. Max filter, given by

$$\hat{f}(x, y) = \max_{(s,t) \in S_{xy}} \{g(s, t)\}$$

This filter is useful for finding the brightest points in an image. Also, because pepper noise has very low values, it is reduced by this filter as a result of the max selection process in the sub image S_{xy}.

The 0 th percentile filter is the min filter.

$$\hat{f}(x, y) = \min_{(s,t) \in S_{xy}} \{g(s, t)\}$$

This filter is useful for finding the darkest points in an image.

Mid Point Filter:

The midpoint filter simply computes the midpoint between the maximum and minimum values in the area encompassed by the filter. This filter combines order statistics and averaging. This filter works best for random distributed noise like speckle noise.

Alpha-trimmed mean filter:

Suppose that we delete the d/2 lowest and d/2 highest gray-level values of g(s, t) in the neighborhoods Sxy. Let $g_r(s, t)$ represent the remaining mn –d pixels. A filter formed by averaging these remaining pixels is called an alpha trimmed mean filter.

$$\hat{f}(x, y) = \frac{1}{mn - d} \sum g_r(s, t)$$

If we choose d = (mn -1)/2 the filter becomes median filter.

Adaptive Filtering:

The wiener2 function applies a Wiener filter which is a type of linear filter to an image adaptively, tailoring itself to local image variance. Where the variance is large, wiener2 performs little smoothing. Where the variance is small, wiener2 performs more smoothing. This approach often produces better result than linear filtering. The adaptive filter is more selective than a comparable linear filter, preserving edges and other high frequency parts of an image. In addition, there are no design tasks; the wiener2 function handles all preliminary computations, and implements the filter for an input image. Wiener2, however, does require more computations time than linear filtering. Wiener2 works best when the noise is constant-power ("white") additive noise, such as speckle noise.

Adaptive median filter:

Adaptive median filtering can handle impulse noise with probabilities. The adaptive median filter is that it seeks to preserve detail while smoothing non impulse noise, something that the traditional median filter does not do.

METHODOLOGY

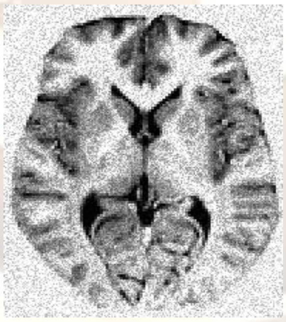
After finding the speckle noise in MRI, Cancer, X-ray and brain images and applying the median filter for these images.

Table 1.1

Noise removal using Median Filter for Speckle Noise.

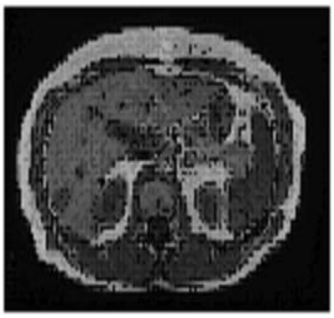
Image	Original Image		Noisy Image		Filtered Image	
	Std	Mean	Std	Mean	Std	Mean
MRI	70.0623	182.2473	68.7852	175.7738	66.6781	177.9070
Cancer	61.2939	62.4918	61.3573	61.6157	50.1053	57.2068
X-Ray	65.4542	145.47576	66.8411	143.1943	64.3425	143.4568
Brain	91.0872	85.9561	87.6710	83.1257	87.1427	83.0331

(a)Original MRI image

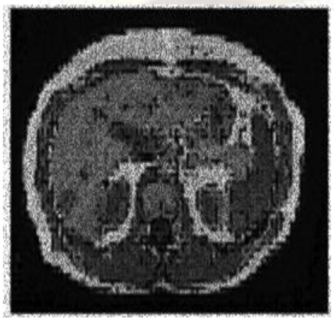


(b) Finding Speckle Noise

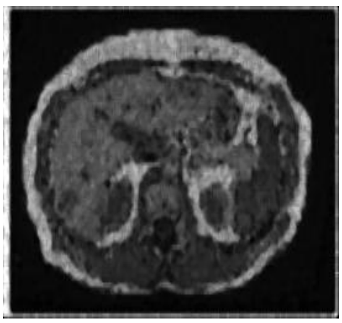
(c) Applying Median Filter



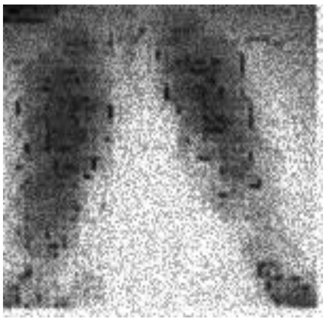
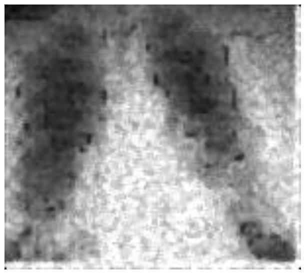
(a) Original Cancer image



(b) Finding Speckle Noise



(c) Applying Median Filter

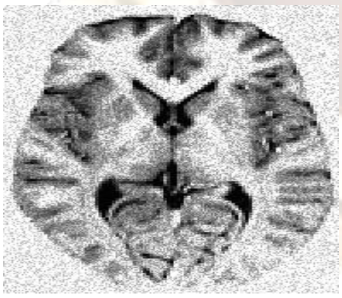
a)Original x-ray image (b) finding a speckle noise (c) Applying median filter



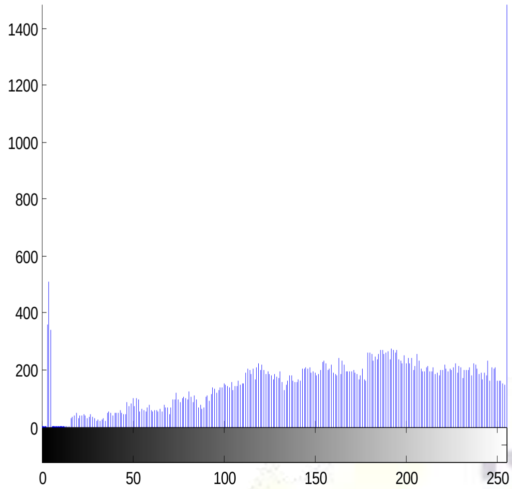
(a)Original image (Brain image) (b) finding a speckle noise in brain image (c) Applying Median Filter

Fig1.1.1. Shows finding the speckle noise in MRI, Cancer, X-ray, Brain images and applying the median filter on these images.

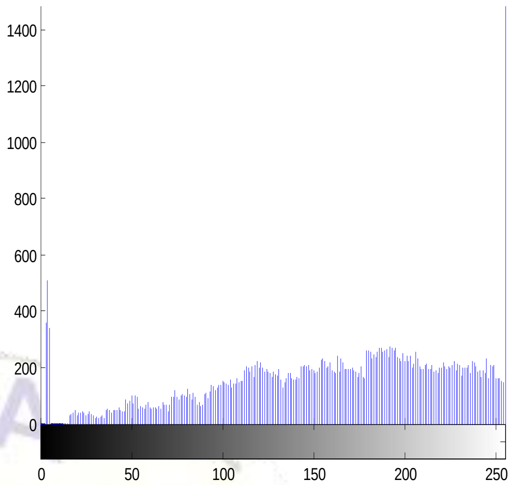
The following figure shows the noise pattern for the MRI, Cancer, X-ray and brain images. In these medical images after finding the speckle noise we have taken a region of interest for noisy images and the histogram shows the noise pattern that is it is the speckle noise.



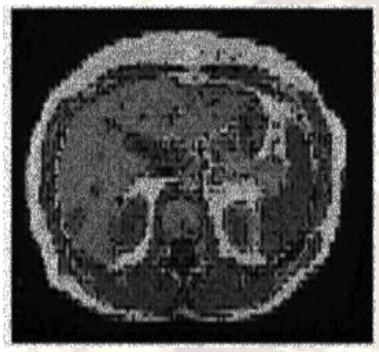

(a) Noisy image (Speckle) (b) ROI generated for noisy image



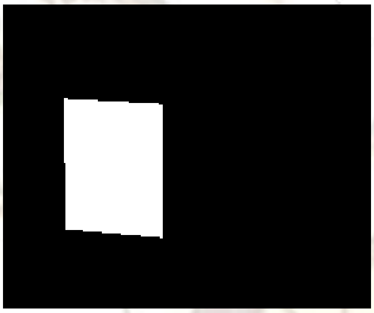
© Histogram for noisy image



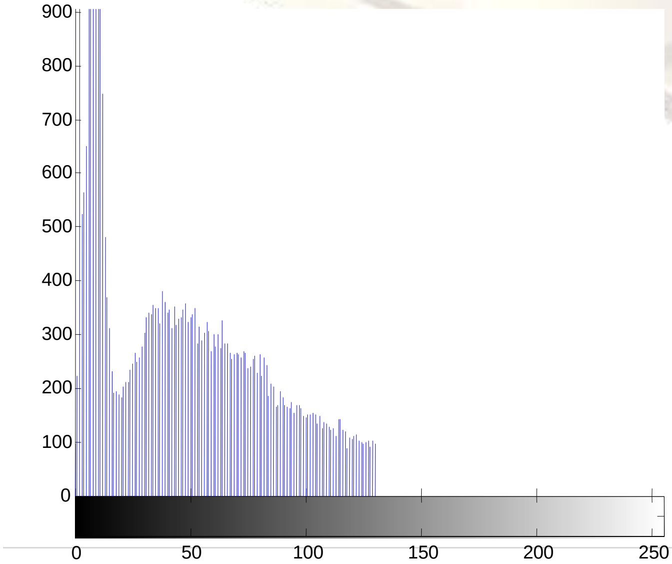
(d) Histogram of ROI

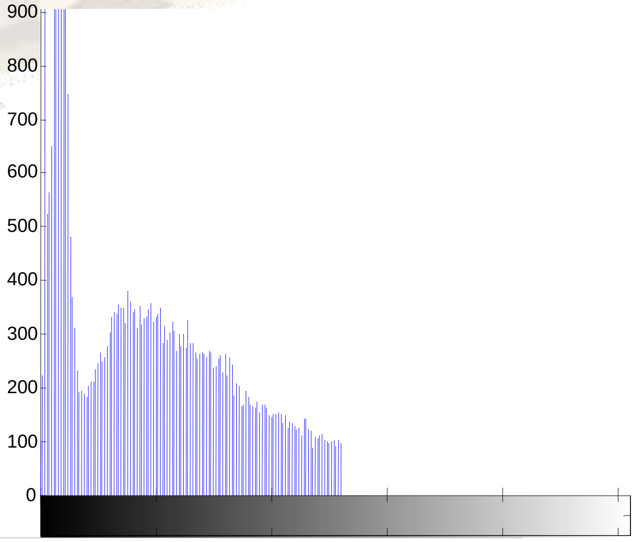


(e) Noisy image (speckle noise)



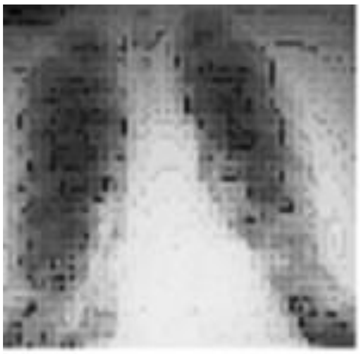
(f) ROI for the noisy image

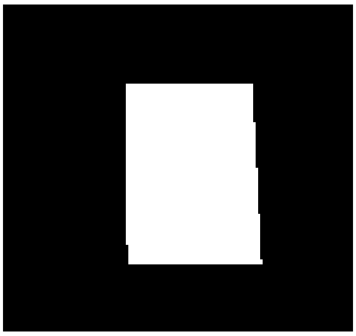




(g) Histogram for the noisy image

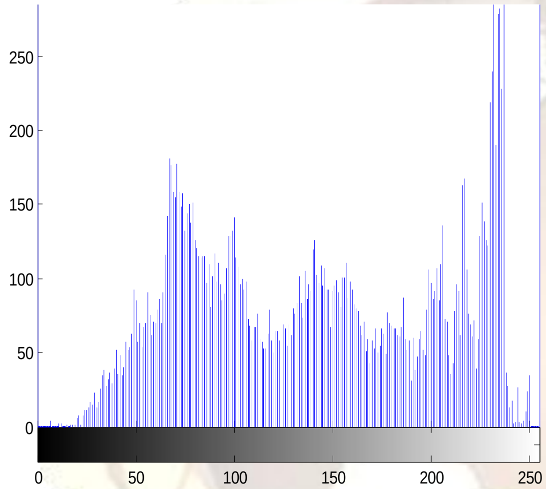
(h) histogram of ROI



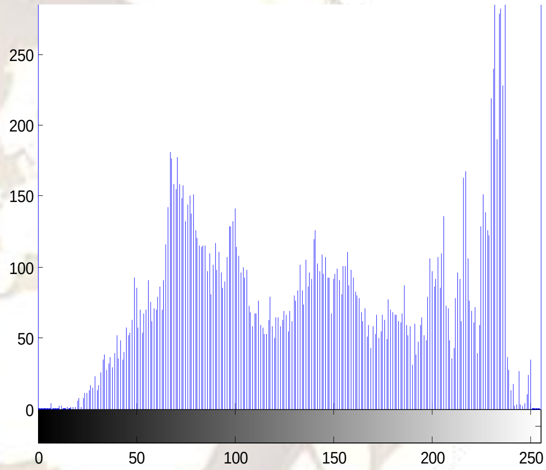


(i) Noisy image (speckle)

(j) ROI of noisy image

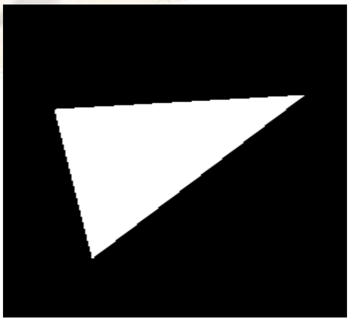


(k)Histogram for the noisy image

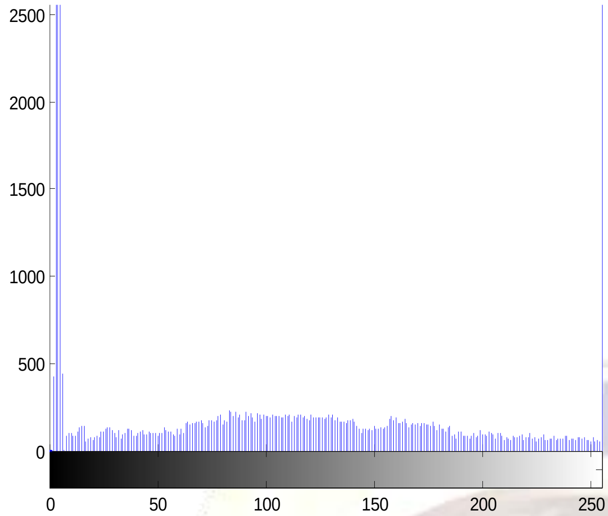


(l) Histogram for the ROI

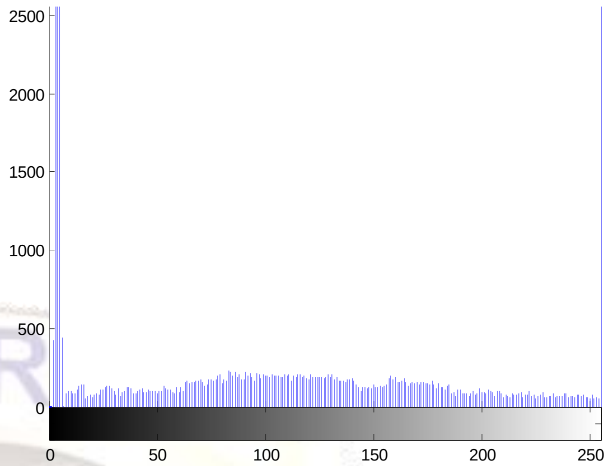
(m)Noisy image (speckle)



(n) ROI of noisy image



(o) Histogram for the noisy image



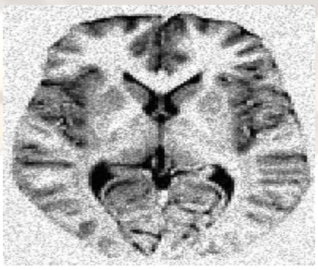
(p) histogram for the ROI

Fig 1.1.2 shows the Histogram for the noisy image and histogram for the selected ROI for speckle noise.
After finding the speckle noise and applying adaptive filter on these images.

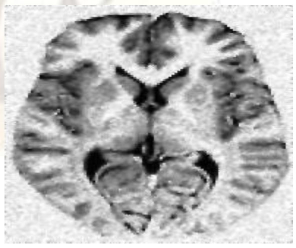
Table 1.2
Noise removal using Adaptive Filter for Speckle Noise.

Image	**Original Image**		**Noisy Image**		**Filtered Image**	
	Std	**Mean**	**Std**	**Mean**	**Std**	**Mean**
MRI	70.0623	182.2473	68.7852	175.7738	62.1669	175.6757
Cancer	61.2939	62.4918	61.3573	61.6157	55.6395	61.7309
X-Ray	65.4542	145.47576	66.8411	143.1943	62.1554	142.9579
Brain	91.0872	85.9561	87.6710	83.1257	85.1484	83.1928

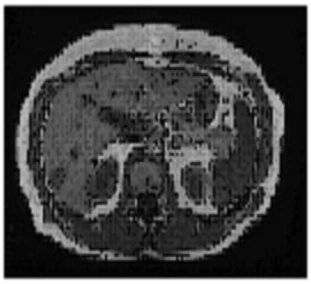
(a)Original MRI image



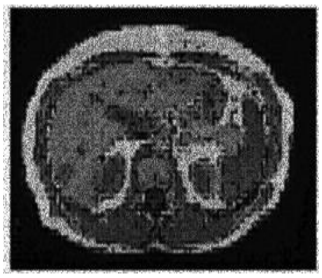
(b) Finding Speckle Noise



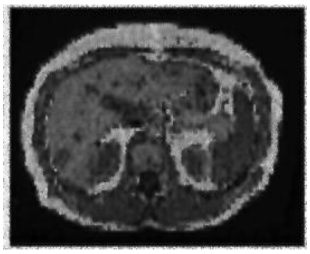
(c) Applying Adaptive Filter



(a)Original Cancer image

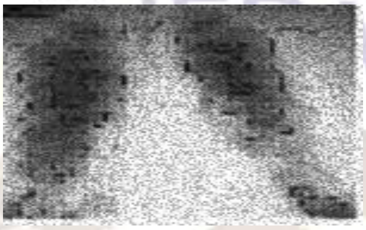


(b) Finding Speckle Noise

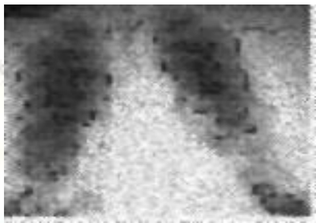


(c) Applying Adaptive Filter

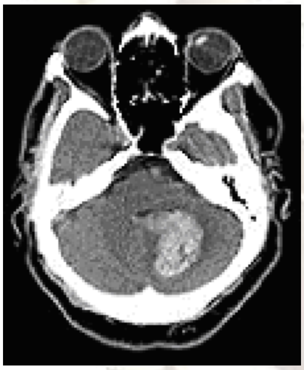
(a)Original x-ray image



(b) finding a speckle noise



(c) Applying adaptive filter



(a)Original image (Brain image)

(b) finding Speckle noise in brain image

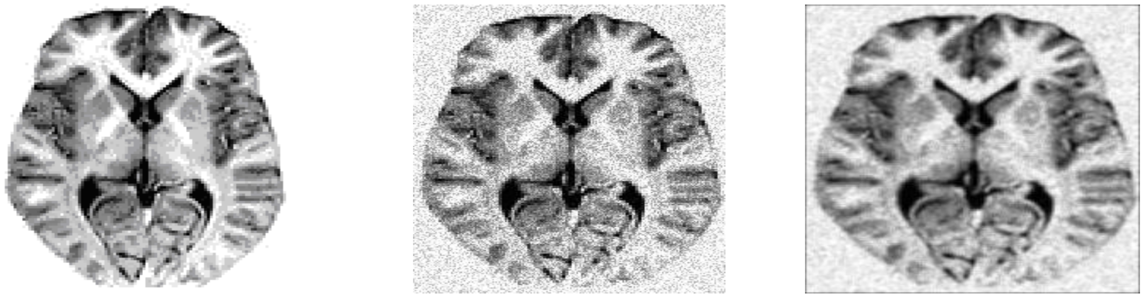
(c) Applying Adaptive Filter

Fig1.2.1 Shows finding the speckle noise in MRI, Cancer, X-ray, Brain images and applying the adaptive filter on these images.

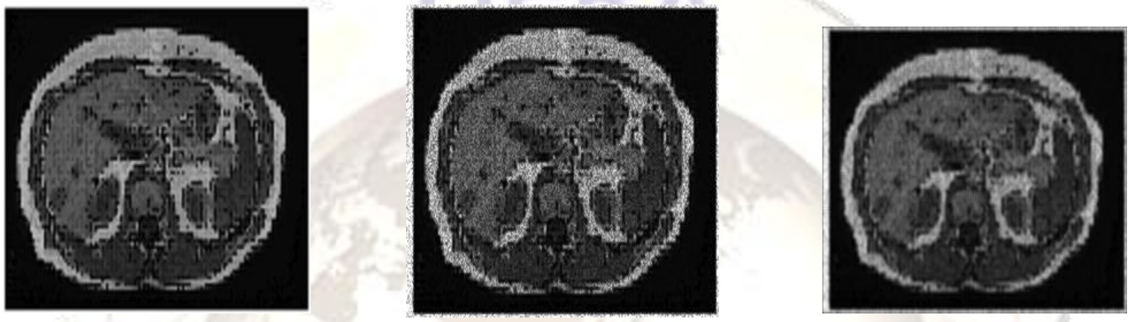
After finding the Speckle noise and applying the average filter on these images.

Table 1.3
Noise removal using Average Filter for Speckle Noise.

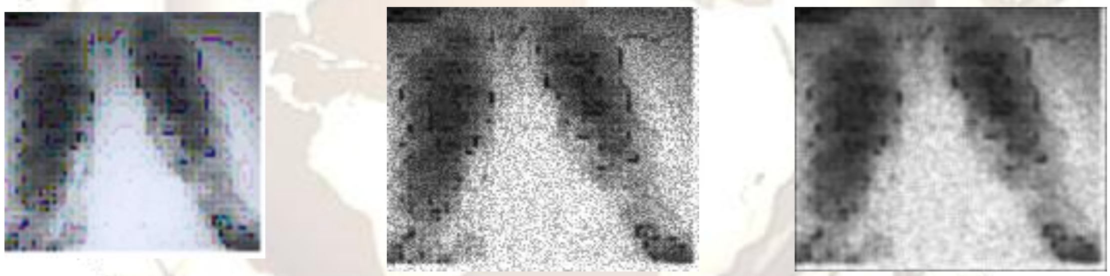
Image	Original Image		Noisy Image		Filtered Image	
	Std	Mean	Std	Mean	Std	Mean
MRI	70.0623	182.2473	68.7852	175.7738	0.2374	0.6836
Cancer	61.2939	62.4918	61.3573	61.6157	0.2029	0.2361
X-Ray	65.4542	145.47576	66.4811	143.1943	0.2393	0.5552
Brain	91.0872	85.9561	87.6710	83.1257	0.3252	0.3259



(a) Original MRI image (b) Finding Speckle Noise (c) Applying Average Filter



(a)Original Cancer image (b) Finding Speckle Noise (c) Applying Average Filter



a) Original x-ray image (b) finding a speckle noise (c) Applying average Filter

(a) Original image (Brain image) (b) Finding Speckle noise in brain image (c) Applying Average filter

Fig 1.3.1 Shows finding the speckle noise in MRI, Cancer, X-ray, Brain images and applying the average filter on these images.

DISCUSSION:

As per discussed in chapter4 Different medical images like MRI, Cancer, x-ray and brain images have been studied. After finding the Gaussian noise in MRI image the various filtering techniques like Median filter, Adaptive filter and Average filter have been applied. We have taken the slandered derivation and mean after filtering the image which is shown in tables.

To find the speckle noise in MRI image various filtering techniques have been applied and it is found that the adaptive filter works better for the noisy image. The standard derivation for the noisy image is 68.7852 and the standard derivation for the adaptive filtered image is 62.1669.

To find the speckle noise in Cancer image various filtering techniques have been and it is found that the median filter works better for the noisy image. The standard derivation for the noisy image is 61.3573 and the standard derivation for the adaptive filtered image is 50.1053.

To find the speckle noise in X-ray image various filtering techniques have been and it is found that the adaptive filter works better for the noisy image. The standard derivation for the noisy image is 66.8411 and the standard derivation for the adaptive filtered image is 62.1554.

To find the speckle noise in Brain image various filtering techniques have been applied and it is found that the adaptive filter works better for the noisy image. The standard derivation for the noisy image is 87.6710 and the standard derivation for the adaptive filtered image is 85.1484.

CONCLUSION:

In this work we have taken different medical images like MRI, Cancer, X-ray and Brain for detecting noises. We have detected speckle noise. These noises from the above medical images by applying the various filtering techniques like Median Filtering, Adaptive Filtering and Average Filtering. The results are analyzed and compared with standard pattern of noises and also evaluated through the quality metrics like Mean, and Standard deviation.

Through this work we have observed that the choice of filters for de-noising the medical images depends on the type of noise and type of filtering technique, which are used. It is remarkable that this saves the processing time. This experimental analysis will improve the accuracy of MRI, Cancer, X-ray and Brain images for easy diagnosis. The results, which we have achieved, are more useful and they prove to be helpful for general medical practitioners to analyze the symptoms of the patient.

REFERENCES:

1. Rafael C.Gonzalez & Richard E.Woods, “Digital Image Processing”, Second edition, 2005.
2. Rafael C.Gonzalez & Richard E.Woods, “Digital Image Processing using MATLAB”, Pearson education 2004
3. S.S.Gornale et.al,”Evaluation & selection of wavelet filters for de-noising medical images using Stationary wavelet Transform (SWT)”International conference on systemic, cybernetics and informatics ICSCI2007.
4. Adrian Low ,”Computer Vision & Image Processing”, McGraw Hill(1991)
5. www.mathworks.com (Digital image processing)
6. Milan Sonka et.al,”Image Processing Analysis and Machine Vision“, International Thomson computer press, UK-1996.
7. A.Buades, B Coil, J.M.Morel (2005),”A Review Of Image Denoising Algorithms with New one”, Multiscale Model, Simulation, Vol.4, No.2, pp: 496-530, Industrial and applied Mathematics.
8. Shalkoff R.J, 1989, John wiley and sons, New York, “Digital Image Processing and computer vision”.
9. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, 1st Edition
10. Ryeol Kim, “Wavelet Domain Partition-based signal Processing with Applications to Image Denoising and Compressing”, Ph. D. Thesis, 2006.
11. www.mathsworks.com
12. Petrou M. and bosdogianni, P [1999]. Image Processing: The Fundaments, John Wiley & Sons.
13. Jain, A. K. [1989].Fundaments of Digital Image Processing, Prentice Hall, Upper Saddle River.
14. R.C. Gonzalez, R.E. Woods and Steven L Eddins “Digital Image Processing using MATLAB”, Second Edition, Pearson Education, 2004.
15. Castleman, K.R [1996]. “Digital Image Processing”, 2nd ed., Prentice Hall, Upper Saddle River.
16. Buades A et. al, “A Review of Image De-noising Algorithms with new one”, Multiscale Model, Simulation Vol 4, No. 2, 2005, PP: 496-530
17. G.Panda, S.K.Meher et. al., "Denoising of Corrupted data using Discrete Wavelet transform”, *Journal of the CSI Vol. 30*. No.3, 2000.