Denoising Of Osteosarcoma Digital Images Using Various Enhanced Filtering Techniques

B.Karthicsonia, Dr. M.Vanitha

Abstract: Medical image processing is a dominant procedure that is used to predict different variety cancers such as bone cancer, brain cancer, lung cancer, liver cancer, breast cancer, etc. Osteosarcoma is a one of the category of bone cancer. It is the most horrible cancer that affects human being's bones. It can be predicted with the help Computed Tomography scan images, Magnetic resonance imaging (MRI) Scan image, Bone scan, X-rays and Histopathological tissue images. These digital medical images plays vital role in diagnostic a patient. The most important feature of investigative medical image is to reduce or compress the Noise. Noises are removed by various filtering techniques. This paper compares performance of a various filter techniques used in removing different types of noises in medical images. The image quality is measured by denoising parameters such as MSE, RMSE and PSNR. MATLAB is used as a programming tool.

Keywords: Osteosarcoma, Image processing Noise, Filtering, Denoising parameters.

I . INTRODUCTION

Now a day, Digital image processing involves the application of exclusive computational algorithmic methods to achieve processing over digital images. Image processingis widely used in Real time system, robotics, remote sensing and medical diagnostic. Digital medical image play vital role diagnostic a patients.Medical images are blurred and noisy.Noise in an image may occur due to insufficient lighting and temperature for imaging sensors, image sensor may be affected, Presence of dust particles over the screen of image sensors and interruption in electronic transmission channels.

II.TYPES OF NOISES

Osteosarcoma can de predicted with help of medical images. Magnetic Resonance Imaging (MRI), Ultrasound image, Digital Microscope image, Digital X-ray and Computed Tomography (CT), are mostly used image capturing equipment for diagnosis. These images may be corrupted with noises for example MRI supposed to be corrupted by salt& pepper noise Gaussian noises and Speckle noises, Ultrasound images can be corrupted with speckle noise, Digital Microscope images may be corrupted with salt and pepper noise, Digital X-ray image can have random noises and Computed Tomography (CT) are supposed to corrupted by Poisson noises .

a)Salt And Pepper Noise:

It is also called as impulse noise. It appear as a black and white points on an image. It is caused by due to error in transmitting a data, faulty of pixel element in image sensors, defective memory location. The typical value of white (salt) is 255 and black (pepper) is 0.

The salt and pepper given by

$$P(z)=\begin{cases} P_a & \text{for } z=a \\ P_a & \text{for } z=b \\ 0 & \text{Otherwise} \end{cases}$$

If a>b ,intensity a will appear as dark dot in a image or intensity will appear light dot in the image.

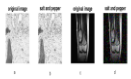

Figure 1

b)Gaussian Noise:

It is also known as electronic noise because it is arises during image acquisition like sensor noise caused by poor illumination, high temperatures, transmission. Gaussian noise having Probability distribution function is equals to that the normal distribution.

Probability density of the normal distribution function of Gaussian random variable given by

$$f_G(x) = \frac{1}{\sqrt{2\pi\sigma}} \exp\left[-\frac{(x-\mu)^2}{2\sigma^2}\right]$$

where x represent the grey level,μ mean or median value of the function and σ represent standard deviation of the noise .

- *Manuscript*
- *Corresponding Authors*
- *Karthicsonia.B,Researchscholar,Dept of Computer Applications,AlagappaUniversity,Karaikudi,India.*
- *Karthicsoniaramesh1@gmail.com*
- *Dr.Vanitha.M, Asstprofessor,Dept of Computer Applications,AlagappaUniversity,Karaikudi,India.*
- *mvanitharavi@gmail.com*

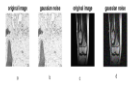

Figure 2

c) Poisson Noise:

Poisson noise is also known as quantum (photon) noise or shot noise. It is an electronic noise. It occurs when the programmeddigit of particles that carry energy, such as photons in an optical device or electrons in an electronic circuit, is a sufficient amount to provide increase to observable statistical fluctuations in a measurement.

Poisson noise follows Poisson distribution is given as in Equation:

$$P(X) = \frac{\lambda^x e^{-\lambda}}{X!}$$

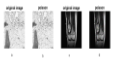

Figure 3

d)Speckle Noise:

Speckle noise is multiplicative noise. Multiplicative means unwanted random signal get multiplied into number of relevant signal during image acquisition, image Transmission and other processes. This is a common noise seen in MRI images their appearance is seen in consistent imaging. This noise looks similar in an image as Gaussian noise. Its probability density function (PDF) of Speckle Noise follows gamma distribution is given as in equation:

$$f(x) = \frac{x^{\alpha-1} e^{\frac{-x}{a}}}{\alpha - 1! \, a^{\alpha}}$$

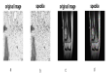

Figure 4

e) Hybrid Noise (Poisson and Gaussian noise):

It is combination of both Gaussian and Poisson noise. These two noises appear mostly Computed tomography scanimages.

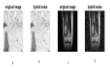

Figure 5

f) Hybrid Noise (GSS NOISE):

It is combination of Gaussian,Salt and pepper noise and Speckle noise. These noises commonly appear in MRI scan images and Using Histopathological Tissue Images.

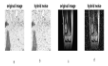

Figure 6

III .FILTERS

Removing the noise from digital images is an essentialprocess in medical image analysis. Image can be enhanced, when the noises are reduced. Noise deduction is done with help of filters. Filters are helps to exact or restore an image corrupted with noise. Filter used in this study are:

a)Average Filter:

Average filter is also known as Mean filter. It is a type of spatial domain and nonlinear filter. It removes noise by smoothing the images. The mean filter replaces the pixel value of image with the Average value of its neighbour and itself.

b) Gaussian Filter:

Gaussian filter is defines Probability distribution of noise, it is used to blur and smoothening image.

c) Median Filter:

Median filter is also known as order statistics filter. It is a type of spatial domain and nonlinear filter. It removes noise by smoothing the images. The median filter replaces the pixel value of image with the middle value.

d)Wiener Filter:

Wiener filter is used to smoothing the speckle noise. The purpose of this filter is to reduce the amount of noise present in an originalimage by comparison with an estimation of the required noiseless image. It is based on a statistical approach.

e) Hybrid filter (WMFilter):

This hybrid filter is combination of Mean and wiener filter. First image is filtered by mean then output of mean filter is given as input to wiener filter then the solution is found.

f)Hybrid filter(MM filter):

This hybrid filter is combination of Mean and median filter. First image is filtered by mean then output of mean filter is given as input to median filter then the solution is found .By this hybrid filter mean filter disadvantage were cleared by median filter and it can be produce better result. The statistical measurements, such asMean square Error (MSE), Root Mean Square Error (RMSE), and Peak Signal-to-Noise Ratio (PSNR) are used to estimate the de-noising performance. Filter having highest PSNR value, consider as a best filter among other filters for denoising performanceThe Mean Square Error is given by following MATLAB CODE: MSE=IMMSE (name of the filter image, original image); The Ratio Mean Square Error (RMSE) is given by following MATLAB CODE:

RMSE=SQRT (MSE);

The Peak Signal-to-Noise Ratio (PSNR) is given by following MATLAB CODE:MAX1=255;

PSNR=10*LOG10(MAXI^2)./MSE;

IV PROPOSED METHODOLOGY

Step1: Input the Image

Step 2: Convert into Grey scale image

Step 3: Apply various Noises to image

Step 4:Then Remove the noises using various filters and computational time is calculated

Step 5:Find MSE,RMSE and PSNR(peak signal to noise ratio)

V SIMULATION RESULTS

It is estimated that the filters (Average, Gaussian, Log, Median, Wiener, Hybrid PG, and HybridGSS) were applied on the original image to remove different types of noises (Salt &pepper, Gaussian, Poisson, and Speckle). It was found that all the filters have more ability and are successful in removing all the mentioned noises, as shown in Figure 7 to18 and The best filter depended on the image quality parameter of PSNR , because the value of PSNR has a maximum value for the Median filter. The results are listed in Tables 1 to 6.Hybrid filter (mean& median) have best time complexity

Salt & pepper Noise:

Figure 7

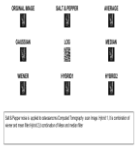

Figure 8

Table I*. Image quality parameters by the Average, Gaussian, Log, Median, and Wiener filters, Hybrid1, hybrid 2 with salt and pepper noises applied on the tissue image and CT scan image*

Filter type	MSE		RMSE		PSNR		Computed Time in sec	
	Tissue	CT	Tissue	CT	Tissue	CT	Tissue	CT
Average	468.5	173.9	21.6451	13.18	0.1027	0.2767	0.0021	0.0107
Gaussian	1277.7	1339.	35.74	36.59	0.0377	0.0359	0.0028	0.0104
Log	31852	2640	178.47	162.49	0.0015	0.0018	0.0031	0.0108
Median	225.76	1.290	15.02	1.1360	0.2132	37.29	0.0044	0.0093
Wiener	843.12	880.9	29.0367	29.68	0.0571	0.0546	0.0117	0.1929
Hybrid1 (WM)	473.14	132.70	21.75	11.5198	0.1071	0.367	0.0100	0.1762
Hybrid2 (MM)	472.06	109.98	21.72	10.487	0.1020	0.4376	0.0037	0.0063

Figure 9

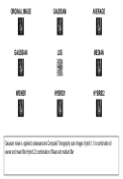

Figure 10

Gaussian noise:

***Table II** . Image quality parameters by the Average, Gaussian, Log, Median, and Wiener filters, Hybrid1, hybrid 2 with Gaussian noises applied on the tissue image and CT scan image*

Filter type	MSE		RMSE		PSNR		COMPUTED Time in sec	
	Tissue	CT	Tissue	CT	Tissue	CT	Tissue	CT
average	417.70	272.44	20.43	16.50	0.1153	0.1767	0.0088	0.0089
Gaussian	504.90	720.40	22.47	26.84	0.0950	0.0668	0.0084	0.0083
Log	30698	28905.8	175.20	170.01	0.0016	0.0017	0.0084	0.0084
Median	472.44	268.47	21.73	16.38	0.1033	0.1541	0.0039	0.0038
Wiener	274.56	312.28	16.57	17.67	0.1766	0.1793	0.2023	0.1741
Hybrid1 (WM)	459.55	247.72	21.43	15.73	0.1048	0.1943	0.1544	0.1722
Hybrid2 (MM)	469.25	246.66	21.66	15.70	0.1020	0.1951	0.0036	0.0053

Speckle Noise:

Figure 11

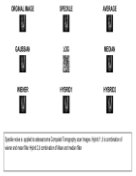

Figure 12

***Table III**. Image quality parameters by the Average, Gaussian, Log, Median, and Wiener filters, Hybrid1, hybrid 2 with Speckle noises applied on the tissue image and CT scan image*

Filter type	MSE	RMSE	PSNR	Computed Time in sec

	Tissue	CT	Tissue	CT	Tissue	CT	Tissue	CT
Average	599.39	32.7915	24.4825	5.7264	0.0803	1.4678	0.0020	0.0094
Gaussian	1473.03	230.79	38.380	15.1893	0.0327	0.2086	0.00198	0.0073
Log	28400.5	26601.60	168.5230	163.10	0.0017	0.0018	0.00199	0.0074
Wiener	483.49	141.6346	21.9884	11.9010	0.0995	0.3398	0.0254	0.0039
Median	706.53	67.1370	26.5806	8.1937	0.0681	0.7169	0.0128	0.1978
Hybrid1 (MW)	598.81	26.3709	24.4708	5.1353	0.0804	1.8251	0.0020	0.0053
Hybrid2 (MM)	600.19	23.0840	24.4988	4.8046	0.0802	2.0850	0.0024	0.0053

Poission image:

Figure 14

Figure 13

Table IV. *Image quality parameters by the Average, Gaussian, Log, Median, and Wiener filters, Hybrid1, hybrid 2 with Poisson noises applied on the tissue image and CT scan image*

Filter type	MSE		RMSE		PSNR		COMPUTED Time in sec	
	Tissue	CT	Tissue	CT	Tissue	CT	Tissue	CT
Average	314.45	6.13131	17.7328	2.47 65	0.1531	7.8477	0.0021	0.0060
Gaussian	178.2588	41.9405	13.3514	6.4762	0.2700	1.1476	0.0022	0.0077
Log	28859.90	27139.98	169.88	164.74	0.0017	0.0018	0.0022	0.0085
Median	249.3542	9.02 63	15.7910	3.0044	0.1930	5.3323	0.0031	0.0049
Wiener	140.4429	17.7252	11.850	4.2101	0.3427	2.7154	0.0117	0.1297
Hybrid1 (MW)	369.20	4.87 85	19.2148	2.208	0.1304	9.8660	0.0122	0.1206
Hybrid2 (MM)	367.39	4.9810	19.1675	2.2318	0.1310	9.6628	0.0027	0.0046

Hybrid PG noises

Figure 15

Table VII*. Image quality parameters by the Average, Gaussian, Log, Median, and Wiener filters, Hybrid1, hybrid 2 with Hybrid PG noises applied on the tissue image and CT scan image*

Filter type	MSE		RMSE		PSNR		Computed Time in sec	
	Tissue	CT	Tissue	CT	Tissue	CT	Tissue	CT
Average	423.08	276.41	20.56	16.62	0.1131	0.1735	0.0020	0.0070
Gaussian	607.32	755.93	24.64	27.49	0.0795	0.0636	0.0020	0.0091
Log	30379.8	28916	174.29	170.9	0.0016	0.0017	0.0023	0.0089
Median	21.86	21.09	4.664	4.591	2.1881	2.9000	0.0025	0.0057
Wiener	287.12	322.911	16.94	17.96	0.1674	0.1916	0.0127	0.1571
Hybrid1(MW)	459.03	250.27	21.42	15.82	0.1043	0.1916	0.0097	0.1708
Hybrid2(MM)	468.99	248.77	21.65	15.77	0.1023	0.1927	0.0040	0.0067

Hybrid GSS noises

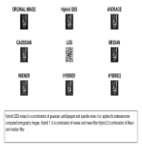

Figure 16

Table VIII. *Image quality parameters by the Average, Gaussian, Log, Median, and Wiener filters, Hybrid1, hybrid 2 with Hybrid GSSnoises applied on the tissue image and CT scan image*

Filter type	MSE		RMSE		PSNR		Computed Time in sec	
	Tissue	CT	Tissue	CT	Tissue	CT	Tissue	CT
Average	756.08	567.54	27.49	23.82	0.0636	0.0848	0.0018	0.0104
Gaussian	2522.2	2152.99	50.22	46.40	0.0191	0.0224	0.00172	0.0078
Log	30164	31103	173.6	176.36	0.0016	0.0015	0.00177	0.0074
Median	26.885	33798	5.184	18.38	1.7902	0.1424	0.0022	0.0033
Wiener	31.06	1106.2	964.6	33.26	00499	0.0435	0.0117	0.1562
Hybrid1 (MW)	26.52	498.58	703.4	22.32	0.0684	0.0965	0.0103	0.1862
Hybrid2 (MM)	26.53	452.60	704.12	21.27	0.0684	0.1063	0.0026	0.0501

VI CONCLUSION:

Average, Gaussian, Log, Median, Wiener, Hybrid PG, Hybrid GSS were applied on the original image to remove various category of noises such as Salt & Pepper, Gaussian, Poisson, a Speckle, Hybrid PG noise, and Hybrid GSS noise. The best filter depended on the image quality parameter of PSNR .The performance of Median filter after removing the noise for salt& Pepper and Both Hybrid noises in histopathological and computed tomography images is better than other filters. The performance of Wiener filter after removing the noise for Poisson, Speckle and Gaussian noises in histopathological images is better than other filters. Hybrid filter (Mean & Median) give best in Poisson noise in computed tomography image. Hybrid filter (Mean &Wiener) give best in Gaussian noise in computed tomography image. Meanwhile Log filter is not suitable removing any type'snoise. Median filter have most ability to remove noise with minimum computation time.

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REFERENCE:

[1] Patidar, Pawan, "Image de-noising by various filters for different noise." IJCA (2010)

[2] Basu, Mitra. "Gaussian-based edge-detection methods-a survey." IEEE Transactions on Systems, Man, and Cybernetics.

[3] Hamad,"De-noising of medical images by using some filters." IJBResearch(2014).

[4] Wang, "Digital image enhancement: a survey." Computer Vision, Graphics, and Image Processing (1983)

[5] Kumar, "Comparative performance analysis of image de-noisingtechniques." ArXiv. (2019).

[6] H. Choi "Analysis of wavelet domain Wiener filters," IEEE Int. Symp. Time- Frequency and Time-Scale Analysis, Oct. 1998.

[7] H. Zhang, "Image denoising via wavelet-domain spatially adaptive FIR Wiener filtering", IEEE Proc. Int. Conf. Acoustic., Speech, Signal Processing, June 2000.

[8] R. G. Baraniuk, "Optimal tree approximation with wavelets," in Proc. SPIE Tech. Conf. Wavelet Applications Signal Processing ,1999.

[9] M. Lang,, "Nonlinear processing of a shift invariant DWT for noise reduction," SPIE, Mathematical Imaging: Wavelet Applications for Dual Use, April 1995.

[10] KAM SajadHyder. And Vanitha M "A Survey On various Image Retrieval Techniques (IJARTET) Vol.3 (20), pp.623-626 ISSN: 2394-3785.