An Approach-Effect of an Exponential Distribution on different medical images

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Summary
Medical imaging refers to technique and process used to create images of human body (or part thereof) for clinical purpose (medical procedures seeking to reveal diagnose or examine diseases) or medical science (including the study of normal anatomy and function) .Image processing techniques in medical imaging are used to analyze the symptoms of the patients with ease. Medical images often consist of random noise and which are affected during acquisition and it spread over the image. In such situation it is very difficult to diagnosis the particular disease. Therefore it is necessary to remove the noise from the image. Real images are often degraded by noise and this noise can occur during image transmission and digitization. The application of this method is to detect the different types of noise in medical images and shows the effect of exponential distribution on the noise by evaluated the Probability density function (PDF) for the medical images. The results are analyzed compared with standard pattern of noise and evaluated through the quality metrics like mean and standard derivations. [1] [4] [9][19].

Key words:
Medical imaging, Detecting noise, and Probability Density Function, Exponential Distribution

1. Introduction

Image-processing techniques have been developed for analyzing the output of medical imaging system to get the advantage to analyze the symptoms of
the patients with ease. MRI, Cancer and Brain images often consist of random noise that does not come from tissues but from other sources in the Electronics instrumentation during acquisition. The noise of an image gives it a gray appearances and mainly the noise is evenly spread and more uniform. MRI, Cancer and X-ray, MRI Brain images are prone to a variety of types of noise. There are several ways that noise can be introduced into an image, depending on how the image is created.

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1.1 Effect of noise in digital image processing: Real images are often degraded by some error this is called Noise. In the digital image noise can occur during image transmission and digitization. Image sensors are affected by environmental condition during image digitization & by quality of elements. In acquiring image with a CCD camera, light levels & sensors temperature are major factors affecting the amount of noise in the resulting images. Noises may be dependent or independent of image content. Images are corrupted during the transmission due to interference in the channel used for transmission.

There are two types' noise models-

1. Noise in the spatial domain: Described by probability density function.
2. Noise in the frequency domain: described by various Fourier properties of noise.

1.2 Noise Probability Density Functions

The spatial noise descriptor may be considered random variable, characterized by a probability density function (PDF) .The following are among the most common PDF found in image processing applications-

Exponential Noise:

The PDF of exponential noise is given by:

$$P(z) = \begin{cases} ae^{-az} & \text{for } z \geq 0 \\ 0 & \text{for } z < 0 \end{cases}$$

Where $a > 0$.

Mean

$$\mu = a+b/2$$

Standard deviation

$$\sigma^2 = 1/a^2$$

Coefficient of Variation

$$CV= S.D/Mean$$

The organization of the paper is as follows. Section 2 deals with the methodology to detect and remove the noise, section3 gives experimental analysis & discussion lastly section4 gives the conclusion. [2][6][10]

2. Methodology

For detection and evaluation of Probability Density Function of noise in medical images, we have proposed the following algorithm.

Step1. Input the image.
Step2. Detect the noise and match with Existing noise pattern
Step3. Once the noise detected find the Mean and variance of noisy image.
Step4. Then apply the exponential distribution technique to find the probability density function.
Step5 Repeat step 3 to 4 for different medical images
Step6. Results are to be tabulated.
Step6. End

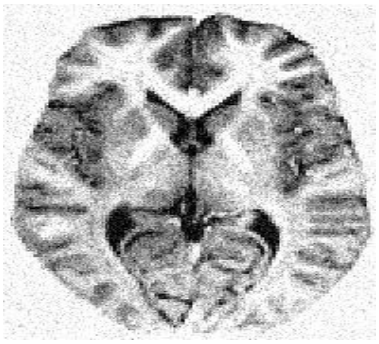
The medical images like MRI and MRI Brain images have been taken as input images. We have detected the noise and match with the existing noise pattern. Once the noise has detected we have applied exponential distribution technique

3. Experimental Analysis & Discussion

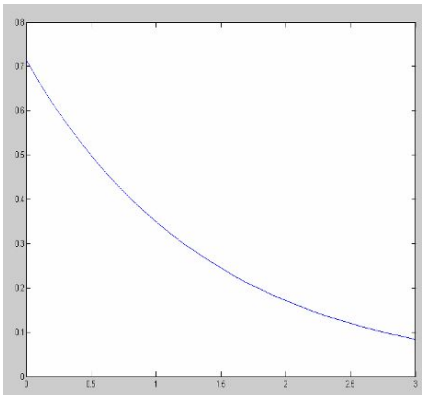
In this experimental work we have taken medical images like MRI and MRI Brain. We had applied the above mention algorithm on these images. This experimental work is a carried in MATLAB. We found Gaussian noise in a MRI image and detected noise matches with the existing noise pattern. Once noise has been detected, then we have evaluated mean, standard deviation and cv. After calculated these we have applied Distribution techniques such as exponential distribution. After applied exponential distribution we had evaluated probability density function of exponential distribution using formula has given above. Gaussian noise shown in table 1.1

The salt & pepper noise in MRI and MRI Brain image and it matches with the existing noise pattern as shown in figure 1. The standard derivations and mean, CV has been evaluated after adding the salt & pepper noise and evaluated the PDF using Exponential distribution as shown in table 1.2.

For The Speckle noise in MRI and MRI Brain image and it matches with the existing noise pattern as shown in figure 1. The standard derivations and mean , CV has been evaluated after adding the salt & pepper noise and evaluated the PDF using Exponential distribution as shown in table 1.3.

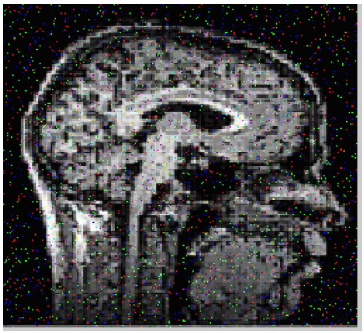


Finding the Gaussian noise in MRI

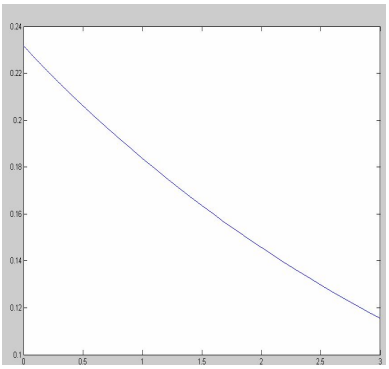


Curve for Gaussian noise in MRI

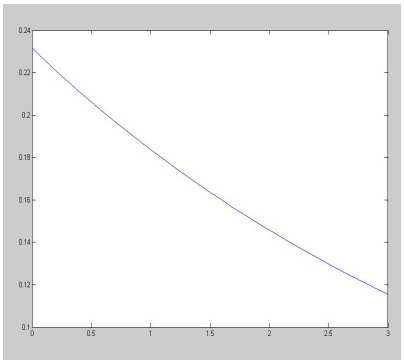
Finding the Gaussian noise in MRI Brain



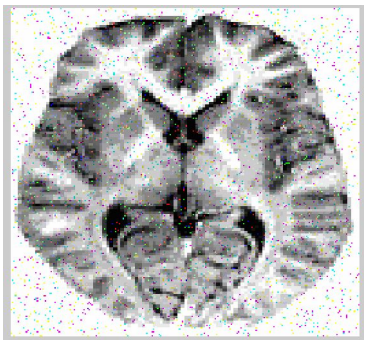
Finding the Salt & Pepper noise in MRI Brain



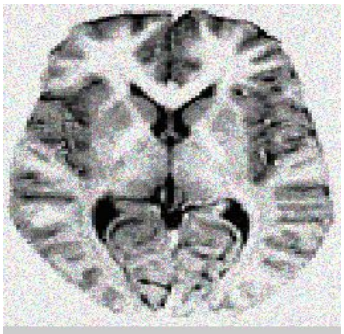
Curve for Gaussian noise in MRI Brain



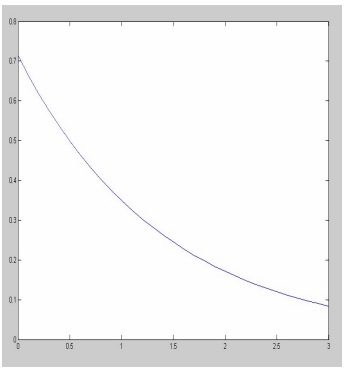
Curve for Salt & Pepper in MRI Brain



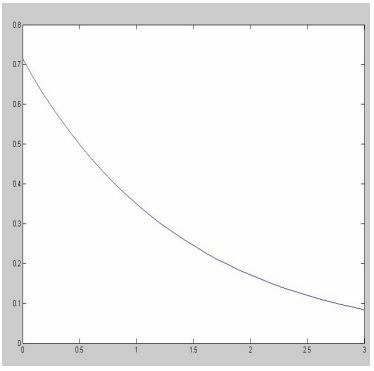
Finding the Salt & Pepper noise in MRI



Finding the Speckle noise in MRI



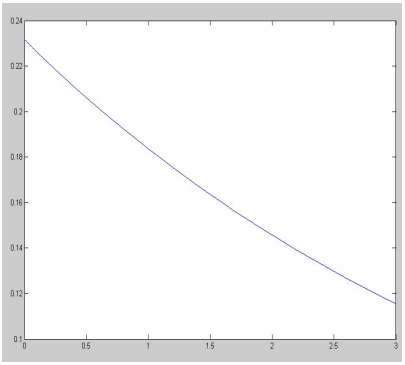
Curve for Salt & Pepper noise in MRI



Curve for Speckle noise in MRI

Finding the Speckle noise in MRI Brain

Curve for Speckle noise in MRI Brain



Table

1. For Exponential Distribution the values of PDF, Mean, Standard Deviation and Coefficient of Variation After finding the Gaussian noise in the various images.

Images	PDF	Mean	SD	CV
MRI Image	0.3637	180.3054	72.7366	0.403
MRI Brain Image	0.1889	61.0514	66.5954	1.090

2 For Exponential Distribution the values of PDF, Mean, Standard Deviation and Coefficient of Variation after finding the salt & pepper noise in the medical images

Images	PDF	Mean	SD	CV
MRI Image	0.3637	185.0274	68.1809	0.368
MRI Brain Image	0.1889	68.8937	64.6711	0.9387

3.For Exponential Distribution the values of PDF, Mean , Standard Deviation and Coefficient of Variation after finding the Speckle noise in the medical images

Image	PDF	Mean	SD	CV
MRI Image	0.3637	175.4644	68.6202	0.391
MRI Brain Image	0.1889	58.9147	64.0687	1.087

4. Conclusion

In these work different medical images like MRI, MRI Brain has been studied for detecting various types of noises. The various types of noise like Gaussian, Salt & pepper and Poisson noise have been tested to detect and we had calculated the Probability Density Function for the Exponential Distribution in the noisy image.

The result are analyzed and compared with the standard pattern of noises and also evaluated through the Coefficient of Variation for the different noisy image. Through this work it is observed that the the PDF for different noise are same but the CV is Consistence for the Gaussian Noise.

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