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Removal Speckle Noise from Medical Image Using Image Processing Techniques

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Abstract: **In image processing, medical images are corrupted by different types of noises. It is very important to obtain precise images to facilitate accurate observations for the given application. Removing of noise from medical images is now a very challenging issue in the field of medical image processing, this paper attempts to undertake the study of speckle noise of medical image by using three types of filters as mean filter, median filter and adaptive median filter applied in the four types of medical image and compared with one another so as to choose the best technique**

Keyword: **Medical Image, Noise, Filters.**

I. INTRODUCTION

They are present a simple and efficient technique to remove noise from the medical images, which combines both median filtering, and mean filtering to determine the pixel value in the noise less image [1].Ultrasound imaging is widely used in the field of medicine. It is use for imaging soft tissues in organs like liver, kidney, spleen, uterus, heart, brain etc. The common problem in ultrasound image is speckle noise which is caused by the imaging technique used that may be based on coherent waves such as acoustic to laser imaging [2, 3].They propose and motivate a two-step denoising procedure, where bias is removed from the squared magnitude image and denoising itself is then performed on the square root of this image in the wavelet domain [4].they are applied various spatial filters on the medical images like CT, MRI, and X-ray images and after comparing the wavelet based denoising methods, noise is removed while preserving the edges with less loss of detail. The main idea is the use of realistic distributions of the wavelet coefficients [5]. Median filtering is a non-linear technique that works best with impulse noise (salt & pepper noise) and speckle noise while retaining sharp edges in the image [6].they describes and analyses an algorithm for cleaning speckle noise in ultrasound medical images. Mathematical Morphological operations are used in this algorithm [7].they are present an ultrasound image enhancement algorithm based on the wavelet transform. The proposed algorithm considerably improves the subjective image quality without generating any noticeable artifact, and provides better performance compared with the existing enhancement schemes[8].they are presents a de-noising method in Magnetic Resonance Images using Wave Atom Shrinkage that leads to the improvement of SNR in low and high noise level images [9].They are proposed new method for image smoothing based on a fourth-order Partial Differential Equation (PDE) model, the algorithm used in MRI medical image and demonstrated good noise suppression without destruction of important anatomical or functional detail, even at poor signal-to-noise ratio[10].The multiplicative noise smoothing of the medical image is carried out by using a Frost filter. The Frost filter replaces the pixel of interest with a weighted sum of the values within the m x m moving window. The weighting factors decrease with distance from the pixel of interest. The weighting factors increase for the central pixels as variance within the window increases [11].

II. MEDICAL IMAGE

Image processing techniques plays important role in medical image to diagnostic and detection the sicknesses and monitor the patient from this sicknesses. The image processing technique using in many application in the medical image like Magnetic Resonance Imaging (MRI), Computerized Topography (CT), ultrasound imaging and X-ray images ect., this applications is very cost to the patient when it don't clear the re-imaging is more cost for that, then the image operation is one of image processing techniques to solve this problem by less cost and fast.

III. MEDICAL IMAGE NOISE

Medical images are often contaminated by impulsive, additive or multiplicative noise due to a number of non-idealities in the imaging process. The noise usually corrupts medical images by replacing some of the pixels of the original image with new pixels having luminance values near or equal to the minimum or maximum of the allowable dynamic luminance range. The identification of type of noise in the medical image is carried out in two stages. In the first stage, a criterion is used to detect the presence of the impulsive noise. If the result of this criterion is negative, the image is then submitted to second stage of another criterion in order to identify either the additive or the multiplicative nature of the noise.

VI. TYPES OF NOISE

A. Impulsive Noise (Salt & pepper)

The salt-and-pepper type noise is typically caused by errors in the data transmission malfunctioning pixel elements in camera sensors, faulty memory locations, or timing errors in the digitization process.

B. Additive Noise (Gaussian)

The Gaussian noise is most often used to model natural noise processes, such as those occurring from electronic noise in the image acquisition system.

C. Multiplicative noise (Speckle)

Speckle noise is multiple noises in the image a ubiquitous artifact that limits the interpretation of optical coherence of medical image. This type of noise is very common and corrupted the medical image.

V. FILTERS

A. Mean Filter (MF)

Mean Filter (MF) is a simple linear filter, intuitive and easy to implement method of smoothing images, i.e. reducing the amount of intensity variation between one pixel and the next. It is often used to reduce noise in images. The idea of mean filtering is simply to replace each pixel value in an image with the mean (average) value of its neighbors, including itself. This has the effect of eliminating pixel values, which are unrepresentative of their surroundings.

Image processing function in the mean filter can be expressed as:

$$g(i,j)=\frac{1}{M}\sum_{(k,l)\varepsilon N} f(k,l)$$

Where,

M is the total number of pixels in the neighborhoods N.

g (i,j) is the processed image, f (k,l) is the input image

For example taken a 3 x 3 neighborhoods about (i,j) yields:

$$g(i,j)=\frac{1}{9}\sum_{k=i-1}^{i+1}\sum_{k=j-1}^{j+1} f(k,l)$$

B. Standard Median Filter (SMF)

Standard Median Filter is the non-linear filter, which changes the image intensity mean value if the spatial noise distribution in the image is not symmetrical within the window. Median filter reduces the variance of the intensities in the image. Median filter is a spatial filtering operation, so it uses a 2D mask that is applied to each pixel in the input image.

This is operation of a3x3 Median Filter for a sample image neighborhood.

3x3:

64 65 76

56 68 61 ⟶ 34 55 56 61 64 65 68 68 76

34 55 68

C. Proposed Adaptive Median Filter (PAMF)

This filter is combined of the mean filter and median filter and work in the two stages:

The first is started when the mean filter is end and the second stage after median filter is stating to remove noise from the edge of image when the median filter unable to remove noise from edge of image.

The proposed adaptive median filter works in two levels denotes Level A and Level B as follows:

Level A: A1 = Zmed – Zmin
A2 = Zmed – Zmax
If A1>0 AND A2<), Go to level B
Else increase the window size
If window size <=Smax repeat level A
Else output Zxy.

Level B: B1 = Zxy – Zmin
B2 = Zxy – Zmin
If B1>0 And B2<) output Zxy
Else output Zmed-

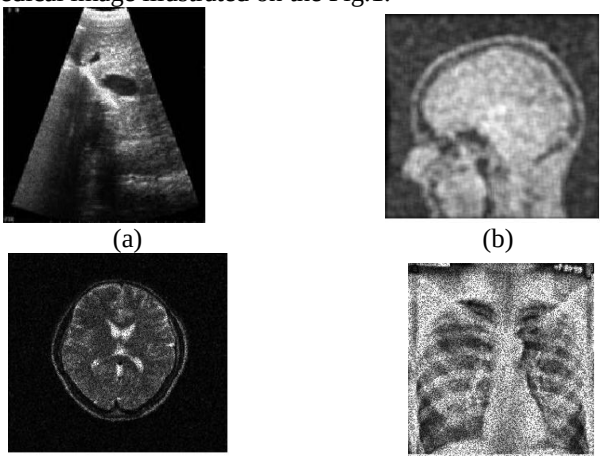
Where,

Zmin = Minimum gray level value in Sxy
Zmax = Maximum gray level value in Sxy
Zmed = Median of gray levels in Sxy
Zxy = gray level at coordinates (x,y)
Smax = Maximum allowed size of Sxy

VI. EXPERIMENTS & RESULTS

A. Testing Proceeding

The removal speckle noise from medical image was implemented using (MATLAB R2007a, 7.4a) by using three image processing techniques as Mean Filter, Median Filter and proposed Adaptive median filter in four types of medical image illustrated on the Fig.1.



(a) (b) (c) (d)

Fig.1: Medical Image Corrupted by Speckle Noise

B. Simulation & Results

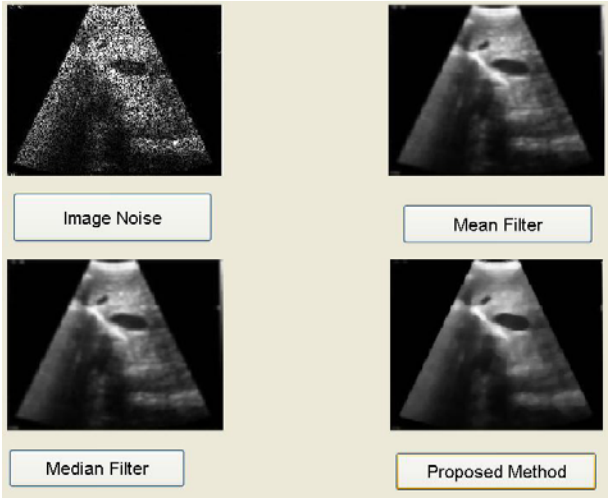


Fig.2: Removal the noise from Ultrasound Image

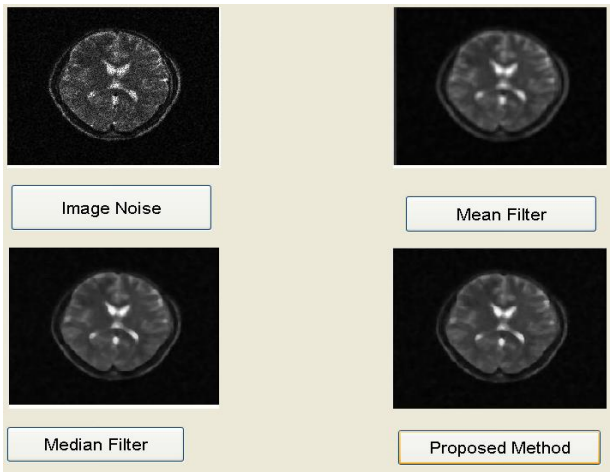


Fig.3: Removal Speckle noise from MRI Image

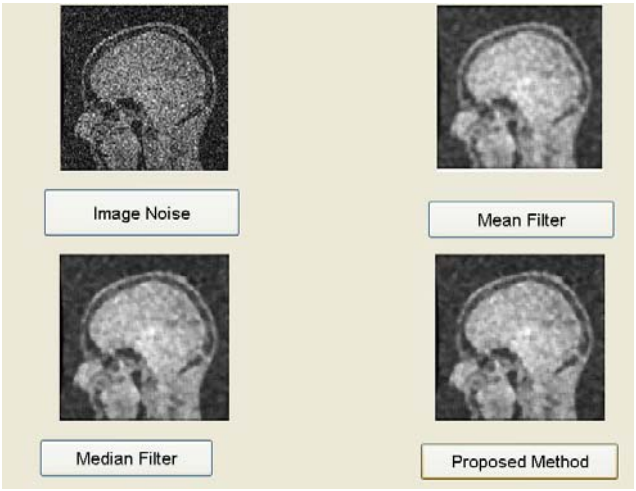


Fig.4: Removal Speckle Noise from CT Image

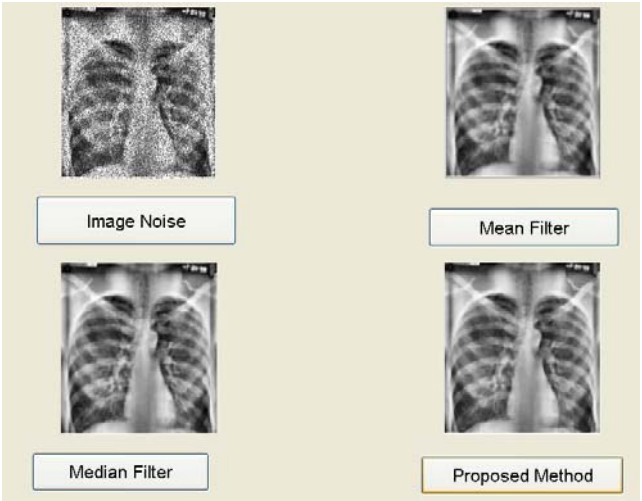


Fig.5: Removal Speckle Noise from X-ray Image

From Fig.2, Fig.3, Fig.4 and Fig.5 the proposed method for removal speckle noise from medical image is best one for this types of image by accuracy about 80% from the another methods.

VII. Conclusion

The selection of the denoising technique is application dependent. So, it is necessary to learn and compare denoising techniques to select the technique that is apt for the application in which we are interested. This paper processing the speckle noise in the medical image by using proposed method called adaptive median filter and comparing with the mean filter and median filter. Experiments and implementations show the proposed filter performs well in the all types of medical image by 80% comparing with other filters and illustrated this in Fig.2, 3, 4, 5.

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