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VARIOUS WAVELET TECHNIQUES FOR X-RAYS USING THRESHOLDING

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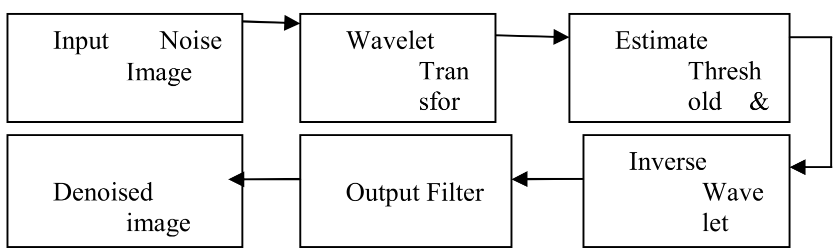
Abstract: In recent years, there are many techniques that are used in image processing for de-noising and retaining the edges of an image. There are different noises found in an image and for their removal application dependent de-noising algorithms are used. Each one of them have different pros and cons. The basic idea is to remove the noise and improve the quality of image. In this paper, de-noising techniques are discussed. The aim of denoising techniques is to reduce noise as well to retain the details of image .This paper analyze the performance of the wavelet-based thresholding approach at different level in the existence of Speckle noise and Poison for Wavelet types Daubechies and Mallat for denoising X-ray image by calculating parameters SNR,MSE,EPI,Correlation coefficient.
Keywords: De-noising, Speckle & Poison Noise, Wavelet.

I. INTRODUCTION

The image usually has noise which is not easily eliminated in image processing. According to actual image characteristics, noise statistical property and frequency spectrum distribution rule, people have developed many methods of eliminating noises, which approximately are divided into space and transformation fields The space field is data operation carried on the original image and processes the image grey value, like neighborhood average method, wiener filter, center value filter.



1 Figure 1.1 Block diagram of Image denoising using wavelet transform

1.1 TYPES OF NOISES

The noise is characterized by its pattern and by its probabilistic characteristics. There is a wide variety of noise
Types while we focus on the most important types, which are; Gaussian noise, salt and pepper noise, poison noise, impulse noise, speckle noise.

- **Poison Noise:** Poisson noise is induced by the nonlinear response of the image detectors and recorders. This type of noise is image data dependent. This term arises because detection and recording processes involve random electron emission having a Poisson distribution with a mean response value. Since the mean and variance of a Poisson distribution are equal, the image dependent term has a standard deviation if it is assumed that the noise has a unity variance.
- **Speckle Noise:** Speckle is a complex phenomenon, which degrades image quality with a backscattered wave appearance which originates from many microscopic diffused reflections that passing through internal organs and makes it more difficult for the observer to discriminate fine detail of the images in diagnostic examinations.

2. Wavelet Transform

The wavelet expansion set is not unique. A wavelet system is a set of building blocks to construct or represents a signal or function. It is a two dimensional expansion set, usually a basis, for some class one or higher dimensional signals. The waveletexpansion gives a time frequency localization of the signal. Wavelet systems are generated from single scaling function by scaling and translation. A set of scaling function in terms of integer translates of the basic scaling function by

$\varphi k^{(t)} = \varphi(t-k)$ K €z φ€L^2 ……. (i)

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Daubechies Wavelet Transform

The Daubechies Wavelets are compactly supported and have highest number of vanishing moments. The types are db1, db2…db45. Discrete Wavelet Transform and continuous wavelet transform is possible for these. These are not symmetrical. The length of the filter is 2N. The number of vanishing moments are N. This wavelet use overlapping window so the high frequency coefficient spectrum display all frequency changes. So this is useful in compression and for the removal of noise in audio signal processing.

3. Mallat Wavelet Transform

It computes DWT wavelet coefficients for a finite set of input data, which is a power of 2. This input data is passed through two convolution functions, each of which creates an output stream that is half the length of the original input. This method is referred to as down sampling. The convolution functions are filters. One half of the output is come through the low pass filter function and the other half is generated by the high pass filter function. The low pass outputs carry most of the information of the input signal and are known as "coarse" coefficients. The outputs from the high pass filter are called as "detail" coefficients. The parameters obtained from the low pass filter are used as the original signal for the next set of coefficients. This process is carried out repeatedly until a trivial number of low pass filter coefficients are left. The final output hold the remaining low pass filter outputs and the accumulated high pass filter outputs. This strategy is called as decomposition.In some applications; some form of processing is done to the wavelet coefficients obtained after the DWT. Once the processing is completed, the data vector is built back from the coefficients. This process of reconstruction is referred to as the inverse Mallat's algorithm.

In the reconstruction procedure, quadrature mirror filters Equation are supplied with the coarse coefficients and the accumulated detail coefficients. The outputs from the two filters are added and are considered as the coarse coefficients for the next stage of reconstruction. This process is continued until the data vector is obtained.

4. THRESHOLDING METHODS

Thresholding is a simple non-linear technique, which operates on one wavelet coefficient at a time. In its most basic form, each coefficient is thresholded by comparing against threshold, if the coefficient is smaller than threshold, set to zero; otherwise it is kept or modified. Replacing the small noisy coefficients by zero and inverse wavelet transform on the result may lead to reconstruction with the essential signal characteristics and with less noise. It is important to know about the two categories of thresholding.

- **Hard Thresholding:** In hard thresholding all coefficients whose magnitude is greater than the selected threshold value λ remains same and the others whose magnitude is smaller than λ are set to zero. It creates a region around zero where the coefficients are considered negligible.
- **Soft Thresholding:** In soft thresholding, the coefficients whose magnitude is greater than the selected threshold value are shrunk towards zero by an amount of threshold λ and others set to zero.

5. METHODOLOGY

Methodology begins with the study of wavelet. Then various types of noise have been studied and denoising methods. So methodology to fulfill objective is described as follow:

- Techniques (Mallat and Daubechies) for denoising can be used.
- Denoising of the Images using some parameters and then find out the thresholding.
- Compare the performance of proposed method with existing approaches.

The operation for calculating the effectiveness is as follow:

- ➢ Add noise to the Image
- ➢ Choose Wavelet type
- ➢ Select decomposition level
- ➢ Implement thresholding approach
- ➢ Perform the denoising of image
- ➢ Calculate SNR,MSE,EPI,CC

6. PERFORMANCE EVALUATION

In order to find out the performance of wavelet the results are calculated of four parameters like Signal to noise ratio(SNR),Mean square error(MSE),Edge preservation Index(EPI),Correlation Coefficient(CC). From results it is clear that wavelet thresholding gives best results.

7. RESULTS

TABLE-I Comparison table of SNR of Speckle Denoised Image at different Noise levels

Noise	DB using HT	DB using ST	Mallat using HT	Mallat using ST
.01	79.3142	79.3178	79.1022	79.5034
.02	74.7756	75.5332	74.6672	75.5569
.03	73.2060	73.9635	73.0760	74.0538

Comparison Chart of SNR of Speckle Denoised Image at different Noise levels

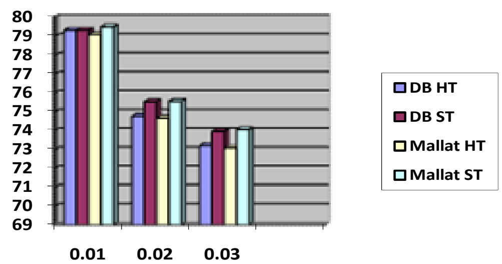


TABLE-II Comparison table of SNR of Poison Denoised Image at different Noise levels

Noise	DB using HT	DB using ST	Mallat Using HT	Mallat using ST
.01	80.8799	80.3920	80.8233	80.5370
.02	79.3782	80.0771	79.3356	80.2369
.03	79.3747	80.0734	79.3329	80.2136

Comparison Chart of SNR of Poison Denoised Image at different Noise levels

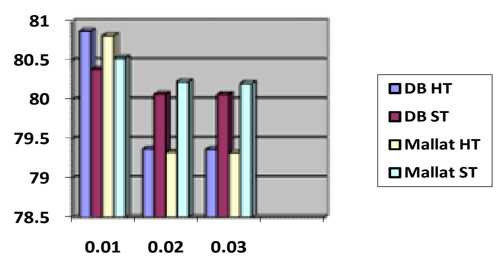


TABLE-III Comparison table of MSE of Speckle Denoised Image at different Noise levels

Noise	DB using HT	DB using ST	Mallat using HT	Mallat using ST
.01	.0275	.0270	.0283	.0269
.02	.0346	.0318	.0365	.0317
.03	.0348	.0322	.0369	.0320

Comparison Chart of MSE of Speckle Denoised Image at different Noise levels

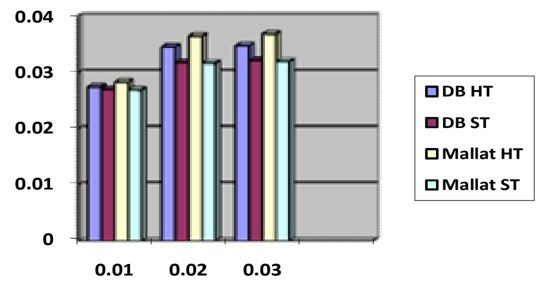


TABLE-IV Comparison table of MSE of Poison Denoised Image at different Noise levels

Noise	DB using HT	DB using ST	Mallat Using HT	Mallat using ST
.01	.0230	.0244	.0232	.0240
.02	.0274	.0252	.0275	.0248
.03	.0274	.0253	.0275	.0249

Comparison chart of MSE of Poison Denoised Image at different Noise levels

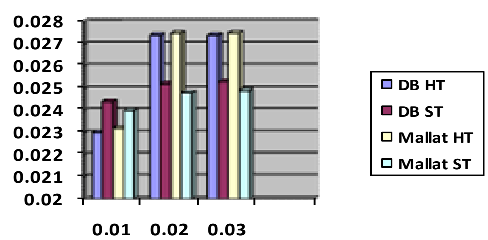


TABLE-V Comparison table of EPI of Speckle Denoised Image at different Noise levels

Noise	DB using HT	DB using ST	Mallat using HT	Mallat using ST
.01	.1309	.1286	.1304	.1316
.02	.1291	.1280	.1291	.1297
.03	.1269	.1279	.1263	.1279

Comparison Chart of EPI of Speckle Denoised Image at different Noise levels

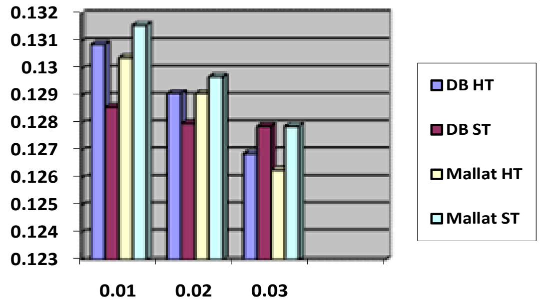


TABLE-VI Comparison table of EPI of Poison Denoised Image at different Noise levels

Noise	DB using HT	DB using ST	Mallat using HT	Mallat using ST
.01	.1341	.1300	.1343	.1307
.02	.1340	.1298	.1338	.1299
.03	.1336	.1299	.1334	.1297

Comparison Chart of EPI of Poison Denoised Image at different Noise levels

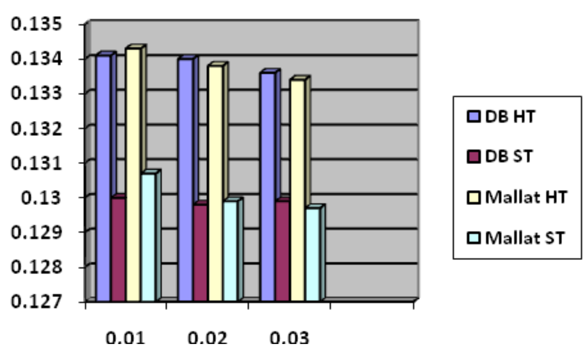


TABLE-VII Comparison table of CC of Speckle Denoised Image at different Noise levels

Noise	DB using HT	DB using ST	Mallat using HT	Mallat using ST
.01	.9959	.9961	.9957	.9959
.02	.9884	.9902	.9881	.9903
.03	.9834	.9860	.9829	.9863

Comparison Chart of CC of Speckle Denoised Image at different Noise levels

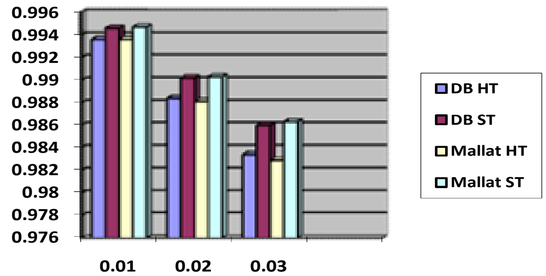
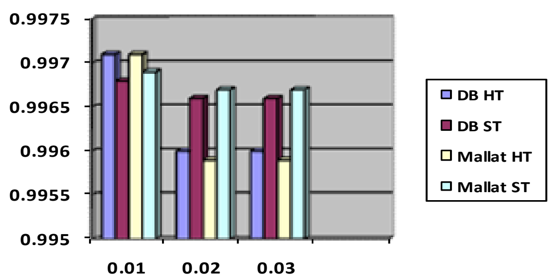


TABLE-VIII Comparison table of CC of Poison Denoised Image at different Noise levels

Noise	DB using HT	DB using ST	Mallat using HT	Mallat using ST
.01	.9971	.9968	.9971	.9969
.02	.9960	.9966	.9959	.9967
.03	.9960	.9966	.9959	.9967

Comparison Chart of CC of Poison Denoised Image at different Noise levels



8. CONCLUSION & FUTURE SCOPE

In this paper, denoising of medical X-Ray images is performed using Daubechies and Mallat wavelet by using hard and soft thresholding techniques. Results shows that Daubechies wavelet gives best results for hars thersholding and Mallat for soft. The parameters are calculated inorder to remove Speckle and Poison noise of the images .In future it can be used for images like CT-Scan and Ultrasound for different types of noises.

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