IJCTA, 9(9), 2016, pp. 3945-3949

Medical Image Denoising Using Wavelet Transform

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ABSTRACT

Signal estimation using wavelet thresholding technique activities the capabilities of wavelet transform for signal processing applications. An ideal choice of the wavelet and thresholding task has controlled their wide spread use in image denoising application. The aim of this paper is to perform image denoising of medical images using different wavelet transforms to explore the optimal threshold. Wavelet transform improves image quality and reduces noise level. A comparative analysis is made between different types of wavelets with respect to different medical images with noisy levels and the efficiency of each transform is calculated.

Keywords: Image Denoising; Wavelet Transform; Thresholding

1. INTRODUCTION

Medical image enhancement technologies have great impact in innovative medical equipment's were put into use in the medical sector. Improved medical images are recycled by surgeons to help diagnosis and understanding of diseases because medical image qualities are often affected by noise and other data acquisition devices, lightning conditions, etc. The purposes of medical image development are mainly to solve problems of the high level noise image. [1] The noise present in the images can appear as an add-on or multiplying component and the main purpose of denoising is to remove these unrefined modules. An image is often corrupt by noise during its acquisition and broadcasting. Image re-construction is used to remove the additive noise while recalling most possible features. The studies are conducted for centuries on wavelet thresholding for signal de-noising, because wavelet offers a suitable basis for separating noisy indication from the image signal. [2,3]

By means of wavelet transform we are able to do compression and de-noising which involves the three process:

a) Perform thresholding

b) Selection of wavelet

c) Calculation of PSNR of each wavelet.

1.1. Introduction to Denoising

The method used in digital image processing aims at the deletion of noise, which can corrupt an image during its acquire or programming process, which may touch its quality while recalling. The images normally have a problem of great level of noisy components. Medical image denoising know-how has attracted the usage of more medical equipment usage. The Main purpose of medical image de-noising to solve issues of high level noise of a medical image.

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Nowadays wavelet transform (WT) is used due for denoising due to its excellent localization property. There are different methods for elimination of noises. All the conventional methods have so many disadvantages which does not analyse the non-stationary signal. In this consignment we advise an alternate method for de-noising the images using wavelet transform using MATLAB software. This technology is more capable by considering its nearby wavelet quantities, with different values. The threshold estimation is carried out by developing the standard deviation, arithmetic mean and geometrical mean of the input image.[5,6]

1.2. Wavelet Transform

Wavelet transform is defined as an oscillation with amplitude begins from zero and gradually increase then decrease back to zero. It can also be a brief oscillation like wave. Specific signal processing properties are present in wavelets hence they are widely used in signal processing. The extraction of information from audio signals and images can be achieved by using wavelets. The idea often moving noise is done by reverse transformation like wavelet transform. The main groups of wavelet transform are continuous and discrete. [7]

2. METHEDOLOGY

For denoising of a medical image many wavelets like db1, sym8, coif1, coif3 etc can be used. In the proposed system we used all wavelets at different level of hard threshold and then decomposed and reconstructed the denoised image. PSNR values are calculated.

2.1. Input Image

The different tests are conducted on medical images like X-Ray, MRI, Ultrasound, CT images.Add noise (Gaussian, Poisson, Speckle, Salt & Pepper) to the image and give it as input.

2.2. Hard Thresholding

Thresholding is one of the user friendly method of image denoising. Thresholding can be used for generation of binary image which helps in denoising.[8] Thresholding is used to fragment an image by fixing all pixels with intensity values which are above a threshold foreground value and all the remaining will be the background value. Hardthresholding will be ordinary. The most common technique is hard thresholding.

2.3. Image Denoisng Using Thresholding

Perform different wavelet transforms like Haar, Daubechies, Coiflet, Symlet, Biorthogonal, Reverse biorthogonal to the noisy image. The Peak Signal to Noise Ratio (PSNR) is exploited while selecting the

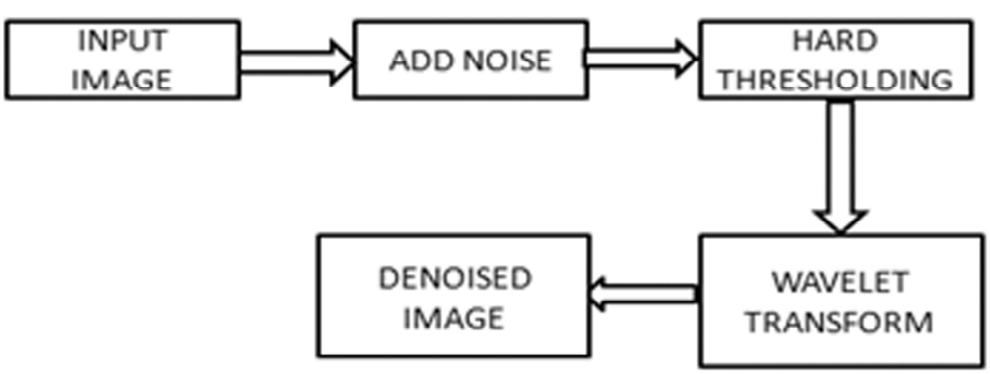
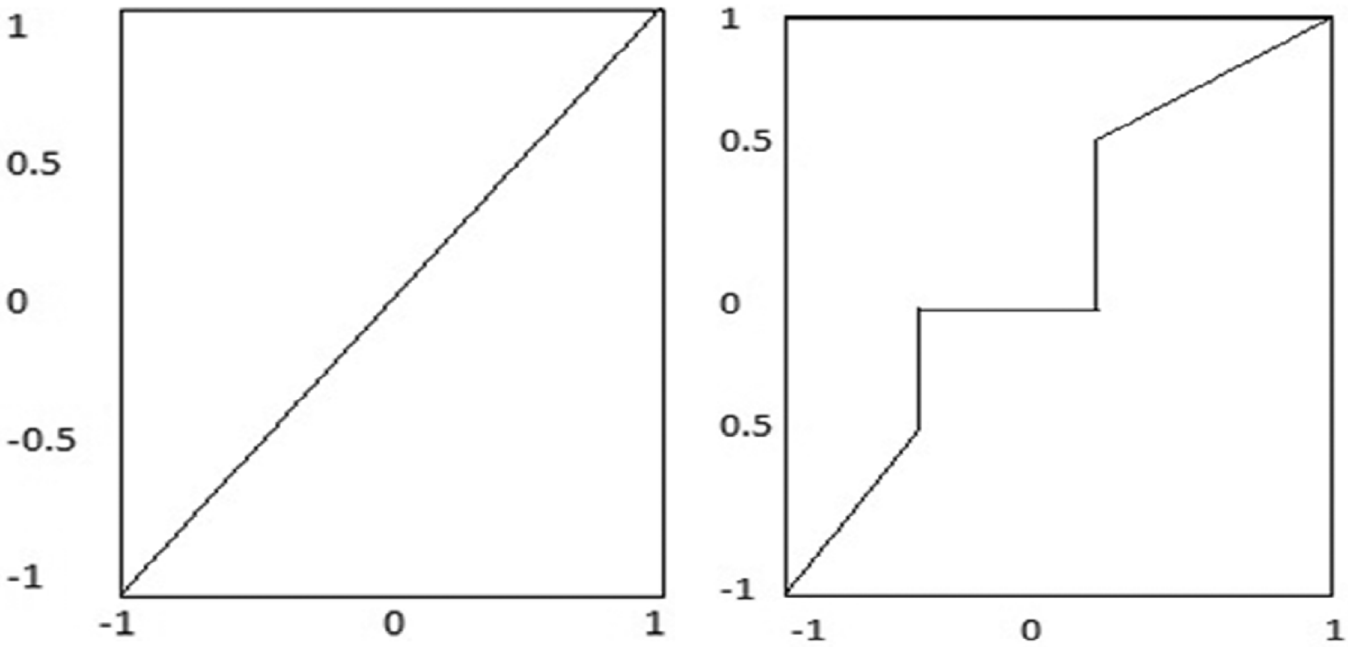


Figure 1: Basic Block Diagram



(a) Input signal **(b) Hard thresholded signal**

Figure 2: (a)Input signal (b) Hard thresholded signal

threshold for image denoising. [9] The minor threshold value will be considered as the noisy coefficient of image and a huge threshold value as the loss of coefficients; these coefficeients carry image signal details. These threshold values help for the image denoising. PSNR values can be obtained by comparing two images the one can be original image and other one is inaccurate image.

The PSNR has been calculated using the following formula

$$PSNR = 10\log_{10}\left(\frac{R^2}{MSE}\right)$$

Where R-maximum fluctuation in the input image data type.

Mean Squared Error (MSE) is one of the ways of assessing this resemblance. Error computation is done by subtracting the input signal from reference signal. Computation of average energy of error signal is then performed. [10,11]

3. RESULTS AND DISCUSSION

In this study, denoising process can be done with different medical images like MRI, ultrasound, X-ray, CT scan which is done using wavelets for hard threshold levels and then the peak signal-to-noise ratio(PSNR) is calculated. A comparison is made for the conventional and proposed method. The comparison is tabulated below:

The parameters evaluated in the paper are tabulated below

Conventional Method	*Proposed Method*
Fourier transforms are used for denoising	Wavelet transforms perform denoising
Cannot analyze non-stationary signals	Analyze non-stationary signals
STFT gives fixed resolution at all times	WT gives variable resolutions
Fourier transform localized only in frequency domain	Wavelets are restricted in both time and frequency domain

Sl. No:	Type of noins	Noins levels	PSNR of noiry images	PSNR of denoised images using our proposed method for different wavelet families					
				Db Db-5	Haar	Coif Coif-5	Sym Sym-5	Bior Bior-1.5	Rbio Rbio-1.5
1		2	17.38	26.65	26.21	26.67	26.64	25.86	26.43
2		4	14.70	23.82	23.83	23.84	23.80	23.39	23.65
3	Gaussian	6	13.20	22.37	22.49	22.40	22.35	21.85	22.16
4		8	12.22	21.24	21.29	21.31	21.23	20.88	21.04
5		10	11.52	20.48	20.55	20.59	20.56	20.12	20.32
1		2	27.27	33.06	33.04	33.18	32.92	31.67	32.88
2		4	27.24	33.15	31.04	33.17	32.92	31.59	32.97
3	Poisson	6	27.26	33.11	31.02	33.25	32.93	31.65	32.92
4		8	27.24	33.10	31.01	33.14	32.95	31.61	32.89
5		10	27.30	33.18	31.02	33.25	32.92	31.60	32.93
1		2	22.20	27.79	27.38	27.86	27.55	27.31	27.80
2	Salt	4	19.23	26.27	25.77	25.86	26.28	25.92	26.10
3	&	6	17.48	25.13	24.73	25.16	24.87	24.52	25.06
4	pepper	8	16.18	24.08	23.82	24.35	24.08	23.64	23.90
5		10	15.28	23.39	23.12	23.50	23.21	22.98	23.11
1		2	22.52	28.11	27.57	28.15	28.13	27.60	27.93
2		4	19.68	25.39	25.45	25.50	25.42	25.21	25.46
3	Speckle	6	18.08	24.27	24.24	24.35	24.33	23.96	24.16
4		8	16.95	23.35	23.38	23.65	23.34	23.04	23.14
5		10	16.08	22.53	22.64	22.85	22.59	22.27	22.49

4. CONCLUSION

In this study, a humble adaptive thresholding method is proposed to address the issue of image recovery. After denoising by these wavelets, PSNR values are compared and it is found that db5 wavelet is well-organized than haar wavelet for eliminating the certain level of speckle noise in the medical images and it also enhances the visual worth of the medical images. It helps to select the finest wavelet transform for the denoising the particular medical image and it will help in effective diagnosis.

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