International Journal of Electrical and Electronics Engineers
Vol. No.7 Issue 02, July-December 2015
www.arresearchpublication.com
IJEEE ISSN 2321 - 2055

IMAGE DENOISING USING FRAMELET TRANSFORM

Ms. Jadhav P.B.[1], Dr.Sangale.S.M.[2]

[1,2,] *Electronics Department,Shivaji University, (India)*

ABSTRACT

Images are created to record or display useful information or details .Due to demerits in the imaging and capturing process or transmission process, the recorded image always represents noisy version of the original image. These imperfections is critical to many of the successive image processing tasks. The visual quality of images plays an important role inmedical imaging, satellite and areal image processing, robot vision, industrial vision systems, micro vision systems, space exploring etc. There are two typical ways for noise reduction in the image processing. One way is that acquiring the data several times and averages them. However this processes is time consuming. Another way for denoise the images by post processing methods. For this purpose construction of efficient, less time consuming and high Quality technique need to be introduce. This paper describe the difference between image denoising using DWT and Framelet transform. Framelet transform provide shift invariance property. So using Framelet transform which is nearly similar to wavelet transform only with the difference is that framelet transform contains two or more high frequency filter bank which is used to produce more subband in decomposition.

Keywords: Framelet Transform, Image Denoising, Shiftinvariance.

I. INTRODUCTION

Image denoising is a classical and flourishing research topic in image processing. The visual information transmitted in the form of digital images is becoming a major method of communication, but the image obtained after transmission is often corrupted with noise.The received image needs processing before it can beused in applications.Image denoising involves the manipulation of the image data to produce a visually high quality image. There are different types of noise models including additive and multiplicative. They include Gaussian noise, salt and pepper noise, speckle noise and Brownian noise. The choice of the denoising algorithm is application dependent. Hence, it is necessary to have knowledge about the noise present in the image so as to select the appropriate denoising algorithm. The filtering approach has been best when the image is corrupted with salt and pepper noise. The wavelet based approach finds applications in denoising images corrupted with Gaussian noise. In the case where the noise characteristics are complex, the multifractal approach can be used. A quantitative measure of comparison is provided by the signal to noise ratio of the image.

An ideal image x is measured when additive white Gaussian noise with zero mean and constant variance is present in the image. We can formulate the observed image as:

$$\mathbf{y = x + n} \qquad \mathbf{(1)}$$

Where y is the observed noisy image, x is the original image and n is the noise added in an image. So many transforms like FFT, STFT, (DWT)wavelet transform, etc. are available for removing noise from images with each have its own advantages and limitations. Images contain the low frequency component and high frequency component. Noise in the low frequency component can be removed easily with certain available techniques. But noise present in high frequency component which contains fine details of image cannot be removed easily. Because when we try to remove noise fromhigh frequency component then there is possibility for losing fine details of the image. Transforms like wavelet transforms are used for image denoising using sub-band decomposition. Wavelet transform [1] is effective technique in noise removal and also reduce computational complexity, better noise reduction performance. But shift invariance property is absent in DWT. Shift variance exist due to critical sub sampling in DWT. Due to this property every second wavelet at each decomposition level is discarded automatically. So there is a need for enhancement of image quality.

In this paper, we discuss about Framelet Transform for noise reduction from noisy image. The organization of this paper is as follows: section II contains the types of noise and Methods of Eliminating noise, Section III contains Framelet Transform and requirements, Section IV contains Image denoising using Framelet Transform and Section V contains the Results and Discussion. Last section contains the conclusion and references

II. NOISE MODELS AND ASSUMPTION

2.1.Additive Noise[2]: Additive white Gaussian noise is evenly distributed over the signal which is added in each pixel evenly and it is also called as Gaussian noise. Each pixel in the noisy image is equal to the sum of the original pixel value and randomly distributed Gaussian noise value.

2.2.Substitutive Noise[2]: Substitutive noise like salt and pepper noise. Due to data transmission error, white and black dots are added in the output image.

2.3.Multiplicative Noise*:* This type of noise is occurred in all coherent imaging systems like laser and synthetic aperture radar imagery [2]. Speckle noise is multiplicative noise.

Methods of Eliminating Noise:Image denoising can be done in three ways that is using filtering techniques, transform domain and using statistical approach[3]. Filtering techniques can be classified into linear as well as non linear filtering. Good image denoising is that it will remove noise while preserving edges as much as possible. For noise removal linear filters have been used like Gaussian filter. Big advantage of linear noise removal model is speed but they are not able to preserve edges in good manner. Non-linear filter overcome this difficulty. Non-linear filter is very good in preserving edges but smoothly varying region in input image are transformed into piecewise constant region in output image. Image denoising using Transform domain is discussed in below section. In statistical / estimation methods, estimation of the noise variance is a essential step in removal of noise for several reasons. First of all it gives a measure of data quality and used to measure the SNR. Knowledge of this noise variance [3] is useful in the analysis. It is very much effective for removal of heavy tail noise and perform effectively for the noise which is depend on signal [4]. It requires prior information of the signal and noise for error estimation and noise removal.

III. FRAMELET TRANSFORM AND REQUIREMENT

Wavelet frames have very desirable properties like wavelet frames can be much more directionally selective for image processing than orthogonal or biorthogonal wavelets.wavelet frames can be shift invariant whereas an orthogonal or biorthogonal wavelet transform is not shift invariant.This is realize by wavelet transforms where the basis functions are obtained from a single model wavelet by shift and extraction/ contraction [5] The frame lets generating from the filter banks possess a combination of properties that are valuable for signal and image processing: symmetry, interpolation, timedomain localization, flat spectra and any number of vanishing momentsThese properties have good error recovery capabilities. Framelet Features Framelet transformation is a transform which does not impose one to one correspondence between signals and its transform coefficients.

Framelet transform is known as double-density discrete wavelets transform (DDWT). This transform has two times more wavelet coefficients than DWT coefficients.The proposed technique is the framelet transform which eliminates coefficient noises and is effectively shift invariant when compared to DT-CWT. Framelet transform is similar to that of wavelet transform but has some differences. Framelets has two or more high frequency filter banks, which produces more subbands in Decomposition. This can achieve better time frequency localization. There is redundancy between the Frameletsubbands, where change in coefficients of one band can be compensated by other subbands coefficients. After framelet decomposition, the coefficient in one subband has correlation with coefficients in the other subband, which means that changes on one coefficient can be compensated by its related coefficient in reconstruction stage which produces less noise in the original image.

IV. IMAGE DENOISING USING FRAMELET TRANSFORM

Tight frame is generated by B-spline scaling function and two framelets with vanishing moment of order 2 and 1 respectively. It means that the constant signal cannot pass through the high pass filter h2 and neither constant nor linear signal can pass thought the h1. For large numbers of images these two framelets are capable of capturing the crucial texture information since the natural images are often piecewise smooth and locally uncorrelated[6]. Lifting factorization of this tight frame provides the sparse approximation. If we are combining the lifting factorization of tight frame with the directional lifting structure then we are getting specific translation invariant directional framelet transform[7].

TIDFT is considered as one of the effective sparse approximation tools with edge preserving property for analysis of images. TIDFT will be used for noise reduction which is based on the MAP estimator. First of all images are transfer into transform domain, and then the denoising algorithm is applied on the framelet coefficient. Algorithm for noise reduction using TIDFT is as follows:

- ApplyTranslation invariant directional framelet transform on the noisy image, after that output noisy framelet coefficients are obtained.
- Apply Maximum A Posteriori estimation criteria based shrinkage rules like SCE and ECE distribution on the framelet coefficient.
- Estimate standard deviation of signal by calculating variance of noise and signal , After that calculate PSNR toanalyse quality of denoised image.

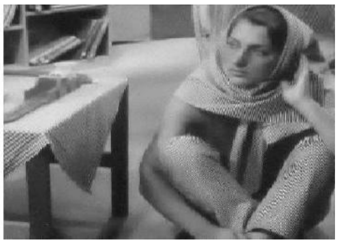
International Journal of Electrical and Electronics Engineers
Vol. No.7 Issue 02, July-December 2015
www.arresearchpublication.com
IJEEE
ISSN 2321 - 2055

V. RESULT AND DISCUSSION

Noise is added to the original image which is removed by Framelet transform as shown below. Noise such as AWGN noise, Salt and pepper noise is added in original image and analyze the Framelet output. Framelet can remove AWGN noise from the original image and give denoisedoutput[8][9]. But Salt andpepper noise cannot be removed totally by the Framelet because Framelet is additive which can not remove multiplicative noise and the salt and pepper noises which are shown below:

5.1.AWGN Noise





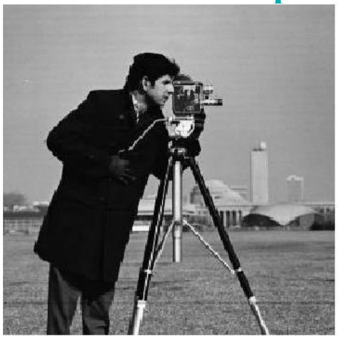
Original image



Noisy image with AWGN noise Denoised image



Original image Noisy image with AWGN noise Denoised image


Original image


Noisy image with AWGN noise


Denoised image

5.2.Salt& Pepper Noise


Original image

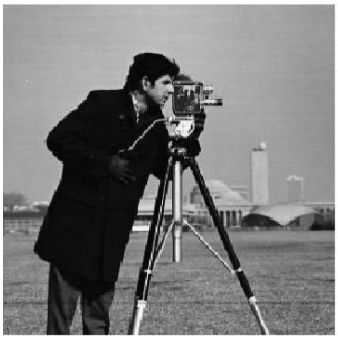

Noisy image with salt & pepper noise


Denoised image


Original image


Noisy image with salt & pepper noise


Denoised image


Original image


Noisy image with salt & pepper noise


Denoised image

VI. CONCLUSION

Image Denoising Using Framelet Transform is implemented and improved PSNR value and recover the corrupted image with high visual quality. Compared PSNR value using Framelet transform for different types of noise such as AWGN, Salt and pepper noise.Framelet Transform have the capability of Noise reduction with edge preserving. Framalet Transform removes the AWGN noise and achieved good PSNR value but can not remove salt and pepper noise completely because Framelet transform is additive and can not remove multiplicative noise.Thus image denoising using framelet transform gives the high quality of images for further uses.

REFERENCES

[1] Xiaoyuan Yang, Yan Shi, Liuhe Chen, and Zongfeng Quan, "The Lifting Scheme for Wavelet Bi-Frames: Theory Structure, and Algorithm",IEEE Transactions On Image Processing, Vol. 19, pp. 612 -624,March 2010

[2] S. Sulochana , R.Vidhya ," Image Denoising using Adaptive Thresholding in Framelet Transform Domain",(IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 3, 2012

[3] J. Mohan, V. Krishnaveni, YanhuiGuo, "A survey on the magnetic resonance image denoising methods", Biomedical Signal Processing and Control, Vol. 9, pp. 56-69, Elsevier, 2014

[4] A. Ben Hamza and Hamid Krim, "Image Denoising: A Nonlinear Robust Statistical Approach", IEEE Transactions on Signal Processing, Vol.49, No. 12, pp.3045-3054, December 2001

[5] Martin Vetterli and Cormac Herley, "Wavelets and Filter Banks: Theory and Design", IEEE Transactions On Signal Processing, Vol. 40, No 9, pp. 2207-2232, September 1992

[6] Yan Shi, Xiaoyuan Yang, andYuhuaGuo,"Translation Invariant Directional Framelet Transform Combined With Gabor Filters for Image Denoising",IEEE Trans. on Image Prosessing, vol. 23, no. 1, jan 2014

[7] X. Wang, G. Shi, and L. Liang, "Image denoising based on translation invariant directional lifting", IEEE conference on ICASSP, pp. 1446– 1449, July 2010.

[8] Claude Knaus, Matthias Zwicker, "Progressive Image Denoising", IEEE Transactions On Image Processing, Vol. 23, No. 7,pp. 3114-3125, July 2014

[9] T. T. Nguyen and S. Oraintara, "Multiresolution direction filterbanks: Theory, design, and applications," IEEE Trans. Image Process., vol. 53, no. 10, pp. 3895–3905, Oct. 2005.

[10] Ö. N. Gerek and A. E. Cetin, "A 2-D orientation adaptive prediction filter in lifting structures for image coding," IEEE Trans. Image Process., vol. 15, no. 1, pp. 106–111, Jan. 2006.

[11] C. L. Chang and B. Girod, "Direction-adaptive discrete wavelet trans- form for image compression," IEEE Trans. Image Process., vol. 16, no. 5, pp. 1289–1302, May 2007

[12] N. Gayathri, A. Hazarathaiah,"Image Denoising Using Complex Framelets",International Journal of Innovative Research in Computer and Communication EngineeringVol.2, Special Issue 4, September 2014.