Review on Colour Image Denoising using Wavelet Soft Thresholding Technique

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Abstract- In this modern age of communication the image and video is important as Visual information transmitted in the form of digital images, but after the transmission image is often ruined with noise. Therefore the received image needs to be processing before it can be used for further applications. Image denoising implicates the manipulation of the image data to produce a high quality of image without any noise. Most of the work which had done in color scale image is by filter domain approach, but we think that the transform domain approach give great result in the field of color image denoising.. This paper reviews the several types of noise which corrupted the color image and also the existing denoising algorithms based on wavelet threshodling technique.

Keywords- *Bivariate Pearson distribution, Bayesian denoising, wavelettransforms*

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I. INTRODUCTION

In recent year Color Image Denoising technique has been emerged as a challenging task for the scientists to remove noise from a multichannel data set.From the review of various paper we have find that lots of work should be done for denoising the image with the help of filter .Also a vital experiment has been done in order to remove noise from a gray scale image. Noise in natural colour photos have special characteristics that are substantially different from those that have been added artificially.

Various methodologies and algorithms have been proposed in the field of gray scale image but in the field of color image denoising there is a broad scope of research is yet to done. A color image denoising having multichannel set of data while in gray scale image single channel data is available that is why color image denoising is somewhat complex than the gray scale image since color image has three channels: red, green and blue. There are three channels which roughly follow the color receptor. Each channel of a color image is separated as the gray scale image of the same size as a color image, which is made up of one of the primary colors. Color Image Denoising are digital images that include color information for each pixel. For proper visualization by the viewers, always there is a need to provide three color channels for each pixel. These color channels are interpreted as coordinates in some color space. The RGB color space is commonly used in computer displays. However, there still exist some other spaces such as YCbCr, HSV, which are often used in other context.

The denoising of natural image corrupted by several noise is one of the classical problem in signal processing. If the wavelet transform and shrinkage technique are used for this problem, the solution requires a priori knowledge about how the wavelet coefficients distributed. So in this paper we have discussed about the wavelet thresholding and its various technique.

II. NOISE MODELS

From the help of various paper we have find that there are several types of noise which corrupted the image basically Noise is a common problem which affects each imaging system. Noise reduces the brightness and contrast of image resulting blurring the edges and defects its size and shape. There are several reasons of occurring noise in an image.

Additive and multiplicative are the two basic models of noise. The noise which is systematically distributed is additive noise and the noise which is complex and distribution is based on image is known as multiplicative noise.

A. Additive Noise

Additive noise is continuous and symmetric in nature. Additive noise is independent in nature and evenly distributed throughout the image

- Gaussian Noise: Gaussian noise is a type of additive noise since it is symmetric in nature and continuous and has smooth probability distribution i.e. it is evenly distributed all over the image which gives each pixel in any image corrupting by Gaussian noise is the sum of random Gaussian distributed noise and true pixel value. And since it is an additive type of noise it is independent of image. As this is an additive type of noise it is also termed as additive white Gaussian noise (AWGN

- Poisson noise:Poisson noise is also a type of additive noise and it is generated from the data instead of adding artificial noise in the data. In this noise, the original

image, is double precision, then input pixel values are interpreted as means of Poisson distributions scaled up by 1e12.If I is uint8 or uint16, then input pixel values are used directly without scaling. Poisson noise generates a noise sequence of integer numbers having a Poisson probability distribution.

B. Multiplicative Noise

Multiplicative noise is dependent on image. This type of noise is randomly distributed through the image. By multiplicative noise the brightness of image is varied.

- Salt & Pepper Noise

Salt-and-Pepper noise is a type of multiplicative noise since it is dependent on the image on which it is applied. It is caused by bit errors in image transmission and retrieval as well as in analog-to-digital converters. Salt and pepper noise is an intensity spikes, which is impulse type of noise. It occurs due to data transmission error. Salt and pepper noise generally contains two possible values a and b. Each having less than 0.1 probabilities. The term “salt and pepper” denote that the corrupted pixels which are set one by one having minimum or maximum value, because of it image looks like “salt and pepper”. Black and white pixels denote (0) and (1) respectively. Where D is the density of noise which has to be applied. Normal value of D is taken 0.9.

- Speckle Noise

Speckle noise is a multiplicative noise and occurs in coherent imaging system like laser, acoustics and SAR (Synthetic Aperture Radar) image. This type of noise is dependent on image. It is a multiplicative noise.

III. WAVELET TRANSFORM

The wavelet transform was established as a development of Fourier transform. In Fourier transform the coefficients are changed from time domain to frequency domain or frequency to time domain, but cannot work in both the time and frequency domains simultaneously. But in wavelet transform one can work in joint time-frequency domain at the same instant of time. Wavelets are wave like functions but localized. Wavelets can be used to compress the information in two-dimensional images from satellites or ground based remote sensing techniques such as radars. The wavelet transform is an efficient mathematical tool which is used for image denoising. In wavelet transform the image is localized in different frequency components which are called sub bands and noise is reduced in those sub bands. In image denoising it is necessary to preserve the actual image discontinuities when noise separation is done but there is always a tradeoff between the two. The wavelet representation is helpful becoause of its edge detection and multi-resolution properties, mostly it is very helpful for adaptive noise filtering.

IV. WAVELET DCOMPOSITION AND RECONSTRUCTION

The Decomposition process is accomplished by the following method is shown in Fig.2 and fig.3 are one-dimensional Low Pass Filter (LPF) and High Pass Filter (HPF) respectively for image decomposition. To obtain the next level of decomposition, sub band LL1 alone is further decomposed.

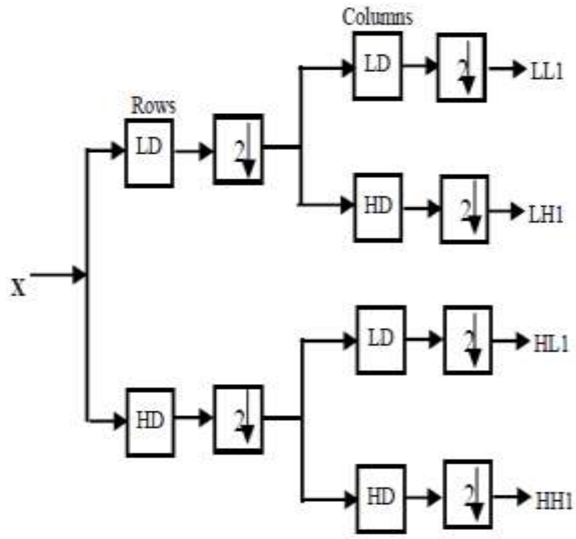

Figure .1Wavelet filter bank of one level image-decomposition

This process continues until some final scale is reached. The decomposed image can be reconstructed using a reconstruction filter as shown in Fig. 3. Here, the filters LR and HR represent low pass and high pass reconstruction filters respectively. Here, since the image size is not changed after decomposition this DWT is called critically sampled transform without having any redundancy.[18]

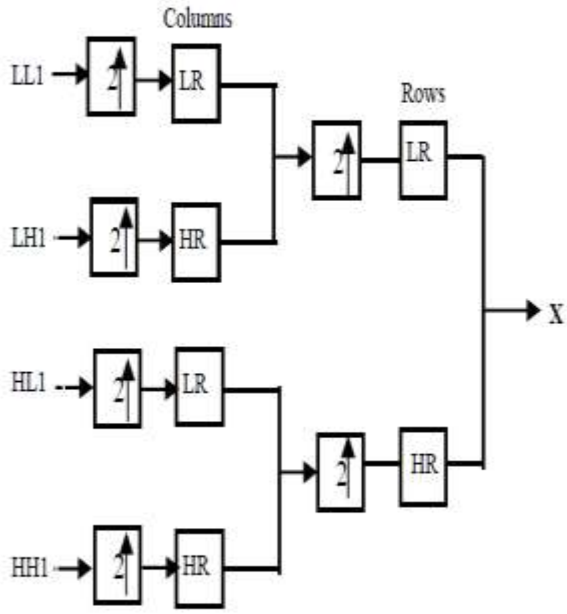

Figure 2 Wavelet filter bank of one level image-Reconstruction

IV. Shrinkage Techniques

There are various shrinkage methods are present in the field of image denoising. Shrinkage methods are used to calculate the threshold level or the threshold value against which the wavelet coefficients are compared in thresholding techniques in wavelet transform method. In this paper we have to discuss some shrinkage technique. Noise reduction in wavelet domain is usually results from wavelet shrinkage. There are many shrinkage techniques available in image denoising.

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A. Sure Shrink

In this paper we are not using Sure-shrink method but it is also a very good method for threshold value calculation. Sure Shrink suppresses noise by thresholding the empirical wavelet coefficients. It is an ultimate procedure in which threshold is estimated from decomposition coefficients at certain level to minimize the unbiased estimate of MSE. This method uses the wavelet transform coefficients at each resolution level j to choose a threshold value λj with which to threshold the wavelet coefficients. The idea is to employ Stein's unbiased risk criterion to get an unbiased estimate of the L2 –risk. It is well suited for Haar thresholding technique. The Sure Shrink threshold t* is defined as [5] [31]

$$t^{*} = \min\left(t\sigma\sqrt{2\log n}\right) \ldots\ldots\ldots\ldots\ldots\ldots..1$$

Here t denotes the value that minimizes Stein's Unbiased Risk Estimator, σ is the noise variance, and n is the size of the image. Sure Shrink follows the soft thresholding rule. The thresholding employed here is adaptive. A threshold level is assigned to each dyadic resolution level by the principle of minimizing the Stein's Unbiased Risk Estimator for threshold estimates. This method is much better than Visu Shrink. The sharp features of image are retained and the MSE is considerably lower. This because Sure Shrink is sub band adaptive. Sure shrink method of threshold calculation gives a tremendous result for hard thresholding technique.

B. Bipearson Shrink

A Bayesian approach is also one of the shrinkage methods, which imposes a prior distribution of noise-free data. In Bayesian prior estimation of noise free data is done by assuming statistically independent data and relies on marginal statistics. And other prior knowledge about inter and/or intra scale dependencies among the wavelet coefficients is getting by use of bivariate or joint statistics, by employing Hidden Markov Tree (HMT) models or Markov Random Field (MRF) models, or alternatively, and by using some local (context) measurements calculated from a surrounding of each coefficient. Here in this paper we are using Bivariate Pearson distribution for distribution of wavelet coefficients and Bayesian shrinkage estimator is used for threshold selection and combining both it is called Bipearson shrink. It is a very effectual method of threshold calculation. It is a new shrinkage function which depends on both coefficient and its parent. [1][21][24]

C .Bayes Shrink

Bayes Shrink is sub band dependent that means it is applied to each decomposed wavelet coefficients and it is used for soft thresholding. Bayes shrink is used to minimize the Bayesian risk. It is used for adaptive threshold technique. The Bayes threshold is defined as

$$th_B = \frac{\sigma^2}{\sigma_s^2}$$

Where σ2 is the variance of noise component present in image and σ_s^2 is the variance of signal without noise component.

D. Visu Shrink

.Visu shrink is also a good technique of threshold selection and it is used with universal thresholding. Universal threshold is given by

$$\alpha\sqrt{\log 2M}$$

where α shows the noise variance and M is the number of pixels which are present in the image. [18]

V. CONCLUSION

We have find that the wavelet transform approach gives tremendous result in the field of image denoising. Many researchers had given lot of thresholding techniques and shrinkage estimators like bayes shrink, Bayesian shrink, sure shrink, visu shrink, neigh shrink, laplacian shrink etc. and also gave comparisons between the techniques, but in the field of gray scale image. Most of the work which had done in color scale image is done by filter domain approach, but we think that the transform domain approach give great result in the field of color image denoising. Since we have studied a lot of papers on image denoising using filters but when we compare those approaches with transform domain we find that transform domain give tremendous result.

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