Edge Preserving Image Filtering Based on OWT-SURE

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Abstract - In the digital world the visual information transmitted in image form.while transmission of image noise get inserted into the image and image quality getting degraded at the reception end. This problem can be overcome using a better denoising algorithm.The search for efficient image denoising methods is still a valid challenge at the crossing of functional analysis and statistics. Inspite of the sophistication of the recently proposed methods, most algorithms have not yet attained a desirable level of applicability. This Paper proposes a novel approach for performing high-quality image filtering. This paper proposes image denoising using Orthogonal-sure based wavelet transform methods. Quantitative analysis would be performed by checking attained Mean Square Error estimation and PSNR of the denoised image.

Keywords: Denoising, wavelet transform,orthogonal wavelet transform, steins unbiased risk estimator, PSNR.

I. INTRODUCTION

Filtering is the most important in image processing and computer vision,it is widely used in many application image sharpening and smooting, noise removal,resolution enhancement and reduction.The simplest technique that is linear time invariant that uses convolution mask,another technique is guassian filter,but this method have disadvantage that while removing the noise it blurs the some important features of the image.

Thus the reduce of undesirable effects of linear filtering, a different variety of edge-preserving filtering techniques have been proposed over the past few years. Since taking into account local structures and statistics during the filtering process, edge preserving filtering is non-linear and can preserve the image details and local geometries while removing the undesirable noise. Most of popular filtering techniques have been developed based on partial differential equations (PDE's) and variational models. For example, non-linear/anisotropic diffusions (AD)[1] , as well as regularization methods based on the total variation (TV)[2], are most popular and widely used non-linear filtering methods in signal and image processing. In general, an initial image is progressively approximated by filtered versions which are smoother or simpler in some sense. Actually, this process introduces a hierarchy into the image structures, thus one can use a scale-space representation for extracting semantically important information. These methods are very effective tools for edge preserving filtering, however they are implemented as an iterative process which is which is usually slow and may raise issues of stability.

Image denoising is a main part of various image processing algorithm.It is often very important step taken before the image data is analysed.Denoising refers to reduce the noise level present into the image by restoring the visual content as per the original image.In primitive denoising algorithms, the original denoise are given as an input.The algorithm takes the difference between the original and denoised image.This difference value is the noisy part that has to be removed.The denoising algorithm try to reduce this difference value.Reduction in this difference value means the better output image with noise free is obtained.

In non reference denoising technique no original image is required along with the noisy image.SURE algorithm is one of the type of algorithm.Computational point of view SURE algorithm is efficient because it converts the unknown weights into a linear equation systems which can be easily processed with very few parameter.we can say the quality of image denoising using SURE algorithm is directly propotional to no of parameter related.

The edge is the most important high-frequency information of a digital image. The traditional filter eliminates the noise effectively. But it will make the image blurry. So we should protect the image of the edge when reduce the noise of the image.Before the couple of decades denoising was a challenging task.But after the advent of wavelet theory,denoising has been simplified to a greater extent. The wavelet analysis method is a time-frequency analysis method which selects the appropriate frequency band adaptively based on the characteristics of the signal. Then the frequency band matches the spectrum which improves the time-frequency resolution. The wavelet analysis method has an obvious effect on the removal of noise in the signal. The paper outlines the principles of wavelet analysis. A de-noising method is put forward based on the wavelet transform to address this dilemma of the noise reduction and protection the image edge, and realizes the de-noising of two-dimensional image signal based on MATLAB

It is known that the denoising performance of an algorithm is often measured in terms of peak signal-to-noise ratio (PSNR). A higher PSNR would normally indicate that the reconstruction is of higher quality.so in our proposed method we are using the orthogonal wavelet transform.With the help of OWT we can denoise the image efficiently and our PSNR value get increases.

II. SYSTEM MODEL

In these proposed paper Orthogonal wavelet transform-SURE denoising algorithm will be implement.

The wavelet transform provides a multiresolution representation using a set of analyzing functions that are dilations and translations of a few functions (wavelets). It overcomes some of the limitations of the Fourier transform with its ability to represent a function simultaneously in the frequency and time domains using a single prototype function (or wavelet) and its scales and shifts

Besides its lighter computational cost, an orthonormal wavelet transform (OWT) has two further advantages over redundant transformations:

• **Energy conservation:** The Euclidian norm is preserved in the transformed domain. In particular, the mean-squared error (MSE) in the image domain is a weighted sum of the MSEs of each individual orthonormal wavelet subband

$$x^j \in R^{N_j}$$

$$\underbrace{\frac{1}{N}\|\hat{\mathbf{x}}-\mathbf{x}\|^2}_{\text{MSE}} = \sum_{j=1}^{J+1} \frac{N_j}{N} \underbrace{\|\hat{\mathbf{x}}^j-\mathbf{x}^j\|^2}_{\text{MSE}^j}$$

where N_j is the number of pixels in subband $j = 1 \ldots J+1$.

Preservation of the AWGN model: The noise remains white and Gaussian with same statistics in the orthonormal wavelet domain. From the noise point of view, the wavelet subbands are therefore statistically independent,and consequently

$$\mathscr{E}\left\{\mathbf{b}^i {\mathbf{b}^j}^{\mathrm{T}}\right\} = \sigma^2 \mathbf{Id}\ \delta_{i-j}$$

Where $\delta n = 1$, if $n=0$

$\delta n = 0$, otherwise

It is the discrete Kronecker delta function.

In each orthonormal wavelet subband $j \in [1; J+1]$, we thus have the following observation model:

$$\mathbf{y}j = \mathbf{x}j + \mathbf{b}j \text{, with } \mathbf{b}j \sim N(0, \sigma 2\mathbf{Id})$$

In the orthonormal wavelet domain, each subband can therefore be denoised independently.

It basically decompose the image data.The wavelet coefficient are then filtered from the wavelet decomposed image data.These wavelet coefficient are analysed using the thresholding technique.Then inverse wavelet transform applied to reconstruct the image.

III. PREVIOUS WORK

llsure method:

Edge-preserving smoothing filters are wildly used as useful tools for a variety of image editing and manipulation tasks, most of them are originally proposed to remove noise while preserving fine details and geometrical structures in the original image.[6] It is well known that the denoising performance of an algorithm is often measured in terms of peak signal-to-noise ratio (PSNR). A higher PSNR normally indicate that the reconstruction is of high quality, To maximize the PSNR, an alternative approach is to minimize the mean square error (MSE) which can be estimated accurately by Stein's unbiased risk estimate (SURE) from the noisy image only.

Algorithm 1: llsure Image denoising base paper method

Input - Noisy Image
Output - Denoised image
Parameters – mxn is size of neighbors window.

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1. Read the image.
2. Calculate w,n of noisy image
3. Let m=5
4. n=5
5. For i=1:w-m+1 // i=1 to no of windows
6. For j=1:h-n+1 // i=1 to no of windows vertically.
7. Cropped image = generate neighbor window
8. Sort the neighbor window contents.
9. Calculate the new position into the noisy image and again insert the sorted neighbor window content
10. end
11. end

RESULT ANALYSIS

We did the testing of llsure algorithm on the standard data set images.The images that are used for testing are gray image of the size 256 x 256.The parameter that are used to do the analysis are PSNR and MSE.

$$PSNR = 10\log_{10}\left(\frac{256 \times 256}{MSE}\right) db$$

$$MSE = 1/3N \|x_n - x_n\|^2$$

IV. PROPOSED METHODOLOGY

De-noising plays a important role in the field of the image preprocessing. It is often a necessary to be taken, before the image data is analyzed. It attempts to remove whatever noise is present and retains the significant information, regardless of the frequency contents of the signal. It is entirely different content and retains low frequency content. De-noising has to be performed to recover the useful information. In this process much concentration is spent on, how well the edges are preserved and, how much of the noise granularity has been removed.

The Wavelet Transform provides a time-frequency representation of the signal. A wavelet series is representation of a square-integral (real or complex value) function by a certain orthonormal (two vectors in an inner product space are orthonormal if they are orthogonal (when two things can very independently or they are perpendicular) and all of unit length). There are two classifications of wavelets [6]: (a) orthogonal (the low pass and high pass filters have same length) and (b) biorthogonal (the low pass and high pass filters do not have same length). Based on the application, either of them can be used.

In the first step of denoising, a digital image is divided into approximation and detail sub band signals. Approximation signal shows the low frequency or general trend of pixel values. The detail sub band signals are horizontal, vertical and diagonal details of an image and contain high frequency information of an image. As noise is a high frequency signal and hence it is majorly distributed over these three sub band signals. If the details provided by these sub band signals are low, then they can be set to zero. The value below which the details are considered to be zero is called as „Threshold" value. This threshold value changes from image to image. There is variety of methods to calculate the threshold value for sub bands.

The Wavelet transforms contribute to the desired sampling by filtering the signal with translations and dilations of a basic function called "mother wavelet". The mother wavelet can be used to form orthonormal bases of wavelets, which is particularly useful for data reconstruction . A wavelet, in the sense of the Discrete Wavelet Transform (or DWT), is an orthogonal function which can be applied to a finite group of

data. Functionally, it is very much like the Discrete Fourier Transform, in that the transforming function is orthogonal, a signal passed twice through the transformation is unchanged, and the input signal is assumed to be a set of discretetime samples. Both transforms are convolutions. Shripathi [6] introduce as The Discrete Wavelet Transform (DWT), which is based on sub-band coding is found to yield a fast computation of Wavelet Transform. It is easy to implement and reduces the computation time and resources required.

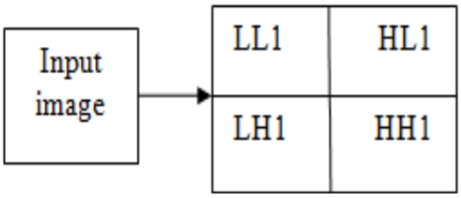


Fig. 1

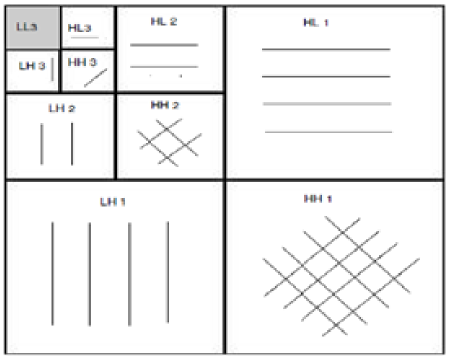
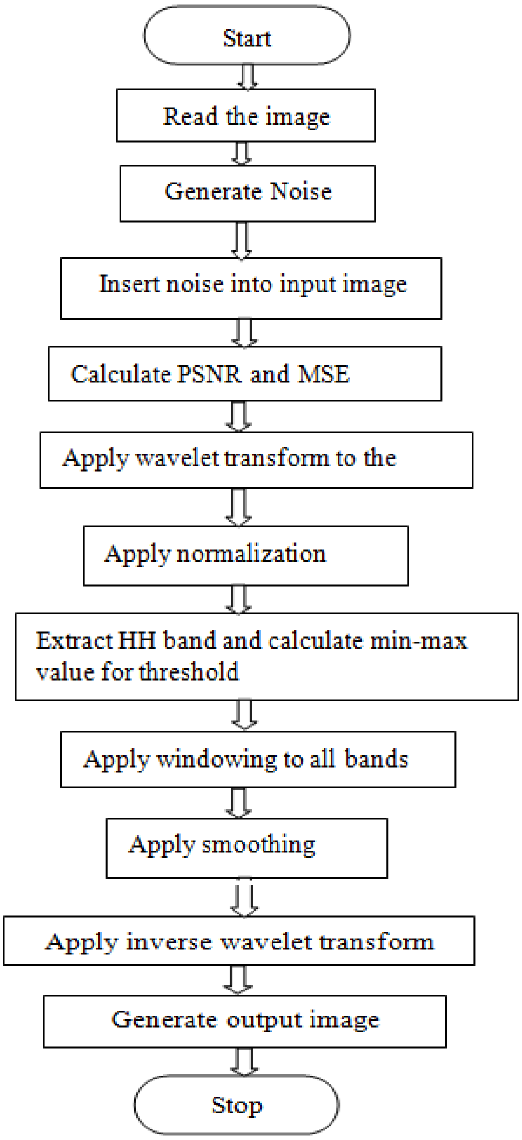


Fig. 2

Flow Chart



Algorithm 2: OWT-SURE based image denoising proposed method

Input – Noisy Image (I_m)

Output – Regenerated output image.

1. Read the image.
2. W,n size of the image (I_m)
3. Iteration that is auxillary no of iteration
4. W_t that is wavelet transform.
5. HH Extract high high frequency subband
6. Calculate the median of HH subband this calculated median value used as an threshold for denoising.
7. Apply windowing technique and apply guassian smoothing,window size is calculated from the MIN-MAX value of HH subband.
8. Calculate inverse wavelet transform.
9. Generate image.

RESULT ANALYSIS

All the experiment of this algorithm has been carried out on N=512 x 512 RGB images from the set presented in the figure.We had applied our interscale inter channel thresholding algorithm after 5 decomposition levels of an orthonormal wavelet transform using the standard daubechies symlet with eight vanishing moments.

V. SIMULATION/EXPERIMENTAL RESULTS

Table 1:-Performance comparison between llsure method and proposed OWT method using sigma=5 and psnr using Gaussian noise

Sr.no	Input image	Noisy psnr	LLsure denoised psnr	Owt denoised psnr
1	cameraman	31.01	34.21	56.66
2	peppers	31.01	32.78	54.17
3	Lena	31.01	32.92	55.18

Graphical representation for table 1

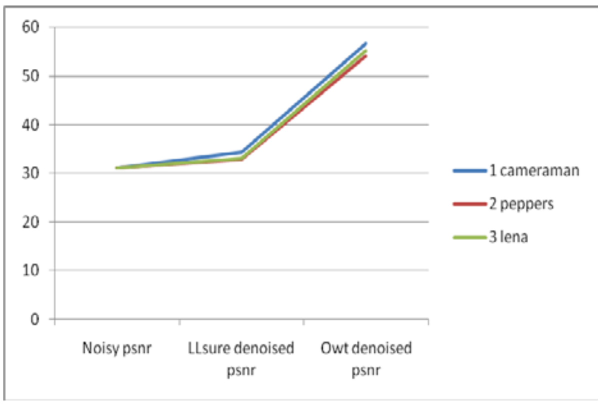


Table 2:-Performance comparison between llsure method and proposed OWT method using sigma=10 and psnr,gaussian noise

Sr.no	Input image	Noisy psnr	LLsure denoised psnr	Owt denoised psnr
1	cameraman	29.83	33.8	56.09
2	peppers	29.83	32.8	53.22
3	Lena	29.83	32.84	55.08

Graphical representation for table 2

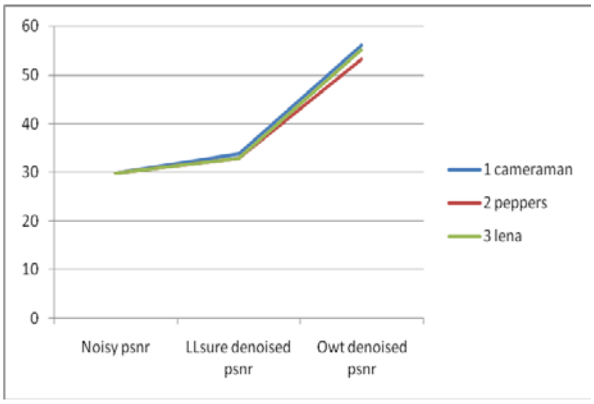
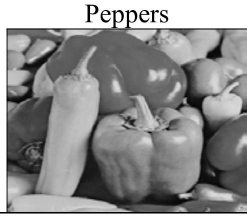


Table 3:-Standard test image on which LLSURE and proposed algorithm implemented

Cameramern 	Peppers 
Lena 	Coco 

VI. CONCLUSION

We have presented a approach for edge preserving image filtering that is based on orthogonal wavelet transform using the principle of sure steins unbiased risk estimator. The proposed method have desirable features.In this we have used wavelet approach,i.e. orthogonal wavelet transform,generated noise is gaussian noise then we applied wavelet transform then extracted hh band.In this we are getting increased PSNR value as comapare to sure-let and llsure method.

For future work we can extend this approach for colour image and video denoising.we extend it for different application including image matting, haze removal, and image colorization.

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