IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Comparative Analysis Of Image De-Noising Techniques By Using Switching Bilateral Filter And Trimmed Mean Of Noisy Image.

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ABSTARCT

Image Processing algorithm are designed to handle Different Problem domains. Efficiency of every algorithm is Dependent upon the Quality of input images. . Image De noising involves the manipulation of the image data to produce a visually high quality image. This work reviews the existing De noising algorithms, such as filtering approach, wavelet based approach, and multi fractal approach, and performs their comparative study. To enhance the quality of images Various images enhancement or restoration techniques are use. Images Enhancement techniques vary for different types noise. Noise is any unwanted signal present in original signal .A Quantitative measure of comparison is provided by the signal to noise ratio of the image. Noise Reductions are basically classified in to two types 1) Linear Techniques 2) Non Linear Techniques. In Linear techniques noise reduction formula is applied for all pixels of image linearly without classifying pixel in to noisy and non noisy pixels

Keywords: De noising, Bilateral Filter, Enhancement techniques, Linear Techniques, Non Linear Techniques.

INTRODUCTUION

During the processing of images its visibility can be affected due to the noise introduced.

Denoising of corrupted image needs to be done in order to get back its original form. Hence denoising is very important in image processing. There are many techniques available for the denoising of images depending upon the different kind of noises. Study of these techniques is very important to understand that which technique is used for which kind of noise. Salt and pepper noise is a kind of noise which can affect the image visibility up to great extent. There are many techniques available for the denoising of salt and pepper noise. But some of them are not able to remove high density noise and those which remove the impulse noise of higher density they also damages the important features of image. Feature preserving in images during denoising is also very important because the important information contained by image should not be effected by the denoising process. Bilateral Filter can preserve the image features like edges. Due to these discussed facts the bilateral filter is used in this research work for the removal of salt and pepper noise so that image details can be preserved during denoising process. Further a new algorithm is purposed for the denoising of high density impulse noise which is very efficient and can also preserves the important details of image during denoising. Computer image processing methods mainly take two categories. First, the space domain processing; that is in the image space of the image processing. The other is the image spatial domain. It should be use frequency domain through the orthogonal transformation in various frequency domain. There are various methods to help restore an image from noisy distortions. Selecting the appropriate method plays a major role in getting the desired image. The de noising methods tend to be problem specific. For example, a method that is used to de noise satellite images may not be suitable for de noising medical images. In order to quantify the performance of the various de noising algorithms, a high quality image is taken and some known noise is added to it. This would then be given as input to the de noising algorithm, which produces an image close to the original high quality image. In case of image de noising methods, the characteristics of the degrading system and the noises are assumed to be known before hand. The image $s(x, y)$ is blurred by a linear operation and noise $n(x, y)$ is added to form the degraded image $w(x, y)$. This is convolved with the restoration procedure $g(x, y)$ to produce the restored image $z(x, y)$.

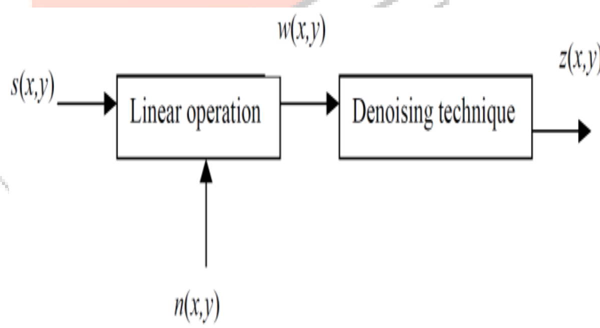

Figure 1.1: Denoising Concept

2 Scope of Research

In my work I have done the study of various kinds of noises and denoising techniques in image processing and my main concentration is on denoising of salt and pepper noise by using Bilateral Filtering technique. Various advancements in the field of Bilateral Filtering and impulse noise removal have been studied and then a new filter for the denoising of impulse noise and edge preserving is purposed by using Switching Bilateral Filter and Trimmed Mean of noisy image. The Scope of my research work will include following aspects:

2.1 Efficient Removal of Noise – The purposed filter is very efficient in removing the salt and pepper noise from images almost at any densities value especially the high density noises but the other BF techniques cannot remove the impulse noise from images. The given technique provides better results than existing techniques for impulse noise removal and can be very effective in image processing applications.

2.2 Edge preserving in images – Bilateral filter is known as an edge preserving filter, because it not only removes the noise from images but also at the same time saves the important features of image. It is the most efficient technique in edge preservation. The proposed algorithm uses this property of BF and can preserve edges of image even when the high density salt and pepper noise is denoised. The other techniques of high density impulse noise removal cannot do this.

2.3 Compatibility with other methods – The proposed filter is basically a combination of two different approaches which are bilateral filter and median filter. To further improve its efficiency it can be used with other techniques also. Previously the BF technique is used with many techniques in order to use for different applications. Hence our proposed technique has a good compatibility with other methods used for image denoising.

2.4 Adaptability– Performance of proposed filter can be improved by optimizing its parameters like domain parameter σd and predefined parameter α.Hence the technique can be used more efficiently by using proper values of these parameters.

3 Techniques for Image Reduction

Noise cannot be removed without the loss of some information in the form of image detail Nevertheless noise-reduction algorithms have been developed to reduce noise without image information too much To get pure signal by detecting and removing noise, a wide variety of filtering algorithms have developed. These include both Temporal Filters and Spatial filters. For example, the median image filter give good results for impulse filtering while the mean image is best for Gaussian noise filtering.

Noise Reduction are basically classified into two types:

1) Linear Technique
2) Non Linear Technique

3.1 Linear Techniques

In Linear techniques, without classifying pixel into noisy and non noisy pixels, a noise reduction formula is applied for all pixels of image linearly. As this algorithm is applied for both noisy and non noisy pixels thus the main drawback of this algorithm m is it damages the non noisy pixels.

3.2 Non- Linear Techniques

It's a two step process

1) Noise detection
2) Noise Replacement

There are many algorithms but with low noise condition such algorithms works well but there performance is poor in case of high noise conditions. To Improve the range of noise reduction, non linear Techniques, MMF, CWMF(Centre Weighted Media Filter),AMF(adaptive Median Filter) Algorithm are proposed.

4 Proposed Method

The SBF [1] and median filter [2] both algorithms of salt and pepper noise removal has their own limitations as SBF cannot remove high density impulse noise and median filter cannot preserve edges in the image during denoising. Hence to overcome these limitations, I have proposed a new algorithm for the removal of impulse noise, which is named as Trimmed Mean based Bilateral Filter.

4.1 Trimmed Mean Adaptive Switching Bilateral Filter (TMASBF)

If WGs,t is the domain filter, WTMSR(s,t)is range filter and f(x+s,y+t) is the neighborhood of f(x,y) in the selected (N×N) window then TMASBF output u(x,y) is given as follows:

u(x,y)=s=-NNt=-NNWGs,tWTMSR(s,t)f(x+s,y+t)s=-NNt=-NNWGs,tWTMSR(s,t) Eq.(4.1)

Where,

WGs,t=exp-x-s2+y-t22σd2 Eq.(4.2)

and

WTMSR(s,t)=exp-ασdTM-f(x+s,y+t)2n2 Eq.(4.3)

The domain filterWGs,t weights in this are calculated in same manner as in conventional bilateral filter as given in Eq. (3.9). The range filter of Trimmed Mean Adaptive Bilateral filter WTMSR(s,t) is calculated as given in Eq. (3.10), Where TM is the trimmed mean value and α is a predefined parameter whose value is empirically set to .003. TMASBF uses trimmed mean of noisy image for the calculation of range filter weightsWTMSR(s,t) hence only noise free pixels are processed during the range filter calculation. Due to which the computational time of proposed TMASBF algorithm is less as compared to SBF method because SBF requires the processing of all noisy and noise free pixels to calculate range filterWSRs,t.

4.2 Calculation of Trimmed Mean

To calculate the trimmed mean from a given set of values usually we neglect the lowest and the highest value and then take the average of remaining values. Now in the case of images which are corrupted by salt and pepper noise we have noise in the form of lowest and highest pixel values (0 and 255). Hence we can remove these noisy pixels by taking the trimmed mean of image. The computation of trimmed mean can be explained by following steps:

i) Check the condition 0<f(x,y)<255 for the input noisy image, where f(x,y) is the center pixel value.

ii) If the selected window has no noisy pixel then take the average otherwise remove the noisy pixels and take the average of remaining pixels.

iii) Thus computed value is called trimmed mean TM.

4.3 Selection of Domain and Range parameters (σdandσr)

The filtering operation of bilateral filter [3] and switching bilateral filter [1] depends on the values of domain (σd) and range (σr) parameters. Hence parameter selection in these filters is very important. In the proposed TMASBF method we modify the[7] switching bilateral filter, as we select the filter parameters in a new manner. We take the value of domain parameter (σd) between 1 and 4. The value of σd is selected according to the density of noise (n) present in the image. As shown in results in next section that the value of σd is 1 for noise density 10% to 50%, 2 for noise density 60% to 70% and 3 and 4 values of σd are taken for noise density of 80% and 90% respectively.[5][6]

4.4 Operation of Proposed Method

The detailed operation of our proposed method for the removal of salt and pepper noise from images shown. The stepwise operation of proposed method is as follows:

(i) Read the noisy image which is corrupted with salt and pepper noise.

(ii) Select a 2D window of size 3 × 3. Assume that the processing pixel is f(x,y).

(iii) If 0<f(x,y)<255 then f(x,y) is a noise free pixel and will be left unchanged.

(iv) If f(x,y)=0 or 255 then f(x,y) is noisy pixel. Hence two cases will be possible:

Case (i): If selected window contain all values as 0 and 255 then replace f(x,y) with mean of values in selected window.

Case (ii): If selected window also contains values other than 0 and 255 then apply the TMASBF on the processing pixel.

(v) The output will be the denoised image f(x,y).

5.1 SIMULATION RESULTS:-

The Original Image is Cameraman title image, adding three types of Noise (Gaussian noise, Speckle noise and Salt & Pepper noise) and De-noised image using Median filter and Trimmed filter and comparisons among them. With image matrices like PSNR, IEF, MSE [4]

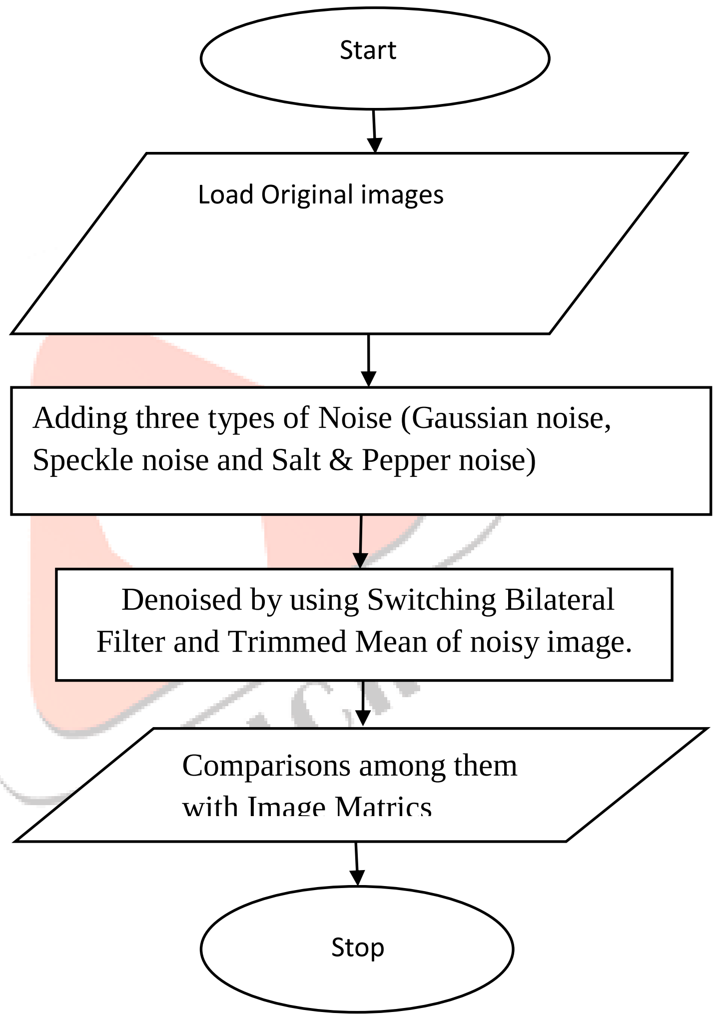

Fig. 5.1: Flowchart of the Methodology Adopted

5.2.3 IMAGE ENHANCEMENT FACTOR:

These metrics were used to check the quality of the image. It checks which technique is giving better output. The output of SMF, TMF and Bilateral Filter is tested using these parameters.

5.3 Load the Original and Distorted Images

Firstly we load the original and distorted images to analyze the quality of distorted images by taking original images as reference. The images used are as follows:

Step1: Load the original grayscale image of cameraman

Fig. 5.2 Original Image of Camera man

Step2: Load the Distorted grayscale image of cameraman at the nose density level 0.9 ,we may include this density level 0.1 to 0.9. In this work we use the maximum density level of noise, through which we easily check the performance of the our filters ,and also calculate the image matrices like, PSNR,IEF,MSE

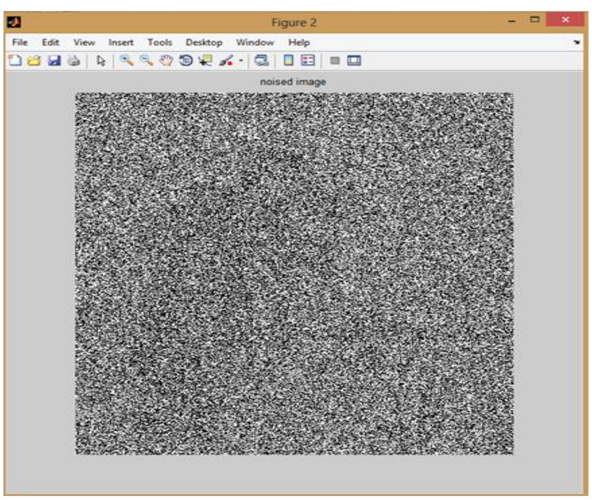

Fig. 5.3 Distorted Image of Camera man at density level 0.9

Step 3: Filtered Image by Trimmed Mean Filter

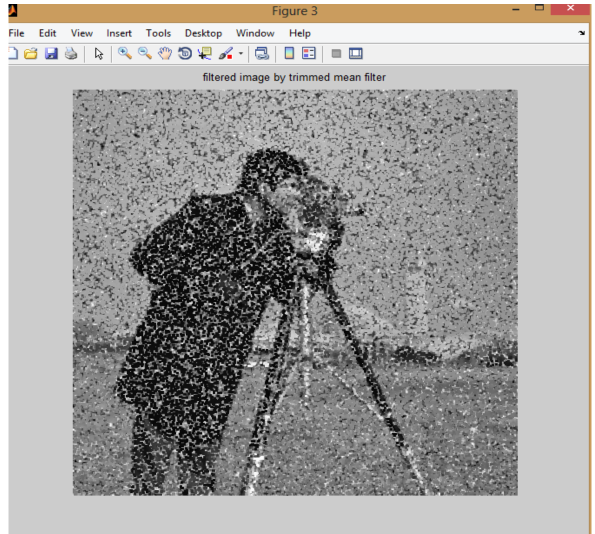

Fig. 5.4 Filtered image by Trimmed filter

Step 4: Filtered Image by Proposed Filter

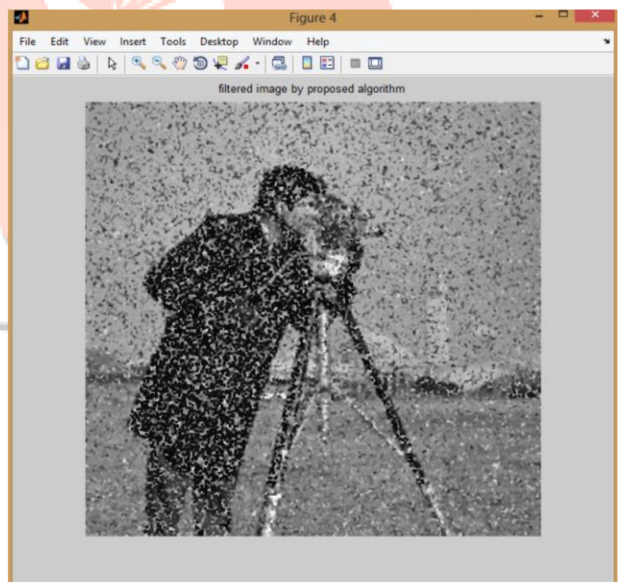

Fig. 5.5Filtered image by Proposed Filter

Step 5 : Filtered Image by Median Filter

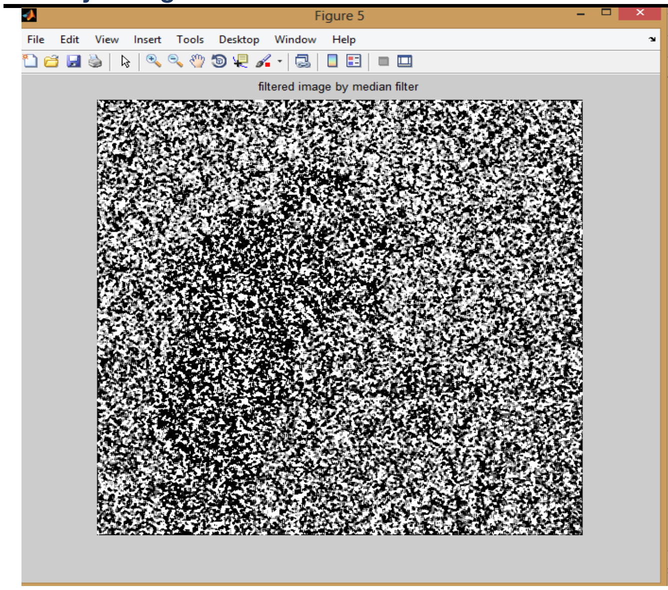

Fig. 5.6 Filtered Image by Median Filter

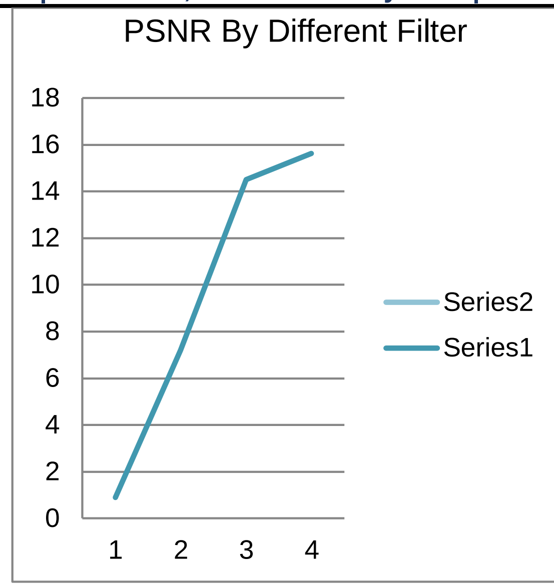

Fig. 5.7 PSNR By Different Filter

5.2 Comparative analysis of Image Metric parameter (PSNR) using different filter

Density Level	PSNR by Conventional filter	PSNR by Trimmed filter	PSNR filter
0.9	**7.2084**	**14.514**	**15.623**

5.3 Comparative analysis of Image Metric parameter using different filter

Density Level	IEF by Conventional filter	IEF by Trimmed filter	Proposed filter
0.9	**7.9074**	**7.9074**	**10.2073**

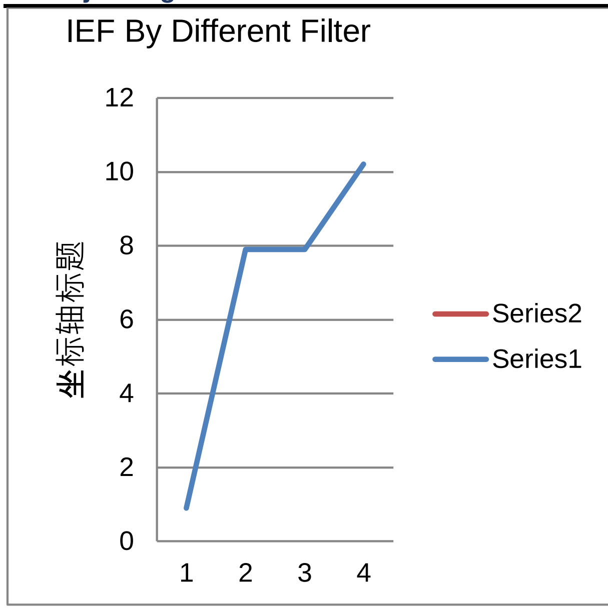

Fig. 5.7 IEF By Different Filter

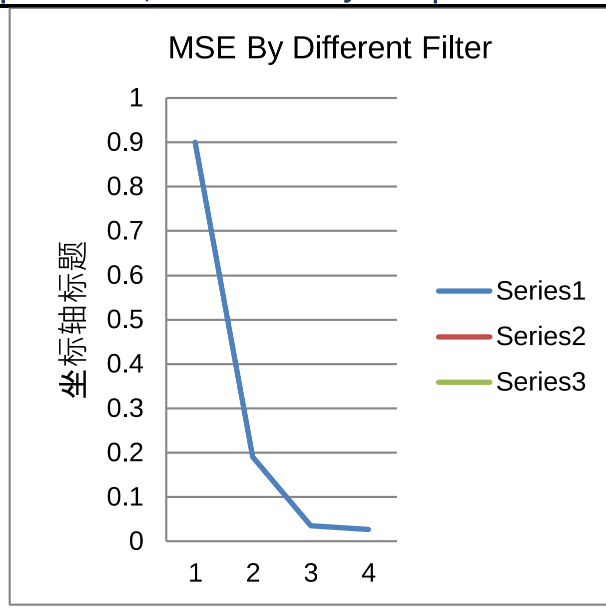

Fig. 5.8 MSE By Different Filter

5.4 Comparative analysis of Image Metric parameter (MSE) using different filter

Density Level	IEF by Conventional filter	IEF by Trimmed filter	Proposed filter
0.9	**0.1902**	**0.0354**	**0.0274**

Conclusion

In this Paper I have proposed a new algorithm for the removal of impulse noise from the gray scale images. This new algorithm is named as Trimmed Mean Adaptive Switching Bilateral Filter (TMASBF). The purposed filter is capable of removing very high density impulse noise from images and it also preserves the important details of image during denoising. To implement this new algorithm first of all Switching Bilateral Filter (SBF) is made adaptive by using parameter tuning and then this ASBF is used with Modified Decision Based Un-symmetric Trimmed Median Filter (MDBUTMF) technique. Hence the purposed filter overcomes the limitations of both these existing techniques. The result analysis shows that the purposed filter is very efficient for the impulse noise removal and gives better quantitative and qualitative results than the existing methods of impulse noise removal.

6.2 Future scope In future this filter can be further improved by adding more advanced impulse noise detection schemes to it. By using an efficient noise detection technique the thin lines and texture can also be classified differently along with edges in image hence the information

contained by thin lines and texture can also be preserved as edges are preserved in this method. All these modifications can make the purposed TMASBF filter more efficient for impulse noise removal.

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