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Simplified Filtering Technique to Edge Reconstruction and Comparison of Original Image in Low to High Density Noise Values

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Abstract: ***From last twenty years, removing noise from the image without any losses like over smoothed, blurred or spoiling edges and lines is challenging problem for researchers. When transmitting images through the network cables or channels the image may contaminate because of the storage characteristics. Even a small intensity values may change the entire view of an image. The change of intensity values is called Noise. There are different noises like Salt & Pepper Noise, Gaussian Noise, Speckle Noise, and White Noise. The pre-processing technique approach is of two types, they are filtering approach and wavelet based approach. There are different existing filtering techniques are there like Median Filter, Standard Median Filter, Adaptive Median Filter and Decision Based Algorithm. These traditional filtering techniques are proved to the best at Low noise densities. In this paper we present a filtering technique which will work efficiently at low noise densities as well as high noise densities. This filtering technique will perform in two states, firstly, eliminating the corrupted pixels based on centre waited pixel, finally reconstruction the original image without disturbing the original image edges. Simulation results are quantitatively measured as PSNR (Peak signal to noise ratio), MSE (Mean Square Error) and MAE (Mean Absolute Values).***

Keywords: Noise, Intensity Values, Filtering Techniques

1. Introduction

Generally images are of two types, one is Gray Scale Images and other one is RGB images. Gray scale image has only one channel and RGB image have three channels. Noise may occur due to heat of camera sensors, analogue to digital conversion and communication channels. This type of noises cause to degrade the image quality, therefore it is very important to remove the positive and negative impulses by using filtering technique. Most probably the Linear Filtering technique will consider the two filtering techniques like Mean Filter (MF) and Least Mean Square (LMS). Median Filter considers under non-liner filtering technique.

Eliminating the noise process may contaminate the nature of an image in order to either improve its original visualization. Pixels corrupt at two intensity levels that is high or low intensity values. To identify the neighboring pixels Standard Median Filter (SMF) proposed in [1]. The SM filter was the first effective impulse noise removal filtering technique.

MAG (Mean Absolute Gradient) filter is presented in [1] which performs effectively to remove noise values and identifying the corrupted pixels based on Directional Filtering technique. This directional filtering technique differentiates the pixel between detail preservation and noise removal pixel after noise reduction. SMF [Standard Median Filter] has the good performance and effective computational efficiency, but it has a lack of disadvantage at high noise density to preserve the details of the image.

The median filter was one of the robust filtering techniques to identify the noise. But the drawback is while restoring the corrupted pixel it replaces the original pixel by using median value without considering the local features at high noise levels [2]. A new filtering technique is presented in [8] which will have mean and median filtering mechanism for medical images. Gradient peer mechanism is presented in [3], it is used to remove noise values in color images and the peer group averaging algorithm is used to predict and delete the noise from RGB images. A new partial differential equation model is presented in [4]. In this method first, it converts convolution noise into additive noise by using Fourier transform and logarithm strategy. Finally traditional filtering technique is used to remove noise in frequency domain.

Automatic estimation using piecewise smooth image model is presented in [6]. In this model they used NCF (Noise Level Functions) to describe the image brightness and to de-noise the image by projecting pixel values of the image. To remove noise and restore the image a new morphology technique is presented in [7]. Here we used mathematical morphology to de-noise and restore the edges apart from traditional edge detection methods such as sobel, prewit and canny edge detectors.

A new and efficient technique is presented in [8] which work very efficiently in color images at high noise densities by using fuzzy filtering techniques. Detailed preservation technique is presented in [9] to reduce impulse noise using a small window technique and window size. In Switching Median Filter, it will identify the edges in different orientation, after that it finds minimum absolute value of the convolution for detection.

Edge the most significant characteristic in any image. Edge detection process eliminates the sharp changes which are happened due to the intensity values. A new algorithm proposed to identify the edges based on Sobel operator and genetic algorithm in [4]. Three step edge detection with embedded confidence is presented in [3] those are gradient estimation, nonmaxima suppression, hysteresis thresholding used to generate the proper edges in an image.

2. Proposed Filtering Technique

Basically we follow windowing technique to create the simulation results. Let X denote the noise corrupted pixel value in the image. Pixel X(i,j) denotes as Xij denotes as a sliding or filtering window size 2(L+1)X (2L+1) is considered as centered pixel at Xij and the windowing elements are treating as {Xi-u, j-v,-L ≤ u,v ≤ L}. In this, firstly we fix the window size as W=5; but calculate the edges based on the window size as W=3.

2.1 MAE & MSE Calculation for Median filter

```
CONV = 0;
for i = 1:ROW
 for j = 1:COL
CONV = CONV + abs(CONV_MED(i,j) - GRAY(i,j));
end
end
MAE_CONV = CONV/ (ROW * COL);
disp('MAE forMedian Filter Algorithm');
disp(MAE_CONV);
 CONV = 0;
for i = 1:ROW
 for j = 1:COL
 CONV = CONV + (CONV_MED(i,j) - GRAY(i,j))^2;
 end
end
MSE_CONV = CONV/ (ROW * COL);
disp('MSE for Median Filter Algorithm');
disp(MSE_CONV);
```

2.2 PSNR Calculation for Proposed Method

```
P = 0;
for i = 1:ROW
 for j = 1:COL
 P = P + abs(Y(i,j) - GRAY(i,j));
 end
end
MAE = P/ (ROW * COL);
disp('MAE for Proposed Algorithm');
disp(MAE);

P = 0;
for i = 1:ROW
 for j = 1:COL
 P = P + (Y(i,j) - GRAY(i,j))^2;
 end
end
MSE = P/ (ROW * COL);
disp('MSE for Proposed Algorithm');
disp(MSE);
```

3. Reconstruction of Edges

```
Y(1,:) = Y(3,:);
Y(2,:) = Y(3,:);
Y(ROW,:) = Y(ROW-2,:);
Y(ROW-1,:) = Y(ROW-2,:);
Y(:,1) = Y(:,3);
Y(:,2) = Y(:,3);
Y(:,COL) = Y(:,COL-2);
Y(:,COL-1) = Y(:,COL-2);
Y = uint8(Y);
```

4. Simulation Results

In simulation result, we compared the image characteristic with median filter and simplified proposed filter. Table 1, shows at high noise densities the median filter generating poor results and simplified filtering technique generating better results in high densities also. Figure 5, shows the plot of original image at 0.5 noise values, figure 6, shows the plot of reconstructed image at 0.5 noise values. Even though the figure 5, & figure 6 both are similar to visualization. Figure 7, shows the difference of the original image and reconstructed image which we cannot identify based on the PSNR values.

Table1: Simulation results compared with Median filter and simplified noise reduction filter technique

	Median Filter		Simplified Filter		Median Filter PSNR	Simplified Filter PSNR
Noise Values	MAE	MSE	MAE	MSE		
0.1	2.69	47.60	0.85	18.11	31.35	35.5515
0.2	3.67	111.25	1.35	28.31	27.66	33.61
0.3	5.76	330.94	2.14	49.79	22.93	31.15
0.4	9.70	825.17	3.04	72.44	18.96	29.53
0.5	17.80	1.9937e+003	4.40	116.05	15.13	27.48
0.6	30.82	3.9116e+003	6.38	187.33	12.20	25.40
0.7	48.51	6.5708e+003	10.25	345.04	9.95	22.75
0.8	71.15	9.9188e+003	18.11	776.09	8.16	19.23
0.9	98.36	1.4111e+004	34.95	2.0861e+003	6.63	14.93

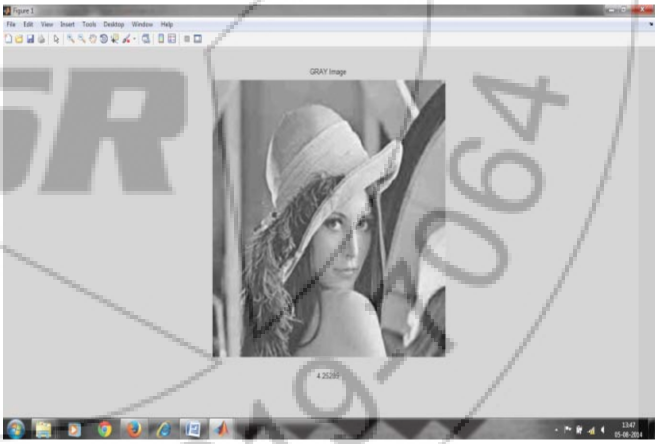

Figure 1: RGB converted in to GRAY scale input

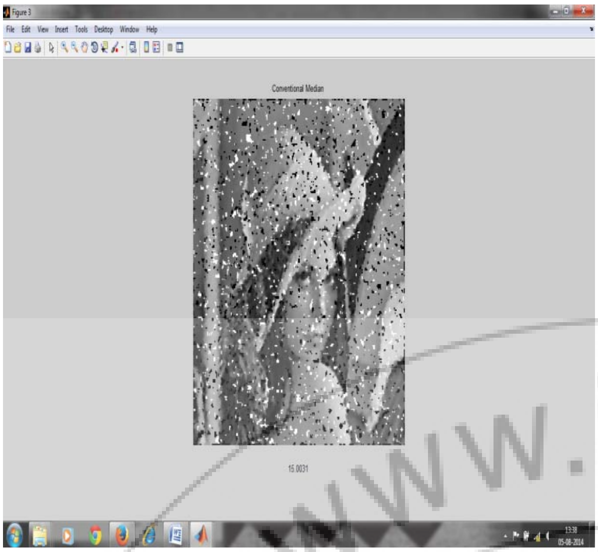

Figure 2: Median filter Gray scale image with PSNR=15.13 at 0.5 noise values

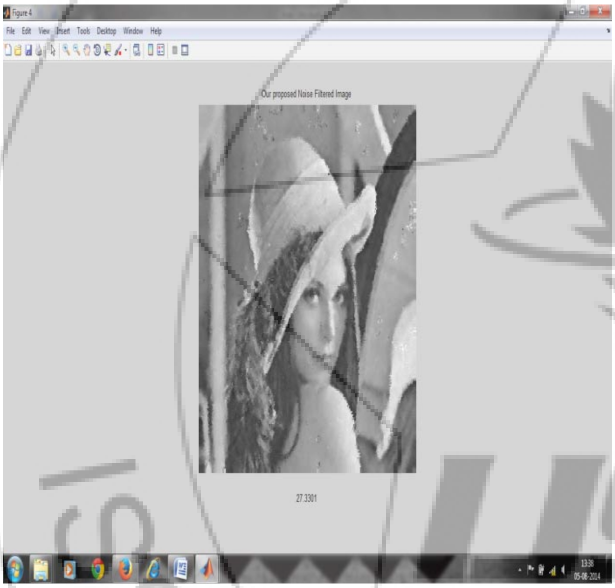

Figure 3: Propose Gray scale image with PSNR=27.48 at 0.5 noise values

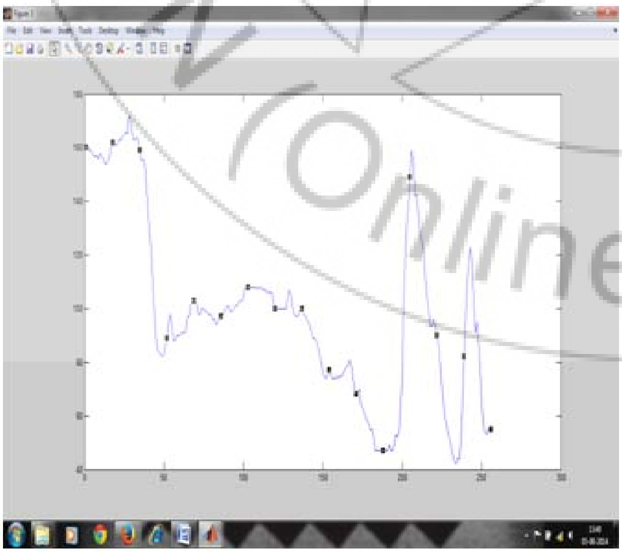

Figure 4: The difference of original image and reconstructed image with the edge detection at 0.5 noise values

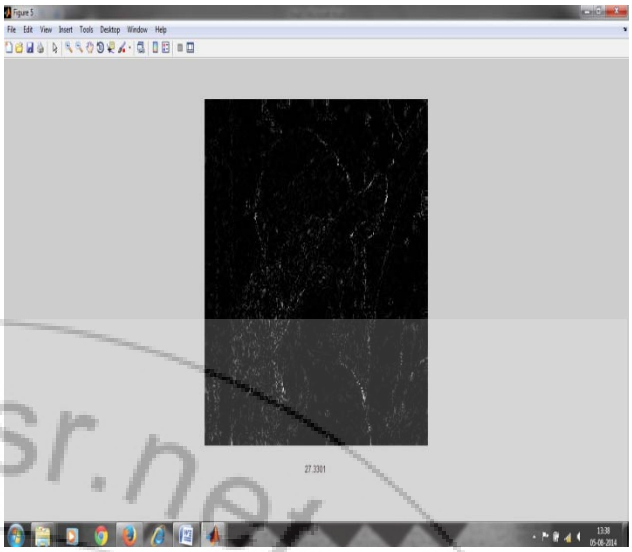

Figure 5: plot of original input image at 0.5 noise value

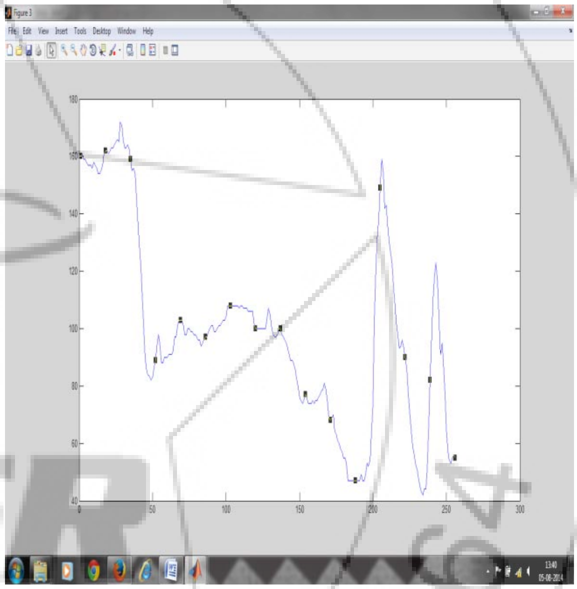

Figure 6: plot reconstruction image at 0.5 noise value

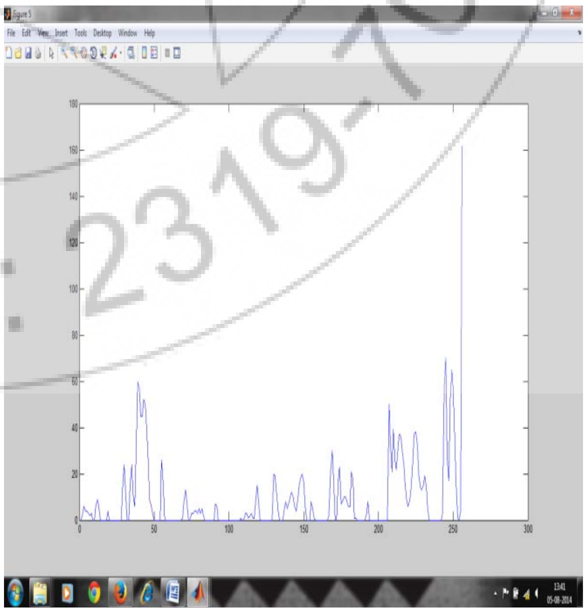

Figure 7: plot specifies the difference between original image and reconstruction image at 0.5 noise values

5. Conclusion

Conventionally median filter technique is used to de-noise the image , but the MF is constructing an image with loss of important feature like edge in all noise densities. However, when noise level increases, the median filter may work poorly. For this reason a new algorithm has been proposed to address the problem namely poor noise removal at high noise density, which are commonly met in median filter. The proposed algorithm uses a 3x3 windowing technique to restructure the original image. The proposed algorithm filter shows steady and stable performance across a wide range of noise density varying from 10% to 90%. Effective noise removal can be observed up to 90% when compared to traditional filter. In simulation we identify the difference of an original image and reconstruction of an image which have the same PSNR values and same visualization.

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