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Gaussian Noise Removal from Gray Scale & Color Images by Using Adaptive Window Techniques

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***Abstract*— Information transmitted in the form of digital images is important part of communication system, but restored image obtained after transmission is often corrupted with noise. The restored image needs processing before it can be used in applications. Aim of the image processing is to visually enhance some aspect of an image which is not readily apparent in its original form. Image processing gives greater perception & vision but it does not add any information content. Image captured by any system is the degraded version of an original image. The degradation is due to sensing environment when it acquire through optical, electro optical and electronics medium. It is necessary to restore such image for further image processing & other tasks. By keeping the integrity of the image information, Gaussian noise removal is a critical issue. The function of the proposed algorithm is to replace each corrupted pixel is by alpha trimmed value of pixels inside an adaptive window. Using threshold which is calculated from noise variance the adaptive window is formed. According to Peak signal to noise ratio (PSNR) performance proposed algorithm is better and effective for images which are highly corrupted by Gaussian noise**

Index Terms: **Adaptive window, Gaussian noise, Alpha trimmed, Threshold**

I. INTRODUCTION

General Image captured by any imaging system is the degraded version of an original image due to additive noise caused by noise sensor, recording process, communication channels, and any combination of them when it acquire through optical, electro optical and electronics medium[1].

Noise is classified as Gaussian noise, salt and pepper noise, Uniform noise, Rayleigh noise, Speckle noise [2].Gaussian noise is a statistical noise which is evenly distributed over the whole image. Gaussian noise has a probability density function (PDF) of the normal distribution also known as Gaussian distribution. Means each pixel in the noisy image is the sum of the true pixel value and a random Gaussian distributed noise value.

In the salt and pepper noise has only two possible values a & b. The probability of each is less than 0.2.The corrupted pixels are set alternatively to the minimum or maximum value & unaffected pixels remain unchanged. Speckle noise is a multiplicative noise which occurs in almost all coherent imaging systems.
This noise follows a gamma distribution Due to quantizing the pixels of image the uniform noise is cause to a number of distinct levels is known as quantization noise. Uniform noise has approximately uniform distribution [3]. A noise used in this paper is Gaussian Noise.

Denoising of an image is very important part of the image reconstruction process. Image denoising, completely remove noise from noisy images with preserving edges. There are different linear and nonlinear techniques were developed to remove noise. For Gaussian noise models linear filters work better while non-linear work efficiently for other noises. The arithmetic mean filter [3] is easy to implement but it does not preserve image details. It causes a certain amount of blurring. Some details of image are removing by using the mean filter. The K-mean filter [5] handles only the value which is close center sample. K decides the smoothening capability Adaptive filter change their behavior on the basis of statistical characteristics of the image region, encompassed by the filter region [6].

This paper proposed simple and efficient algorithm to remove Gaussian noise. In this paper first input image is taken and Gaussian noise is added to image to make it as noisy image and then each corrupted pixel is replaced by alpha trimmed value of pixels inside an adaptive window. This paper is organized as follows: Section II describes propose algorithm. Section III describes Experimental results & analysis. Sections IV address the conclusion.

II. PROPOSED ALGORITHM

Digital image is degraded by Gaussian noise. It is assume that noise is statistically independent of the signal. Mathematically degraded image $y_{i,j}$ is represented as,

$$y_{i,j} = x_{i,j} + n_{i,j} \qquad (1)$$

Where $x_{i,j.}$ denote true image and $n_{i,j}$ represents additive noise.

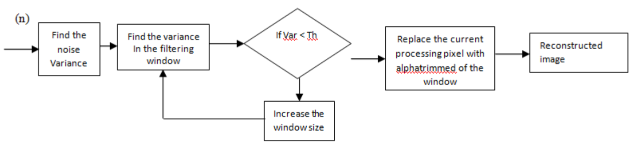

Figure.1. Structure of the proposed filter

To remove Gaussian noise from the images, it is very important to remove noisy component [6, 7]. Instead of keeping fixed threshold to remove noisy components from the images, proposed algorithm discriminate the noisy and noise free pixels to applying noise removal filter.

Algorithm description:

First read the input image. Input images taken are gray as well as color. The Gaussian noise is added in the original image to make image noisy. Then noise variance of the noisy image is calculated. Subtracting each element in the filtering window with the center pixel the absolute difference between the center pixel and neighboring pixels in the filtering window is acquired. For highly corrupted image this difference is large. Absolute difference is compared with a threshold. The threshold is defined as the product of smoothing factor and noise variance. The value of smoothing factor is chosen as 0.3 for optimum performance. High smoothing factor has better noise removal capacity at the cost of loss of image details. If absolute difference is within the threshold, the corresponding pixel only further processed. Each pixel is processed with 3x3 sliding window. If the noise variance exceeds the threshold value, increase the window size till 9 and repeat above the steps. . If absolute difference is less than threshold, we have to find the mean of window and replace the current processing pixel with K mean. Continue the processing over the entire image. The proposed algorithm can be summarized as follows:

III. EXPERIMENTAL RESULT

The proposed algorithm is tested using gray and color standard images like Lena, Pepper, Elaina, and Pepper, Mandrill of size 512×512. The results of Arithmetic mean filter, Adaptive filter, K mean filter & proposed algorithm are compared. Each time the test image is corrupted by Gaussian noise with sigma ranging from 5 to 30 with an increment of 5 will be applied. To assess the quality of the image, the performance of the proposed algorithm is measured by peak signal-to-noise ratio (PSNR) [8]. Performance of all Filters & proposed methods are summarized in table 1 & 2. The restoration results obtained in terms of PSNR shows that proposed method performed well instead of existing filters.

For analysis, performances of the filters are tested at different noise level. The results of the analysis are shown in Figures. 2-3. In Figure 2 & 3, shows visual image quality of the proposed method with

Arithmetic mean filter, Adaptive filter & K mean filter for the Lena (gray) image corrupted by Gaussian noise. To show visual performance of proposed methods, results of sigma equal to 5 &15 is shown in this paper. Figure 4 & 5, shows the visual image quality of the proposed method with other methods for the Pepper color image corrupted by noise standard deviation 5 & 15. The proposed algorithm has higher peak signal to noise ratio (PSNR) than arithmetic mean filter, K mean filter, and adaptive filter.

IV. CONCLUSION

This paper proposed a new adaptive window based algorithm is to remove the Gaussian noise in gray scale and color images. In this study the performance of the existing methods & proposed methods are evaluated and compared. The restoration results obtained in terms of PSNR shows that proposed algorithm is better than existing methods. The complexity of the proposed algorithm is very less as compared to the other methods.

Table I: PSNR for Various Filters for Lena (Gray) Image at Different Sigma

Sigma	Arithmetic	Adaptive	K mean	**Proposed Technique**
5	37	30.09	35.24	37.67
10	34.96	24.56	34.94	37.19
15	33.27	21.72	33.31	36.68
20	32.14	18.63	32.13	36.12
25	31.14	17.33	31.35	35.50
30	31.35	15.88	30.75	34.95

Table II: PSNR for Various Filters for Pepper (Color) Image at Different Sigma

Sigma	Arithmetic	Adaptive	K mean	**Proposed Technique**
5	37.04	26.06	36.09	38.02
10	34.84	21.84	35.22	37.71
15	33.41	20.58	33.59	37.08
20	32.32	17.44	32.48	36.29
25	31.57	15.94	31.67	35.66
30	30.98	16.15	31.05	35.03

Figure.2 Restoration Results of Lena image corrupted with a noise standard deviation (σ=5) by various filter

Figure.3 Restoration Results of Lena image corrupted with a noise standard deviation (σ=15) by various filters

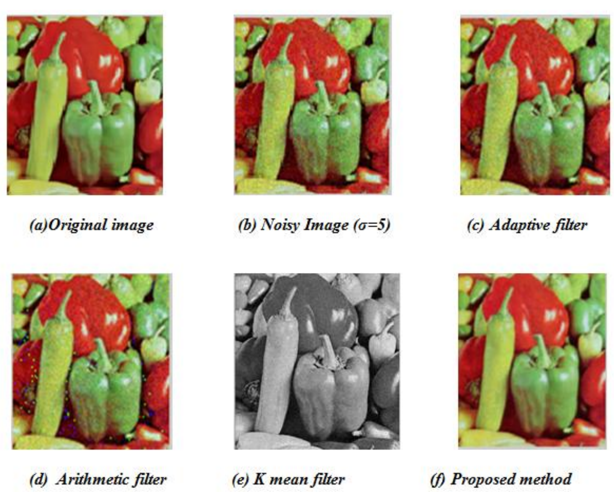

Figure.4Restoration Results of Pepper image corrupted with a noise standard deviation (σ=5) by various filters

Figure.5 Restoration Results of Pepper image corrupted with a noise standard deviation (σ=15) by various filters

REFERENCES

[1] A.K. Jain, Fundamentals of Digital Image Processing. Englewood Cliffs, NJ: Prentice-Hall; 1989.

[2] Gonzalez and Woods, Digital Image Processing, Prentice Hall, 2nd edition, 2001.

[3] Chanchal Srivastava, Saurabh Kumar Mishra, Pallavi Asthana3, G. R. Mishra4, O.P. Singh, “Performance Comparison of Various Filters and Wavelet Transform for Image De-Noising”, e-ISSN: 2278-0661, p- ISSN: 2278-8727Volume 10, Issue 1 (Mar. - Apr. 2013), PP 55-63.

[4] Priyanka Kamboj And Versha Rania, “Brief Study Of Various Noise Model And Filtering Techniques” ISSN 2229-371X,Volume 4, No. 4, April 2013

[5] J. Astola and P. Kuosmanen, Fundamentals of Nonlinear Digital Filtering. Boca Raton, FL: CRC, 1997.

[6] J. Astola and P. Kuosmanen, Fundamentals of Nonlinear Digital Filtering. Boca Raton, FL: CRC, 1997.

[7] Vijay Kumar, Priyanka Gupta, “Importance of Statistical Measures in Digital Image Processing,” ISSN 2250-2459, Volume 2, Issue 8, August 2012.

[8] Alain Horé Djemel Ziou , “Image quality metrics: PSNR vs. SSIM” IEEE International Conference on Pattern Recognition,2010