IJETST- Volume||01||Issue||07||Pages 1227-1232||September||ISSN 2348-9480 2014

Open access Journal International Journal of Emerging Trends in Science and Technology

Compartive Evaluation of Standard and Adaptive Median Filter for Removing Different Type of Noises

Authors

Swati Singhal[1], Vandana Vikas Thakare[2]

[1]Student, Department of Electronics & Communication Engineering, Madhav Institute of Technology & Science, Gwalior, India

Email: *swati89singhal@gmail.com*

[2]Associate Professor, Department of Electronics & Communication Engineering, Madhav Institute of Technology & Science, Gwalior, India

Email: *vandanavt_19@rediffmail.com*

Abstract

In the present paper a comparative performance evaluation of standard median filter and adaptive median filter for impulsive and non- impulsive noises has been discussed. The Adaptive Median Filter eliminates the problems faced with the standard median filter, preserving the edges while smoothing the image. The difference between the two filters is that, in Adaptive Median Filter, the size of the window surrounding each pixel is variable. This variation depends on the median of the pixels in the present window. It is seen that impulse noise is greatly attenuated if filtered adaptively.

Keywords: *De- noising, median filtering, Adaptive median filtering, impulsive noise, non-impulsive noise*

INTRODUCTION

Removal of noise is an important step in the image restoration process, but de-noising of image remains a challenging problem in recent research associate with image processing. De-noising is used to remove the noise from corrupted image, while retaining the edges and other detailed features as much as possible. This noise gets introduced during acquisition, transmission & reception and storage & retrieval processes. Noise may be classified as substitutive noise (impulsive noise: e.g., salt and pepper noise, random valued impulse noise, etc.), additive noise (e.g., additive white Gaussian noise) and multiplicative noise (e.g. speckle noise). However, in this paper the investigation has been limited to salt and pepper noise, additive Gaussian noise and speckle noise. In general, the goal of any noise removal scheme is to suppress noise as well as to preserve details and edges of image as much as possible. The probability density function of the noise used in this paper is given below:

Salt & Pepper Noise: These are dark pixels on light background and bright pixels on dark background. It is also called as impulse noise whose probability density function is given:

p(z) = P_x , for z=x

p(z) = P_y , for z=y

p(z) = 0 , Otherwise

If y>x, gray level y will appear as light dot in the image else x will appear as dark dot.

Gaussian Noise: These are randomly distributed normal noise expressed as:

$$P(z) = {}^{1}\!/_{\sqrt{2\pi\sigma}}\,\pi e^{\frac{-(z-\mu)^2}{2\sigma^2}} \quad .....(1)$$

Where z is gray level, μ is mean of z, σ is standard deviation, σ^2 is called variance of z.

Speckle Noise (SPKN): The distribution noise is given as:

J=I + n*I …… (2)

Where J is the distribution speckle noise image, I is the input image and n is the uniform noise image.

In this paper, noise removal is done using both standard median filtering and Adaptive median filtering. The Adaptive Median Filter is used to eliminate the problems faced with the standard median filter. The basic difference between the two filters is that, in the Adaptive Median Filter, the size of the window surrounding each pixel is variable. This variation depends on the median of the pixels in the present window. If the median value is an impulse, then the size of the window is expanded. Otherwise, further processing is done on the part of the image within the current window specifications. 'Processing' the image basically entails the following: The center pixel of the window is evaluated to verify whether it is an impulse or not. If it is an impulse, then the new value of that pixel in the filtered image will be the median value of the pixels in that window. If, however, the center pixel is not an impulse, then the value of the center pixel is retained in the filtered image. Thus, unless the pixel being considered is an impulse, the gray-scale value of the pixel in the filtered image is the same as that of the input image. Thus, the Adaptive Median Filter solves the dual purpose of removing the impulse noise from the image and reducing distortion in the image. Adaptive Median Filtering can handle the filtering operation of an image corrupted with impulse noise of probability greater than 0.2. This filter also smoothens out other types of noise, thus, giving a much better output image than the standard median filter.

The remainder of this paper is organized as follows: Section 2 gives the overview of the related works. Section 3 describes the implementation of the algorithm. Results are analyzed in section 4. Section 5 contains the concluding remarks and future enhancement.

1. Overview of related works

Over the last few years there has been innumerable research carried on median filters for removal of salt and pepper noise from the images, by various authors [3,4,5]. The success of median filters can be attributed to two intrinsic properties: edge preservation and efficient noise attenuation with robustness against impulsive type noise. Adaptive median filter proved better than a standard median filter, but owing to its increasing window size lead to blurring of images [4]. Switched median filters [5,6] were proposed. But these filters do not have a strong decision or does not consider the local statistics. To elude the flaw, Decision based filter [7] was proposed. This filter identifies the processed pixel as noisy, if the pixel value is either 0 or 255; else it is considered as noiseless pixel. Under High noisy environment the DBA filter replaces the noisy pixel with neighborhood pixel. To modified median filter the concept of median deviation is added and used in estimating and removing the noise, and implemented by developing a Graphical User Interface in MATLAB and also implemented using the Spartan 3E Filed Programmable Device [8]. The results are found to be better than earlier methods and also robust in terms of preserving the contrast and fine details of the image even at high noise densities.

A comparative study on three types of noise as Salt & Pepper noise, Gaussian Noise and Speckle noise has been undertaken under six different noise densities varying from 10% to 60% with the use of four filters as Average filter(AF), Adaptive Median filter(AMF), Standard Median filter(SMF) and Alpha Trimmed Mean filter (ATMF) in [9]. Improved Impulse noise Detector (IID) for Adaptive Switching Median (ASWM) filter is presented in [10]. The idea behind the improved impulse noise detection scheme is based on normalized absolute difference within the filtering window, and then removing the detected impulse noise in corrupted images by using ASWM filter. This detection scheme distinguishes the noisy and noise-free pixels efficiently. A ROAD (Rank Order Absolute Difference) statistics in adaptive median filter is introduced to identify the noisy pixels in image corrupted with salt & pepper noise [11]. ROAD statistics values quantify how different in intensity the particular pixels are from their most similar neighbors. After identify the presence of impulse noise, adaptive window filtering concept is used to filter the salt & pepper noise.

IMPLEMENTATION

The adaptive filter works on a rectangular region $S_{x,y}$. The adaptive median filter changes the size of $S_{x,y}$, during the filtering operation depending on certain criteria as listed below. The output of the filter is a single value which then replaces the current pixel value at (x, y), the point on which $S_{x,y}$ is centered at the time. The following notation is adapted from the [1] and is reintroduced here:

Z_{min} = Minimum gray level value in $S_{x,y}$

Z_{max} = Maximum gray level value in $S_{x,y}$

Z_{med}= Median of gray levels in $S_{x,y}$

$Z_{x,y}$= gray level at coordinates (x, y)

S_{max}= Maximum allowed size of $S_{x,y}$

The adaptive median filter works in two levels denoted Level A and Level B as follows:

Level A:

A1= Z_{med} - Z_{min}

A2= Z_{med} - Z_{max}

If A1 > 0 AND A2 < 0, Go to level B

Else increase the window size

If window size <= S_{max}repeat level A

Else output $Z_{x,y}$

Level B:

B1 = $Z_{x,y} - Z_{min}$

B2 = $Z_{x,y} - Z_{max}$

If B1 > 0 And B2 < 0 output $Z_{x,y}$

Else output Z_{med}

The algorithm has three main purposes:

(a) To remove 'Salt and Pepper' noise.

(b) To smoothen any non-impulsive noise.

(c) To reduce excessive distortions such as too much thinning or thickening of object boundaries.

RESULTS

The adaptive median filter is designed to remove impulsive noise from images. Therefore, our algorithm's performance was first tested with basic salt and pepper noise with a noise density of 0.25. The next test involves processing images that contain impulsive and/or non-impulsive noise. It is well known that the median filter does not provide sufficient smoothening of non-impulsive noise. Therefore, Gaussian and 'salt and pepper' noise were added to the image which was then processed by the algorithm. The adaptive median filter does a fairly good job of smoothening the image out in the presence of non-impulsive noise.

The image used here is tested for all three noises. Firstly it is processed for salt n pepper noise (fig 1(a)), the results of standard and adaptive median filter are shown in figure 1(b) & (c) respectively. Figure 2(a) show the image corrupted by Gaussian noise and results of standard and adaptive median filter are shown in figure 2(b) & (c) respectively. Figure 3 shows the image corrupted by Speckle noise and output of standard and adaptive filter.

Figure1 (a): Image corrupted by salt n pepper noise

Figure1 (b): Output of standard median filter

Figure 1(c): Output of adaptive median filter

Figure1: Processing of salt n pepper noise

Figure 2(c):Output of adaptive median filter

Figure2: Processing of Gaussian noise

Figure2 (a): Image corrupted by Gaussian noise

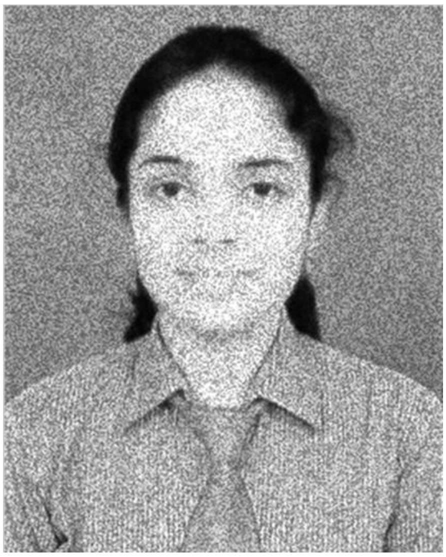

Figure 3(a): Image corrupted by Speckle noise

Figure 2(b): Output of standard median filter

Figure 3(b): Output of standard median filter

Figure 3(c): Output of adaptive median filter

Figure3: Processing of Speckle noise

CONCLUSION

We have implemented the above-mentioned adaptive median filter in Matlab. Our inputs include deciding the initial size of the window, the maximum allowable size of the window for a particular pixel etc. For example, for pixels located near the edge of the image, we would be devising a method for determining the maximum window size, the pixels that would make up the window beyond the image dimensions etc.

The adaptive median filter successfully removes impulsive noise from images. It does a reasonably good job of smoothening images that contain non-impulsive noise. Overall, the performance is as expected and the successful implementation of the adaptive median filter is presented.

REFERENCES

[1] Adaptive median filters: new algorithms and results
Hwang, H., Haddad, R.A., Image Processing, IEEE Transactions on, Volume: 4 Issue: 4.

[2] Selective removal of impulse noise based on homogeneity level information GoucholPok; Jyh-Charn Liu; Nair, A.S.; Image Processing, IEEE Transactions on , Volume: 12 Issue: 1, Jan. 2003.

[3] Pawan Patidar, Manoj Gupta, Sumit Srivastava and Ashok Kumar Nagawat, Image De-noising by Various Filters for Different Noise‖, International Journal of Computer Applications (0975 –8887), Volume 9– No.4, November 2010.

[4] Shiv Singh, Dr. G.C.Lall, Performance Analysis of Various Impulse Noise Reduction Techniques in Images., International Journal of Advanced Research in Computer Science and Software engineering,Volume 2, Issue 6, June 2012 ISSN: 2277 128X.

[5] Chanchal Srivastava, Saurabh Kumar Mishra, Pallavi Asthana, G. R. Mishra, O.P. Singh, Performance Comparison of Various Filters and Wavelet Transform for Image De-Noising‖, IOSR Journal of Computer Engineering, e-ISSN: 2278-0661, p- ISSN: 2278-8727Volume 10, Issue 1 (Mar. - Apr. 2013), PP 55-63.

[6] Neenu Raju, V. Karunakaran, • \An Efficient Method for Removing Impulse Noise From The Image., International Journal of Computer Science and Management Research, Vol 2 Issue 3 March 2013.

[7] Hadi Sadoghi Yazdi, Faranak Homayouni, Impulsive Noise Suppression of Images Using Adaptive Median Filter‖, International Journal of Signal Processing, Image Processing and Pattern Recognition, Vol. 3, No. 3, September, 2010.

[8] Dr. M.Anand, Y. Narasimha Murthy, "Removal of Salt and Pepper Noise fromhighly Corrupted Images using Mean Deviation statistical parameter", International Journal on Computer Science and Engineering (IJCSE), ISSN : 0975-3397.

[9] R. Srinivas, Satarupa Panda, "Performance Analysis of Various Filters for Image Noise Removal in Different Noise Environment", International Journal of Advanced Computer Research, ISSN (online): 2277-7970), Volume-3 Number-4 Issue-13 December-2013.

[10] Irphan Ali Shaik et.al. , "Impulse Noise Detection and Filtering Based On Adaptive Weighted Median Filter", International

Journal of Engineering and Science, ISBN: 2319-6483, ISSN: 2278-4721, Vol. 1, Issue 8 (November 2012), PP 49-54.
[11] Sukhwinder Singh, Dr. Neelam Rup Prakash, "Modified Adaptive Median Filter forSalt & Pepper Noise", International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 1, January 2014.

Author Profile

Swati Singhal received her B.Tech. Degree from Gautam Buddha Technical University, India, in 2011. And she is currently working toward the M.Eng. Degree in Communication, Control andNetworking from Madhav Institute of Science and Technology, India. Her research interest includes the rectification of images degraded by various factors such as noise, illumination variation, shadow, haze , fog, etc.

Dr. Vandana V. Thakare received the B.Tech. Degree from Rani Durgawati University, India in 1999. She received her M.Eng. Degree and Ph.D. Degree from Rajeev Gandhi ProdyogikVishwavidhyalaya, India, in 2003 and 2011, respectively. She has been into technical teaching for 14 years in the field of Electronics and Communication. She has received National ISTE best women Engineer teacher award in 2011. Her research field includes Microwave Engineering.