ADAPTIVE TECHNIQUES BASED HIGH IMPULSIVE NOISE DETECTION AND REDUCTION OF A DIGITAL IMAGE

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ABSTRACT

As reducing impulse noise in a digital image is a very active research area in image processing, this paper proposes a novel algorithm for digital image impulsive noise detection and reduction based on adaptive nonlinear techniques which seems to be a boom in digital image restoration process. The main objective of this algorithm is to consider a particular digital image as input and make the preprocessing to remove the impulsive noise content by employing suitable adaptive nonlinear filter after identifying the impulsive noise of overall image. The proposed algorithm consists of two parts. First, identifying the type of noise present in the image as additive, multiplicative or impulsive by analysis of local histograms and secondly, denoising the detected impulsive noise by employing adaptive nonlinear filtering technique which comprises a process of adaptive noise identification of a corrupt pixel and filtering it by employing adaptive nonlinear filter. In this paper, a new adaptive noise identification and adaptive nonlinear filtering algorithm is described to detect and remove the impulsive noise. Noise present in the digital image should be removed in such a way that the important information of image should be preserved. A decision based nonlinear algorithm for elimination of impulsive noise in digital images has been described in this paper. In order to improve the performances of classical median filter, an adaptive nonlinear filter is proposed and results obtained have been compared. The proposed algorithm has been simulated on MATLAB GUI. A simulation result shows that the proposed algorithm effectively identifies and removes the high impulsive noise by preserving image originality compare to standard median filter.

Keywords: *Impulsive noise, additive noise, multiplicative noise, adaptive noise identification, adaptive nonlinear filter.*

1. INTRODUCTION

Image processing is a field that continues to grow, with new applications being developed at an ever-increasing pace. It is a fascinating and exciting area to be involved in today with application areas ranging from the entertainment industry to the space program. One of the most interesting aspects of this information revolution is the ability to send and receive complex data that transcends ordinary written text. Visual information, transmitted in the form of digital images, has become a major method of communication for the 21st century.

Noise modeling in images is greatly affected by capturing instruments, data transmission media, image quantization and discrete sources of radiation. Different algorithms are used depending on the noise model. Most of the natural images are assumed to have additive random noise, which is modeled as a Gaussian.

Automated techniques for identification of image noise are of considerable interest, because once the type of noise is identified from the given image, an appropriate algorithm can then be used to de-noise it. Only a few researchers have addressed this issue to date. However, algorithms proposed in [1] are pretty complicated, because their main goal is to estimate the statistical parameters of the noise. In this paper, a comparison of two simple techniques for identification of the type of noise present in an image is proposed. It may be pointed out that de-noising often constitutes a first step that is followed by other automated image processing operations that analyze the image and extract useful features from it. The performance of the follow-up operation is often adversely affected due to poor de-noising results obtained in the first step. Since poor de-noising often results from poor noise identification, a better noise identification technique is always preferred.

It is possible to identify the nature of the noise by recoding variations of local statistics computed in the homogeneous regions of the observed image. If the recording is parallel to the average axis, then the noise is declared as an additive one and its standard deviation is equal to the sampling average of the different values of the local standard deviation. If the recording can be assimilated by a line passing through zero, then the noise is declared as a multiplicative one and its standard deviation is given by the slope of the line. Finally, if the recording cannot be viewed as a line passing through zero, then the noise is declared as an impulsive one.

It is well known that linear filters are not quite effective in the presence of impulsive noise. In the last decade, it has been shown that nonlinear digital filters can overcome some of the limitations of linear digital filters. Median filters are a class of nonlinear filters and have produced good results where linear filters generally fail [4]. Median filters are known to remove impulse noise and preserve edges. There are a wide variety of median filters in the literature. In remote sensing, artifacts such as strip lines, drop lines, blotches, band missing occur along with impulse noise. Standard median filters reported in the literature do not address these artifacts. Impulse noise appears when disturbing microwave energies are present or the sensor is degraded. Band missing [5] is a serious problem and is caused by corruption of two or more strip lines continuously. For removal of these artifacts, generally separate methods are employed. Strip lines and drop lines are considered as line scratches by Silva and Corte-Real [6] for image sequences. Kokaram [7] has given a method for removal of scratches and restoration of missing data in the image sequences based on temporal filtering. Additionally, impulse noise is a standard type of degradation in remotely sensed images. This paper considers application of median based algorithms for removal of impulses while preserving edges. It has been shown recently that an adaptive length algorithm provides a better solution for removal of impulse noise with better edge and fine detail preservation. Several adaptive algorithms [8–15] are available for removal of impulse noises. However, none of these algorithms addressed the problem of noise type identification and filtering of highly corrupted impulsive noise like strip lines, drop lines, band missing, and blotches in concert.

The objective of this paper is to propose an adaptive length median algorithm that can simultaneously remove impulses after identifying the impulsive noise by preserving edges. The advantage of the proposed algorithm is that a single algorithm with improved performance can replace several independent algorithms required for noise type identification and removal of high density impulsive noise of a digital image.

The proposed paper has been organized in the following manner; section 2 describes image noise models, section 3 proposes the concept of noise type identification description, section 4 describes adaptive noise identification of a noisy pixel, section 5 proposes the concept of adaptive nonlinear filtering technique description, section 6 describes the step by step execution methodology of implementation of proposed algorithm, subsequently section 7 describes simulation and the discussions of results obtained for the proposed method, section 8 gives concluding remarks and final section incorporates all the references been made for completion of this work.

2. DIGITAL IMAGE NOISE MODELS

The image noise is unwanted information. The variation is generally referred to as noise. Noise is an important defect in the image that can take many different forms and arises from various sources such as heat generated might free electrons from the image sensors itself, thus contaminating the "true" photoelectrons. Noise is a disturbance that affects a signal and may distort the information carried by the signal. Image noise can also be originated due to the electronic noise in the sensors in the digital cameras or scanner circuitry. Many types of noises exist today. These are mainly classified and modeled as follows:

2.1 Additive Noise

The additive noise is caused primarily by Johnson–Nyquist noise (thermal noise), including that which comes from the reset noise of capacitors ("kTC noise"). This Johnson–Nyquist noise is a fundamental noise source which depends only upon the temperature and resistance of the resistor, and is predicted by the fluctuation–dissipation theorem. Thermal noise is a random fluctuations present in all electronic systems. Amplifier noise is a major part of the "read noise" of an image sensor, that is, of the constant noise level in dark areas of the image. The mathematical model given for this type of noise is:

$$f(i, j) = y(i, j)+w(i, j) \; ; \quad \text{where } 1\leq i\leq M,\ 1\leq j\leq N \qquad (1)$$

2.2 Multiplicative Noise

This kind of noise is also called as the speckled noise. This noise gives a 'magnified' view of the original image. For example, in an image where there is high pixel intensities or a bright area. When this noise is applied it presents a magnified view of the area and there is a higher random variation observed. On the other hand, when this noise is applied to a darker region in the image, the random variation observed is not that much as compared to that observed in the brighter areas. Thus, this type of noise is signal dependent and distorts the image in a big way. The mathematical model for this type of noise is:

$$f(i, j)=y(i, j)w(i, j) ; \quad \text{where } 1\leq i\leq M,\ 1\leq j\leq N \quad (2)$$

2.3 Impulsive Noise

Impulsive noise is sometimes called as salt-and-pepper noise or spike noise. This kind of noise is a form of noise typically seen on images. It represents itself as randomly occurring white and black pixels. An image containing this type of noise will have dark pixels in bright regions and bright pixels in dark regions. This type of noise can be caused by dead pixels, analog-to-digital converter errors, bit errors in transmission, etc.

3. NOISE TYPE IDENTIFICATION USING LOCAL HISTOGRAMS

Noise identification using Local Histograms method consists of roughly segmenting and labeling the noisy image. The image of labels is then used for the selection of homogeneous regions. This is a new way of identifying homogenous regions. The noise type identification is accomplished by first roughly segmenting the noisy image using a multithresholding technique. The multithresholding technique mentioned in [2] is used for the analyses the histogram and finally extracts the valleys required as threshold value for segmentation. The basis of histogram analysis approach is that the regions of interest tend to form modes which are dominating peaks those represent regions in the corresponding histogram. A typical histogram analysis employed for noise type identification of digital images generally comprises following steps.

Step1: Recognize the dominant modes of the histogram.

Step2: Find the valleys between different modes.

Step3: Apply the extracted thresholds to the image for segmentation.

After segmenting the image, regions with similar configuration dynamics and similarity are given the same label. The second stage merges the regions, which present similar brightness, and allocates to them the same label. In order to identify the nature of the noise, the approach suggests to construct a window around each pixel in the image of size m*m. In this approach, all the pixels in the window having the same label constitute a homogeneous region. In order to identify the type of noise affecting the image, the behavior of the dynamics of the grey levels of the M local homogeneous regions are studied. Each of the M local homogeneous regions consists of at least 128 pixels. This value varies from image to image based on its size. The identification criterion is carried out in two stages. In the first stage, a criterion is used to detect the presence of the impulsive noise. If the result is negative, then the image is submitted to second criterion in order to identify either the additive or multiplicative nature of the noise.

3.1 Detection of Impulsive Noise

If the ratio of the mean of the dynamics of the grey levels of the homogeneous regions to the maximum value of the dynamics of the grey levels of the homogeneous regions is greater than a threshold value than the noise affecting the image is declared to be an impulsive noise.

$$(mean(D(n))/max(D(n)))>\lambda \quad (3)$$

3.2 Detection of additive or multiplicative noise

Histograms of the different labels given to the image are constructed and the dynamics of these histograms are computed. If the evolution of the dynamic fluctuates around a constant value, then it is declared as additive noise. If the dynamic fluctuates around a line passing through zero then it is declared as multiplicative noise. The decision criterion [5] is based on a mathematical formulation which is as specified below

$$(A/B)>(C/D) \quad (4)$$

The above equation denotes that the fraction A/B should be less than C/D if it has to be an additive noise or else it is designated as multiplicative noise. In the above equation B corresponds to the average of the of the estimated local standard deviation and A corresponds to the dispersion factor of A. whereas D corresponds to the average of the relationship between the local standard deviation and the local average and C corresponds to the dispersion factor associated with D.

3.3 Estimation of Noise standard deviation

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Estimation of the standard deviation is done by considering only regions in the window for each pixel having the frequent label. The mean and variance are found for all the regions for each pixel and then standard deviation is calculated. For the additive noise, the average of the square root of the variance identified for each of the homogeneous region in the noisy image gives you the estimate of the standard deviation of the additive noise affecting the image. For the multiplicative noise, the variance increases with an increase in mean value in a parabolic manner. So the standard deviation is estimated a little different. The standard deviation is found for each of the homogeneous region and it is divided by the corresponding mean of the homogeneous region to get a corresponding value. This corresponding value is got for all the homogeneous regions present in the noisy image. The average of all the values thus got constitutes the estimated standard deviation of the multiplicative noise.

4. ADAPTIVE NOISE IDENTIFICATION OF A NOISY PIXEL

To distinguish the edge of the image and noise pixel of the window is analyzed. The centre pixel is uncorrupt if the gray values of the centre pixel and its adjacent pixels are near most. That is, the absolute gray values difference between centre pixel and its adjacent pixel are more than the value of any threshold. The centre pixel is in the edge if the gray values of the centre pixel and four of its adjacent pixels are near, and the gray values difference between other four distinct pixels and centre pixel are large. That is, the absolute gray values difference between centre pixel and its adjacent pixels are more than the value of the threshold is about four. The centre pixel is noise pixel, even if there is one or two noise pixels adjacent to the centre pixel, the absolute values of the difference of them are more than the threshold value is greater than or equal to six. Based on the above assumption, a noise image can be divided into three parts which are impulse noise pixel, image edge signal pixel and smooth area signal pixel.

4.1 Determination of Adaptive Threshold

To identify the impulse noise, the adaptive threshold has to be determined. The threshold value is determined from each noisy image to obtain the more precise result. Consider, for simplicity, the difference vector of 3x3 window as

$$P = \left\{ \left| x - x_k \right| \right\};\ k = 1\ to\ 8 \tag{5}$$

Then the mean and variance can be determined as follows;

$$\mu = \frac{1}{m \cdot n} \sum_{i=1}^{m} \sum_{j=1}^{n} \delta(i, j) \tag{6}$$

$$\sigma^2 = \frac{1}{m \cdot n} \sum_{i=1}^{m} \sum_{j=1}^{n} \left(\delta(i, j) - \mu \right)^2 \tag{7}$$

Where $\delta(i, j) = \frac{1}{8} \sum_{k=1}^{8} P(k)$ (8)

Then the threshold value is given by

$$\tau = \mu + \sigma \tag{9}$$

5. ADAPTIVE NONLINEAR FILTER FOR IMPULSIVE NOISE REDUCTION

An adaptive nonlinear filter does a better job of denoising images compared to the linear filter. The fundamental difference between the linear filter and the adaptive nonlinear filter lies in the fact that the weight matrix varies after each iteration in the adaptive filter while it remains constant throughout the iterations in the linear filter. Adaptive nonlinear filters are capable of denoising non-stationary images, that is, images that have abrupt changes in intensity. Such filters are known for their ability in automatically tracking an unknown circumstance or when a signal is variable with little a priori knowledge about the signal to be processed [17]. In general, an adaptive filter iteratively adjusts its parameters during scanning the image to match the image generating mechanism. This mechanism is more significant in practical images, which tend to be non-stationary.

A median filter belongs to the class of nonlinear filters unlike the mean filter. The median filter also follows the moving window principle similar to the mean filter. A 3× 3, 5× 5 or 7× 7 kernel of pixels is scanned over pixel matrix of the entire image. The median of the pixel values in the window is computed, and the center pixel of the window is replaced with the computed median. Median filtering is done by, first sorting all the pixel values from the surrounding neighborhood into numerical order and then replacing the pixel being considered with the middle pixel value. Note that the median value must be written to a separate array or buffer so that the results are not corrupted as the process is performed. The ideology of median filter can be advanced as an adaptive nonlinear filter which can be applied for the removal of all the range of impulsive noise of the digital images.

6. IMPLEMENTATION OF PROPOSED ALGORITM

In this research paper a novel approach to identify the noise type and filtering high impulsive noise by developing an adaptive nonlinear filter is proposed. The algorithm implemented to achieve the proposed task comprises the following steps:

Step1: Perform image segmentation by using multi-thresholding technique.

Step2: Find the set of points corresponding to the local maximums of the histogram.

$$P_0 = \{i, h(i) \mid h(i) > h(i-1) \& h(i) > h(i+1)\} \qquad (10)$$

Step3: Consider local neighborhood of consecutive three bins of histogram and find maximum frequency value.

$$P_1 = \{P_i, h(P_i)) \mid h(P_i)>h(P_i-1) \& h(P_i)>h(P_i+1)\ P_i \in P_0\} \qquad (11)$$

Step4: If a peak is too small compared to the biggest peak, then it is removed.

Find y_{max}; if $y_i/y_{max}<0.02$ then remove y_i

Step5: Choose one peak if two peaks are too close.

$$h(P_1)\ \&\ h(P_2)\ ,\ P_2>P_1\ ,\ P_2-P_1<10 \qquad (12)$$

$$h = max\{h(P_1), h(P_2)\} \qquad (13)$$

Step6: Ignore a peak if the valley between two peaks is not obvious.

$$Havg=sum\ (counts(P_1:P_2))/(P_2-P_1+1) \qquad (14)$$

Step7: Extract valleys as thresholds.

Step8: Perform labeling of image for selection of homo- geneous regions.

Step9: Apply the window of size m*m for each pixel of the observed image and the image of labels.

Step10: Analyze the dynamics *D(n)* of the grey levels of the M local homogenous regions of the observed image.

Step11: Compute mean and max of dynamics D(n).

Step12: If (mean(D(n))/max(D(n)))>λ then it is an Impulsive noise.

Step13: Else if (A/C)>(B/D) then it is a multiplicative noise.

Step14: Else it is an additive noise.

Step15: If the noise present in the image is impulsive then read pixels of 3x3 moving window of the noisy image.

Step16: Identify the corrupt pixel by using proposed adaptive noise identification technique of a noisy pixel.

Step17: If the central pixel is corrupt then identify the number of corrupt pixels in the window.

Step18: If the numbers of corrupt pixels in the window are less than five then replace the corrupt pixel by the median of the pixels in the widow.

Step19: If the numbers of corrupt pixels in the window are greater than four and less than thirteen then replace the corrupt pixel by the median of the pixels of 5x5 moving window.

Step20: Repeat the steps 15 to 18 for all corrupt pixels of the noisy image. in nature.

7. IMPLEMENTATION OF PROPOSED ALGORITM

To validate the proposed algorithm, a Lena 512 ×512 GIF image is used in the simulation. The proposed algorithm has been implemented on MATLAB GUI. The results of the simulation for identification of the noise type are as shown in Fig.1, Fig.2 and Fig.3 for impulsive, multiplicative and additive noises respectively.

NOISE TYPE DETECTION AND ADAPTIVE NONLINEAR FILTERING OF A DIGITAL IMAGE

Mean(D) / Max(D) 2.0035

A 0
B 0
C 0
D 0
A/C 0
B/D 0

THE NOISE DETECTED IN THE IMAGE IS IMPULSIVE NOISE

Figure 1. The input image noise identified as inpulsive one.

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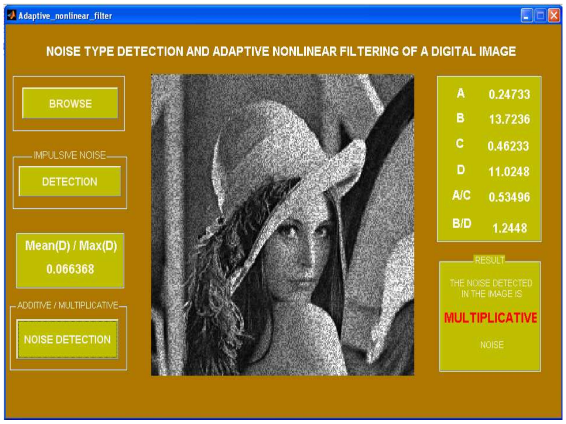


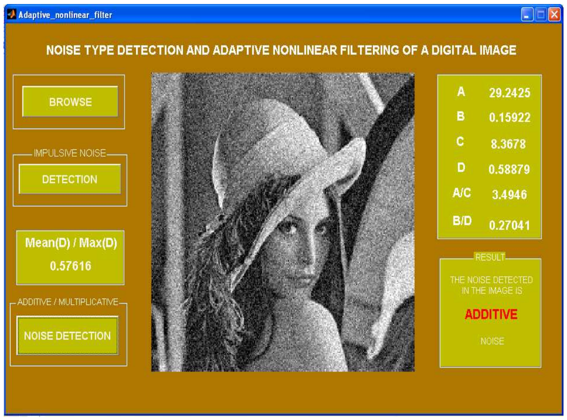
NOISE TYPE DETECTION AND ADAPTIVE NONLINEAR FILTERING OF A DIGITAL IMAGE

Mean(D) / Max(D) 0.066368

A 0.24733
B 13.7236
C 0.46233
D 11.0248
A/C 0.53496
B/D 1.2448

THE NOISE DETECTED IN THE IMAGE IS MULTIPLICATIVE NOISE

Figure 2. The input image noise identified as multiplicative one.



NOISE TYPE DETECTION AND ADAPTIVE NONLINEAR FILTERING OF A DIGITAL IMAGE

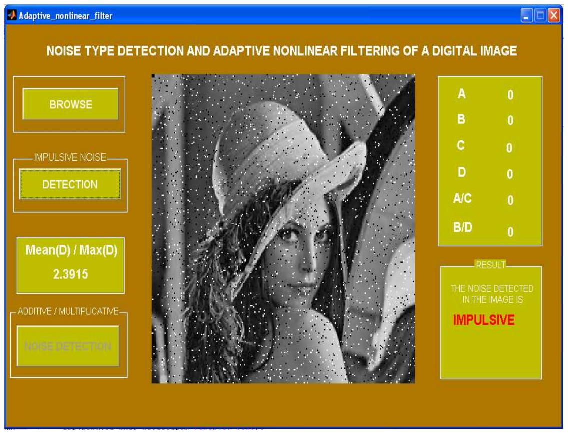
Mean(D) / Max(D) 0.57616

A 29.2425
B 0.15922
C 8.3678
D 0.58879
A/C 3.4946
B/D 0.27041

THE NOISE DETECTED IN THE IMAGE IS ADDITIVE NOISE

Figure 3. The input image noise identified as additive one.

The results of the simulation for identification of the impulsive noise and its removal using the proposed adaptive nonlinear filter are as shown in Fig.4 and Fig.5 respectively. As it could be observed from Fig.5, the proposed adaptive nonlinear filter could restore as well as preserve image edge well.



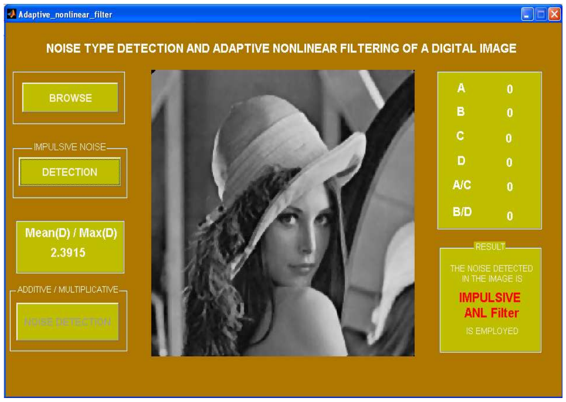
NOISE TYPE DETECTION AND ADAPTIVE NONLINEAR FILTERING OF A DIGITAL IMAGE

Mean(D) / Max(D) 2.3915

A 0
B 0
C 0
D 0
A/C 0
B/D 0

THE NOISE DETECTED IN THE IMAGE IS IMPULSIVE

Figure 4. The input image noise identified as inpulsive so it is fed to proposed adaptive nonlinear fiter



NOISE TYPE DETECTION AND ADAPTIVE NONLINEAR FILTERING OF A DIGITAL IMAGE

Mean(D) / Max(D) 2.3915

A 0
B 0
C 0
D 0
A/C 0
B/D 0

THE NOISE DETECTED IN THE IMAGE IS IMPULSIVE ANL Filter IS EMPLOYED

Figure 5. The filtered out put of proposed adaptive nonlinear (ANL) fiter for the identified impulsive noise image

In addition, 512 × 512 Lena gray image has been employed to add 10% to 80% impulsive noise with an incremental interval of 10% is used to denoised by standard median filter and proposed Adaptive Nonlinear (ANL) filter respectively. After smoothing by using above methods, peak signal-to-noise ratio (PSNR) and mean absolute error (MAE) are used for analysis.

$$PSNR = 10\log_{10} \frac{255^2}{\frac{1}{m \cdot n}\sum_{i=1}^{m}\sum_{j=1}^{n}\left(I(i,j) - I_o(i,j)\right)^2} \qquad (18)$$

$$MAE = \frac{1}{m \cdot n}\sum_{i=1}^{m}\sum_{j=1}^{n}\left|I(i,j) - I_o(i,j)\right| \qquad (19)$$

Where I(i,j) and $I_o(i,j)$ are the pixel values of restored and original images respectively at the location (i, j). Fig.6 and Fig.7 shows the plots of PSNR and MAE of standard median filter and proposed Adaptive Nonlinear filter with various noise levels. As it could be observed in fig.6, if the noise is too bad, the proposed denoises very well and its PSNR is approximately far higher than standard median filter. Hence the proposed filter successfully preserves details in the image as well as at the same time efficiently removes the high impulsive noise which is present in the digital noisy image.

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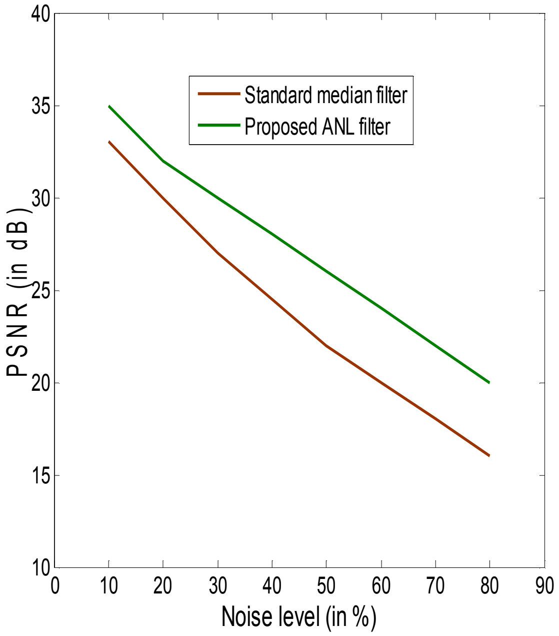

Figure 6. Response of PSNR for the Lena image at various noise level

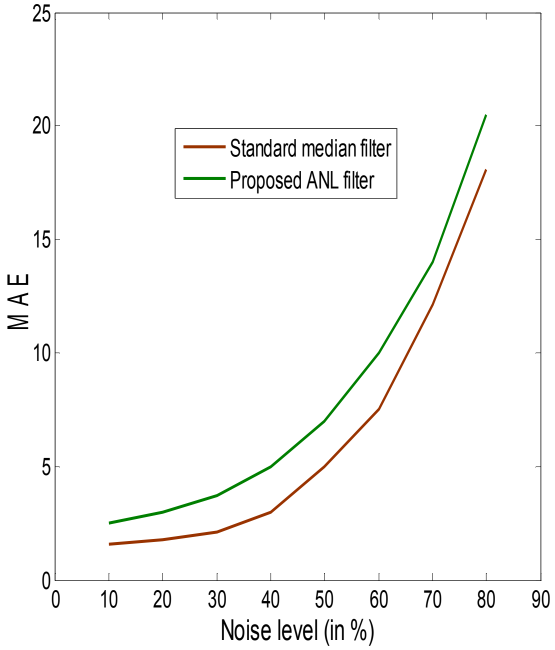

Figure 7. Response of MAE for the Lena image at various noise level

REFRENCES:

[1] L. Beaurepaire, K. Chehdi, and B. Vozel, "Identification of the nature of noise and estimation of its statistical parameters by analysis of local histograms," *Proc. 1997 IEEE International Conference on Acoustics, Speech and Signal Processing,* Vol. 4, pp. 2805-2808.

[2] Soumya Dutta, Bidyut B. Chaudhuri, "Homogenous Region based Color Image Segmentation," Proceedings of the world Congress on Engineering and computer Science 2009 Vol II WCECS 2009, October 20-22, 2009, San Francisco, USA.

[3] K.Chehdi. "Automatic Identification of noises for an Optimal Filtering," *Proceedings IEEE CCSP 93*, pages 474-477 March 1993.

[4] I. Pitas and A. N. Venetsanopoulos, "Nonlinear Digital Filters: Principles and Applications", *Kluwer Academic Publishers,* Boston, Mass, USA, 1990.

[5] S. M. Shahrokhy, "Visual and statistical quality assessment and improvement of remotely sensed images," *Proceedings of the 20th Congress of the International Society for Photogrammetry and Remote Sensing (ISPRS '04),* pp.1–5, Istanbul, Turkey, July 2004.

[6] A.U. Silva and L. Corte-Real, "Removal of blotches and line scratches from film and video sequences using a digital restoration chain," *Proceedings of the IEEE-EURASIP Workshop on Nonlinear Signal and Image Processing (NSIP '99),* pp. 826–829, Antalya, Turkey, June 1999.

[7] A. Kokaram, "Detection and removal of line scratches in degraded motion picture sequences," *Proceedings of the 8th European Signal Processing Conference (EUSIPCO '96),* vol. 1, pp. 5–8, Trieste, Italy, September 1996.

[8] H. M. Lin and A. N. Willson, Jr., "Median filters with adaptive length," *IEEE Transactions on Circuits and Systems,* vol. 35, no. 6, pp. 675–690, 1988.

[9] H. Hwang and R. A. Haddad, "Adaptive median filters: new algorithms and results," Transactions on Image Processing, vol. 4, no. 4, pp. 499–502, 1995.

[10] T. Chen and H. R. Wu, "Adaptive impulse detection using center weighted median filters," *IEEE Signal Processing Letters*, vol. 8, no. 1, pp. 1–3, 2001.

[11] W. Luo, "An efficient detail preserving approach for removing impulse noise in images," *IEEE Signal Processing Letters,* vol. 13, no. 7, pp.413–416, 2006.

[12] K. S. Srinivasan and D. Ebenezer, "A new fast and efficient decisionbased algorithm for

removal of high-density impulse noises," *IEEE Signal Processing Letters,* vol. 14, no. 3, pp. 189–192, 2007.

[13] D. A. F. Florencio and R. W. Schafer, "Decision-based median filter using local signal statistics", *Visual Communications and Image Processing '94,* vol. 2308 of Proceedings of SPIE, pp. 268–275, Chicago, Ill, USA, September 1994.

[14] J. N. Lin, X. Nie, and R. Unbehauen, "Two-Dimensional LMS Adaptive Filter Incorporating a Local-Mean Estimator for Image Processing," *IEEE Transactions on Circuits and Systems-II: Analog and Digital Signal Processing*, Vol 40, No.7, pp. 417-428, July 1993.

[15] G. Panda, B. Majhi, P. K. Dash, "Development of Efficient Filtering Techniques for Image Data Corrupted by Impulse Noise", *The Journal of the Computer Society of India*, vol. 30 no.1, pp.25-33, March 2000

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