

An improvement in noise suppression from images using local thresholding based efficient weighted average filtering (LT-EWA) in image processing

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Abstract

In this paper, we are using a filtering method for image sequence degraded by median filtering. In general, for the image sequence filtering, discrete wavelet compression (DWC) and EWA (efficient weighted average method) is required in order to obtain good compression performance both in the still and moving regions of image sequence. In this paper we propose a hybrid method which is detection phase where a modified Local thresholding weighted-average filter in outer boundary impulsive counter (LT-EWA) is used to detect impulse noise pixels and also consider the SSIM technique to improve peak signal noise ratio (PSNR) for pixel similarity index assignment and compared with base author technique (EWA) using MATLAB 2014Ra.

Keywords: DWC, LT-EWA, noise suppression etc.

1. Introduction

The degraded image sequence is restored by additive noise is very efficient not only for improving image quality but also for a preprocessing of image coding or computer-vision, and so on^[1, 2]. Images are often corrupted motivation obtaining and transmission. In this method, an effective commotion concealment technique is required before consequent picture handling operations. Numerous current techniques initially identify the undermined pixels and afterward reestablish them without influencing the uncorrupted pixels. Different answers for evaluating the force of boisterous pixels can be separated into four classifications of median based channels^[12], fluffy based calculations, ad-hoc thoughts and weighted-normal channels. The majority of drive commotion evacuation calculations are varieties of middle sifting. Best cases are Decision Based Algorithm (DBA), Median based Switching channel^[3], and Decision Based Unsymmetrical Modified Trimmed Median Filter^[4]. Additionally, because of the way of motivation clamor, a few strategies are proposed in view of fluffy rationales, for example, Detail Preserving Filter (DPF), Noise Adaptive Fuzzy Switching Median (NAFSM) channel and Turbulent Particle swarm advancement based Fuzzy Filtering^[13] (TPFF). In Specialized Regularization strategy is proposed to reestablish uproarious pixels. Opening Closing Sequence channel is introduced in view of scientific morphology. An algorithm is proposed to preserve edges which is Edge Preserving Algorithm (EPA), which receives a Correlation in a particular direction subordinate sifting system. In Outlyingness Robust Ratio is joined with the Non Local Means to recognize and channel the boisterous pixels. In a strategy is exhibited which utilizes an iterative drive finder and an Adaptive Iterative Mean^[7] channel to evacuate the general settled esteemed motivation clamor. Another outstanding methodology is average weighted shifting, which misuses the relationship among neighboring pixels to reestablish the debased pixels. The Switching based Adaptive Weighted Mean channel and the Cloud^[6] Model channel

utilize this approach for motivation concealment. Both channels adaptively decide the sifting window and utilize complex weighting rules. In SAWM technique, the weights are indicated in view of the level of similarity amongst pixels, and the CM channel utilizes the assurance degrees of uncorrupted pixels as their weights. These channels are time differing; that is they need to perform pixel by pixel reclamation, as opposed to handling the picture all in all. This requirement contradicts effective usage. A two-stage technique is proposed for ongoing motivation commotion concealment. To begin with, we utilize a motivation indicator to distinguish the defiled pixels. It inspects the spatial relationship of suspicious picture pixels to diminish the bogus identification of uncorrupted pixels as defiled. Second, we reestablish the picture utilizing a weighted-normal channel. The channel works on the closest neighboring inserted picture and actualized utilizing framework based operations. Whatever is left of this paper is composed as takes after. The exploratory outcomes and correlations are given in finishes up the letter.

2. Problem statement

The Major problem encountered in digital images are the corruption of images with noise. The noise will degrade the quality of the image, if it is not cleared properly. There are various noise reduction technique is used to remove noise. The challenging issue in the digital image is Impulse Noise for past few decades. This impulse noise causes white and black points within the digital pictures that urgently sprinkled on image space. Many different methods are used for identifying and cancelling impulse noise. Some of the real world application that is based on the images is Medical Field, Social Media, Environmental Monitoring; Security based Recognition and so on. These fields required to have images for analyzing and predicting the output behavior. To solve the given problems we proposed the Local thresholding weighted-average filter in images.

3. Proposed Methodology

Below steps are following sharp edge and replace using proposed local filtering technique below are as:

3.1 Median filtering

It is a non-linear filtering technique that is known for the ability to remove impulsive-type noise, while sharp edges are preserved. It is an order statistics filter. Also Mean filter is used to remove the impulse noise. It replaces the mean of pixel values but it does not preserve details of image. Mean Filter removes some details. The median is obtained 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.

In median filter, the median of pixel value of 8-neighborhood of a point 'p' is replaced by the value of pixel of a point p. The operation of this filter can be expressed as:

$$g(p) = \text{median} \{f(p), \text{ where } p \in N_8(p)\}$$

Fig illustrates an example calculation

123	125	126	130	140
122	124	126	127	135
118	120	150	125	134
119	115	119	123	133
111	116	110	120	130

Fig 1: Pixels of an image

Neighborhood values:

115,119,120,123,124,125,126,127,150.

Median values: 124.

If the impulse noise percentage is less than 0.1%, then median filter gives good result. If the quantity of impulse noise is increased the median filter does not work well. Since edges are minimally degraded, median filters can be applied repeatedly, if necessary. The median filter tends to preserve brightness differences across signal steps, resulting in minimal blurring of regional boundaries. The median filter also tends to preserve the positions of boundaries in an image, making this method useful for both visual examination and measurement. In addition, application of a median filter may be repeated until there are no further changes in the filtered image. Multiple applications of the median filter (with smaller neighborhood masks) can improve noise suppression at the expense of a loss in image detail. With repeated applications of the filter, pasteurization can occur. Normally median filters have not been used for spatial grain-suppression because grain noise is not impulsive. But have found wide application in the suppression of impulsive noise. Median filtering is also used in television applications, for example in the generation of an image sequence with progressive scanning from an interlaced original. Unlike filtering by convolution (linear filtering) non-linear filtering uses neighbouring pixels according to a non-linear law. The median filter (specific case of rank filtering), which is used in this exercise, is a classic example of these filters. Just like the

linear filters, a non-linear filter is performed by using a neighborhood.

3.2 Proposed algorithm Steps

In this thresholding technique, a threshold $T(x, y)$ is calculated for every pixel, based on some local statistics such as range, variance [9], or surface-fitting parameters of the neighborhood pixels within a block of size $w \times w$. Agray scale document image at location (x, y) is considered having intensity $I(x,y)$ In local adaptive thresholding [7, 11] techniques, the purpose is to compute a local threshold $T(x, y)$ for every pixel such that

$$\begin{aligned} \text{If } & I(x, y) > T(x, y) \\ \text{Then } & b(x, y) = 1 \\ \text{Else } & b(x, y) = 0 \end{aligned}$$

Where $b(x, y)$ is the binarized image and $I(x, y) \in [0, 1]$ be the intensity of a pixel at location (x, y) of the image I [11]. Based on some local statistics such as range, variance, or surface-fitting parameters of the neighborhood pixels, a threshold is calculated by using local adaptive technique.

This new technique of binarization is carried out with a local thresholding technique which uses local contrast and mean [8]. It is expressed as below:

$$T(x, y) = k [m(x, y) + (I_{\max} - I_{\min}) (1 - I(x, y))]$$

where $k (0, 1)$ is a bias constant, $m(x, y)$ is local mean, and I_{\max} , I_{\min} are the local maximum and minimum pixel values within the local window of size $w \times w$ and $I(x, y)$ is the concerned pixel value. In this new technique local maximum and local minimum pixel values are associated. As a result of using local minimum and maximum this technique is not suitable for using integral image which is suitable for finding local mean in very less time. Hence it works like the other local techniques whose computational time is local window size dependent. The bias constant k takes a major role to control the level of binarization by influencing the threshold value [8]. The greater value of k will result the greater value of threshold resulting more in foreground (black) and like this less the value of k will result the less in foreground (black). If the local region is uniform i.e. $I_{\max} - I_{\min} \sim 0$, then $T(x, y) \sim k * m(x, y)$. Thus the value of $T(x, y)$ dependent on the value of k . In this case the region becomes background for the other techniques while this technique, $T(x, y)$ is under controlled. This technique gives better results as compared to other local techniques.

Step 1: Read the input image and add Random Valued Impulse Noise to the image.

Step 2: Compute the weighted mean value of the image

$$M(I,J)=$$

$$\sum_{m,n} \frac{Wm, n \quad Xi + m, j + n}{\sum_{m,n} (x+a)^n = \sum_{k=0}^n \binom{n}{k} x^k a^{n-k}} \quad Wm, n$$

Step 3: Weighted standard deviation is calculated using the weighted mean value.

$$\sigma(I,J) = \frac{\sum W_{m,n} (X_{i+m,j+n} - M(i,j))^2}{\sum_{m,n} W_{m,n}}$$

Step 4: Threshold is obtained from the above statistical parameters which is given by $\alpha x(i,j)$, $\alpha=1$

Step 5: Noisy pixel is found when difference between centre pixel and weighted mean exceeds threshold.

Step 6: Binary flag represents as follows:

- 1- Noisy pixel
- 0- Noise free pixel.

Step 7: Compute the median value for noise free pixels

Step 8: Determine absolute difference.

$$D(i,j) = \max\{d(m,n)\}$$

Where $d(m,n) = |x(m,n) - x(i,j)| / 255$, $x(m,n) \in \omega(x)(i,j)$

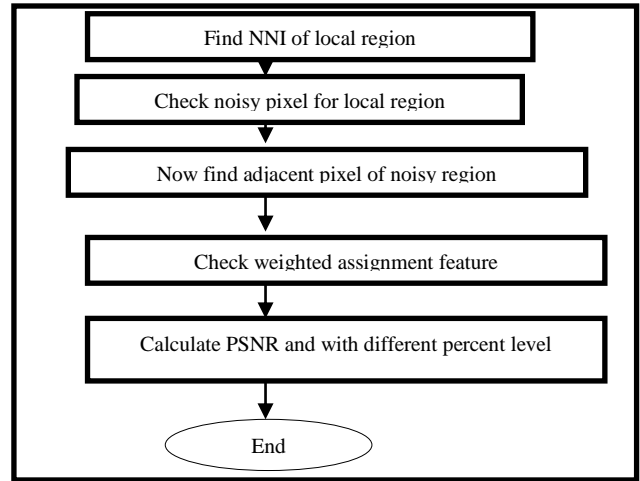
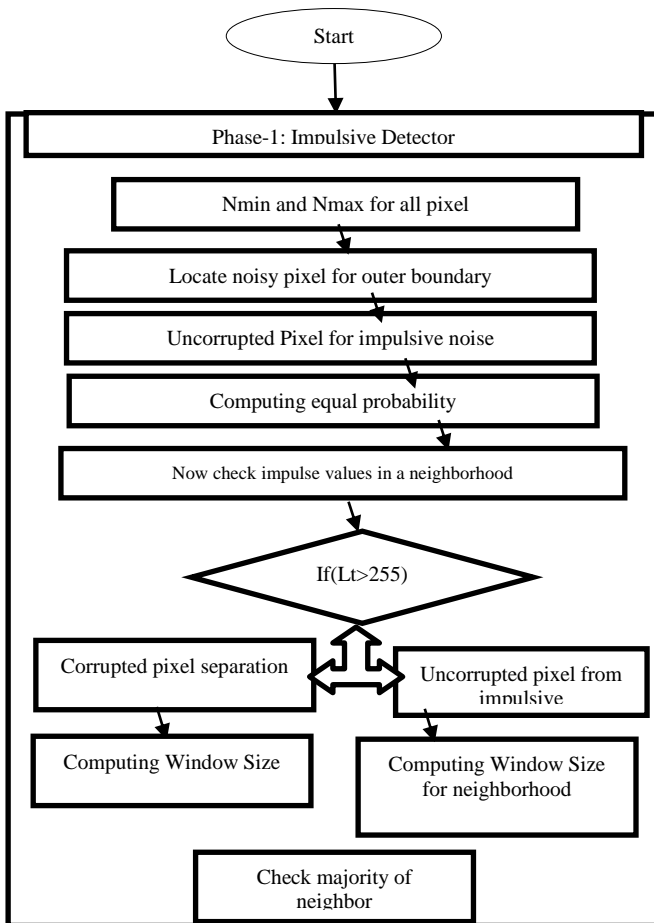
Step 9: Compute the median value $F(i,j)$

$$F(i,j) = 0 \text{ if } D(i,j) < T1$$

$$F(i,j) = 1 \text{ if } D(i,j) \geq \text{or equal to } T2$$

Step 10: Compute the restoration term $y(i,j)$

3.3 Proposed Flow Diagram



4. Result and discussion

A novel hybrid method filtering operator and local thresholding for removing mixed noise from digital images is presented. The fundamental superiority of the proposed operator over most other operators is that it efficiently removes impulse noise from digital images while preserving thin lines and edges in the original image. Extensive simulation results verify its excellent impulse detection and detail preservation abilities by attaining the highest PSNR. Thus rampant loss of image is reduced without exposing image fine details.



Fig 2: Input image

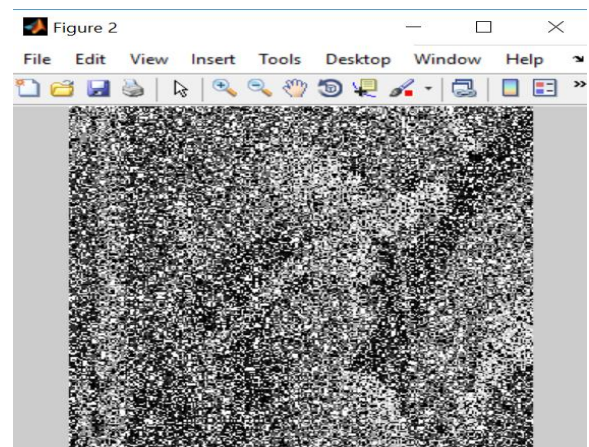


Fig 3: Noisy corrupted image using LT-EWA

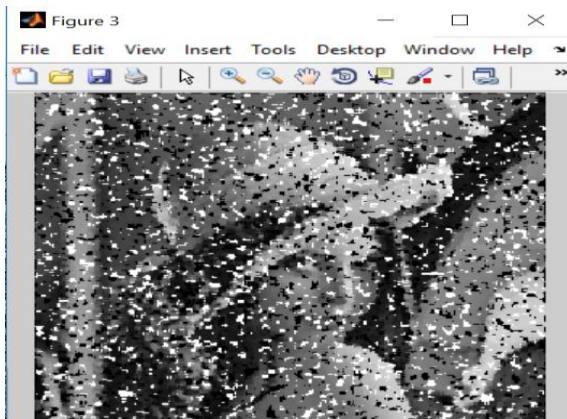


Fig 4: Image using traditional Median filter



Fig 5: Image using EWA



Fig 6: Corrupted Image using Local Thresholding- EWA



Fig 7: Reconstructed Image using LTEWA

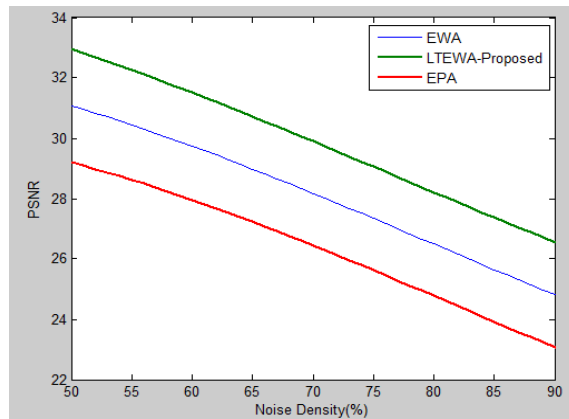


Fig 8: PSNR value over Noise density

In this section we showed the efficiency of the proposed filter through following simulations. The proposed filter extends Median filters to LT-EWA (Local Thresholding- EWA). The results of different methods for restoring images corrupted by EWA with various noise densities. The results demonstrate that the LT-EWA filter performs better than other methods.

We proposed a method for fast impulse noise removal from images. The proposed filter first taken an initial image from the dataset and then filter image using Median technique and also improves it by employing a Local three holding weighted-average filter, which applies different procedures for weighting the known and noisy pixels. Experimental results verify that the proposed method outperforms the best existing methods in both qualitative and quantitative measures [9] and is quite suitable for real-time applications. The performance in terms of PSNR and SSIM. This is achieved at a reasonable computational complexity.

5. Conclusion

In this paper, a new efficient impulse noise removal technique is presented. Extensive computer simulations indicate that it outperforms significantly many other well-known algorithms. The proposed technique (local thresholding Efficient Weighted-Average) can be used to remove impulse noise due to its performance and low complexity. In addition, effective complexity scalability can be realized by exploiting the complexity performance.

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