Image Restoration Using Bi-Orthogonal Wavelet Transform

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Abstract: With the usage of multimedia materials becoming more common from day to day life. Unfortunately, digital images came by through numerous consumer electrical devices products are commonly subjected to the infectivity of impulse disturbance. There are many filters are available although these methods have been improved many times, but the quality of de-noising image is still not providing satisfactory results. Elimination of noise is a necessary and challengeable operation in image processing. To reduce the impulse noise level in digital images we present orthogonal wavelet transform (OWT) based algorithm for image denoising with minimum mean square error (MMSE). Denoising algorithm first phase is used to detect the impulse noise and the second phase which is also called as filtering phase replaces the detected noise pixel, which also includes orthogonal wavelet to deal with uncertainties, is capable of filtering all types of impulse noise. The goal of image de-noising is to estimate the original image from the noisy image.

Keywords: Orthogonal Wavelet, MMSE, PSNR IEF etc.

Introduction:

Whenever an image is converted from one form to another such as digitizing, scanning, transmitting, storing, etc., some of the degradation occurs at the output. Hence, the output image suffers from disturbance. Random value noise significantly degrades the image quality. Due to which some information is lost .This can be dangerous for real time image capturing [1]. Noise Reduction Techniques, Noise removal techniques basically categories into two types: 1) Linear filters 2) Non-linear filters.

Different filters and algorithms that are used for Impulse noise removal. Noise Removal belongs to the image restoration process in digital image processing. The Restoration has been used for filtering noise in X-rays, digital angiographic images, Magnetic Resonance Imaging (MRI) etc [2].

Literature Review:

In [3] J.N. Lin, X. Nie, and R. Unbehauen, introduced Two-Dimensional LMS Adaptive Filter Incorporating a Local-Mean Estimator for Image Processing. The fundamental difference between the mean filter and the adaptive 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 mean filter. Adaptive filters are capable of de-noising non-stationary images. S-J Ko and Y.H. Lee introduced a new filter that is “Center Weighted Median Filter and their application to Image Enhancement” The center weighted median (CWM) [4] filter is a special case of weighted median (WM) filters. This filter gives more weight only to the central pixel of a window and thus it is easy to design and implement. CWM filter preserves more details at the expense of less noise suppression like other non-adaptive detail preserving filters.

Z. Wang and D.Zhang introduced a new method that is –“Progressive switching median filter for removal of impulse noise form highly corrupted image”. This filter is median based filter is median based filter [5]. It consists of two points (i) switching scheme – an impulse detection algorithm is used before filtering; thus only noisy pixels are filtered and (ii) progressive methods – both impulse detection and progressive filtering are applied through several iterations one after the other Hence, it is referred as PSM filter.

A good analysis of the limitations of the top ranking median filters, the Progressive Switching Median Filter, PSMF and the Rank-order based Adaptive Median Filter, RAMF is made and are overcome very effectively by the proposed filter which cleans the impulse corruptions of a digital image in two distinct phases of impulse detection and impulse correction. The detection phase identifies the corrupted pixels into a flag image by a spatial rank ordered approach and the correction phase modifies the corrupted pixels identified in the flag image by a more suitable rank ordered value by considering the neighboring features [6].

Salt & Pepper Impulse Noise Removal using Adaptive Switching Median Filter", An effective median filter for salt & pepper impulse noise removal is presented. This computationally efficient filtering technique is implemented by a two pass algorithm: In the first pass, identification of corrupted pixels that are to be filtered are perfectly detected into a flag image using a variable sized detection window approach; In the second pass, using the detected flag image, the pixels to be modified are identified and corrected by a more suitable median [7].

weighted median filtering algorithm used for image Processing", Aimed at the excellence and shortcoming of the traditional median filtering algorithm, this paper proposes a new adaptive weighted median filtering (AWMF) algorithm. The new algorithm first determines noise points in image through noise detection, then adjusts the size of filtering window adaptively according to number of noise points in window, the pixel points in the filtering window are grouped adaptively by certain rules and gives corresponding weight to each group of pixel points according to similar it, finally the noise detected are filtering treated by means of weighted median filtering algorithm [3].

Cluster-based Adaptive Fuzzy Switching Median (CAFSM), was composed of a cascaded easy-to-implement impulse detector and a detail preserving noise filter. Initially, the impulse detector classifies any possible impulsive noise pixels. Subsequently, the filtering phase replaces the detected noise pixels. In addition, to deal with uncertainties existing in local information The filtering phase employs fuzzy reasoning Contrary to many existing filters that only focus on a particular impulse noise model, the CAFSM filter is capable of filtering all kinds of impulse noise – the random-valued and/or fixed-valued impulse noise models [8].

Removal of high density impulse noise through modified non-linear filter". Various filters were discussed in this paper for removal of noise from gray scale and color images. The values for the comparison of different filters were taken from this paper as a reference. In this method the noisy pixel were replaced by trimmed median value when other pixel were not all 0"s or 255"s. But if the all the pixel value were 0 or 255 then this method increases the window size and then trimmed median value was calculated and noisy pixel were replaced [9].

ISSN 2229-5518

Impulse noise and presented a brief literature review of techniques and architecture that was used for the implementation of the impulse noise filtration. They presented the causes and effects of the impulsive noise and the basic working of the median filter for removing it respectively [10]. An efficient method for noise reduction is that it applies fuzzy logic for removing the impulse noise. Given results from the proposed method was compared to those of median filter and mean filter [11].

Orthogonal Wavelet Transform for Image Denoising:

Orthogonal wavelet transform for image denoising is consist of following steps given below:

1. Select input image from data base.
2. Apply wfilter function on input image which convert it into different sub-band by applying wavelet transform
3. We will select a particular wavelet from wavelet family?
4. Scale spatial denoising using denss function.
5. Using Wfilter on input image we obtained LL,LH, HL and HH
6. Apply Inverse OWT on each HW,WH,WW
7. To compute error by original image and reconstructed image
8. Calculate PSNR and reconstruct image.

Figure 1: Flow chart for image denoising based on orthogonal wavelet transform

Experimental Results:

The image shows de-noising results for lena image is in figure2.1 to 2.9. Figure 2.1 (a) shows the original lena image on which the de-noising operation will be performed. 2.1 (b) shows the lena 10% noisy image on which our proposed method will apply 2.1 (c) shows the de- noised image by lena image. Other Figures 2.1 to 2.9 shows lena different noise density images corrupted impulse noise and de-noised lena images. Figure 2.2 (b) shows image corrupted by 20% noise density and Figure (c) shows image de-noised by the proposed method. Similarly figure 2.3 (b) ,2.4 (b) ,2.5 (b), 2.6(b), 2.7(b), 2.8(b) and 2.9(b) shows lena image corrupted by 30%, 40%,

ISSN 2229-5518

50%, 60%, 70%, 80% and 90% noise density respectively and figure 2.1(c), 2.2(c), 2.3(c) 2.4(c), 2.5(c), 2.6(c), 5.1.7(c) , 2.8(b) and 2.9(b) shows images De-noised by proposing method at 10% to 90% noise density respectively.


2.1(a) Original image


2.1 (b) 10% Noise density

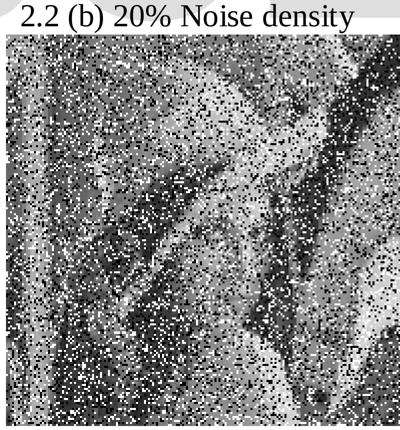

2.1 (c) Denoised image


2.2 (a) Original image


2.2 (b) 20% Noise density


2.2 (c) Denoised image

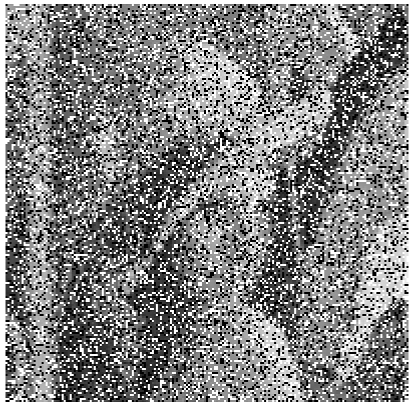

2.3 (a)Original image


2.3 (b) 30% Noise density


2.3 (c) Denoised image

ISSN 2229-5518

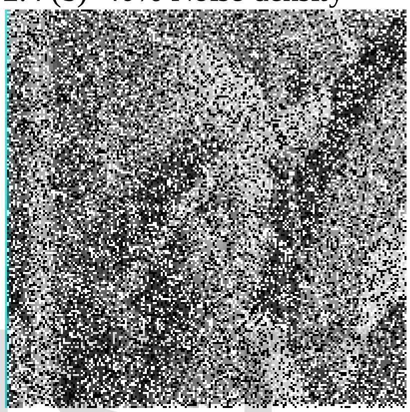
2.4 (a) Original image



2.4 (b) 40% Noise density

2.4 (c) Denoised image

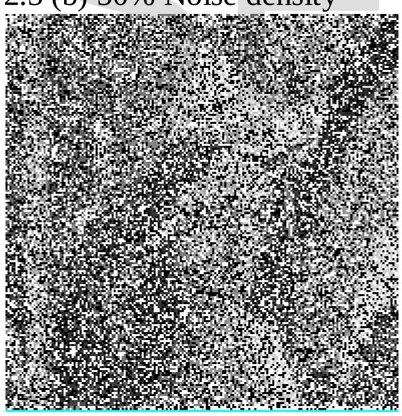
2.5 (a) Original image



2.5 (b) 50% Noise density

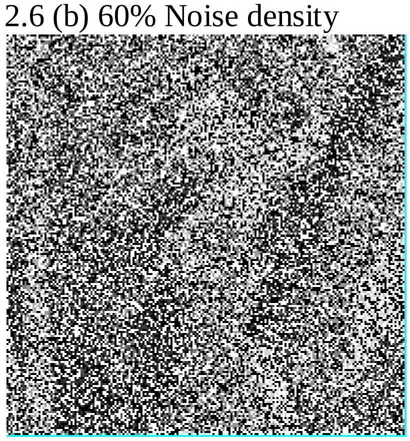
2.5 (c) Denoised image

2.6 (a) Original image



2.6 (b) 60% Noise density

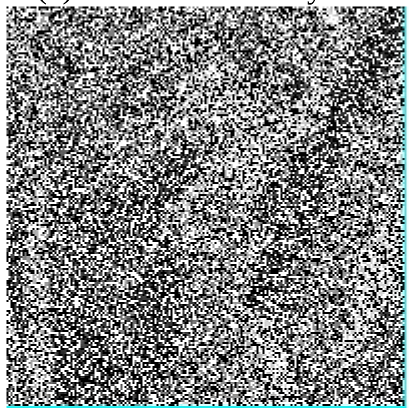
2.6 (c) Denoised image



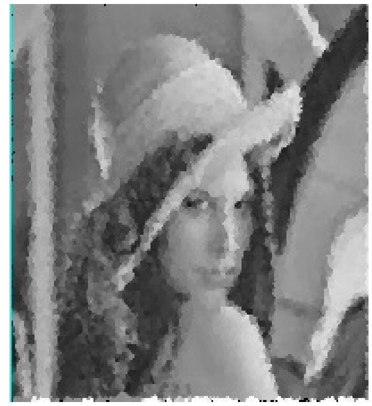
ISSN 2229-5518

2.7 (a) Original image

2.7 (b) 70% Noise density

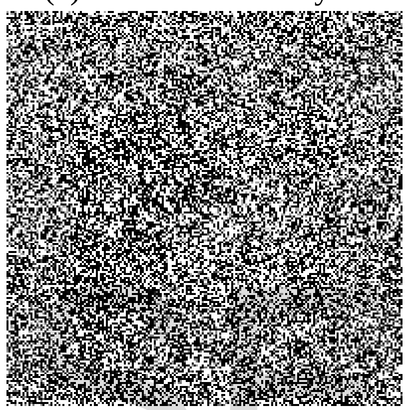


2.7 (c) Denoised Image

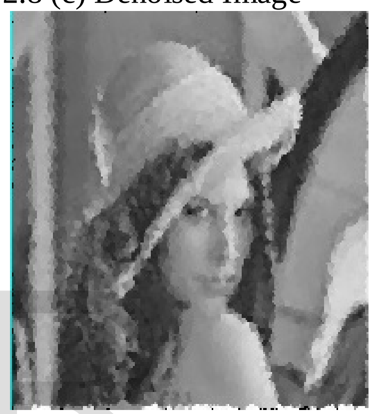


2.8 (a) Original image

2.8 (b) 80% Noise density



2.8 (c) Denoised Image



2.9 (a) Original image

2.9 (b) 90% Noise density

2.1 (c) Denoised Image

Conclusion:

Minimum mean square error (MMSE) based denoising scheme with a wavelet interscale model and discussed the optimize wavelet basis from family of wavelet. With orthogonal wavelet transform the wavelet coefficients at the same spatial locations at two adjacent scales are represented as a vector and the MMSE is applied to the vector. In this work orthogonal wavelet based with mmse is used for enhancing the peak signal to noise ratio (PSNR). The New algorithm filter also shows reliable and stable performance across a different range of noise densities varying from 10% - 90%. The performance of the proposed method has been tested at low, medium and high noise densities on gray scales. Infect at high noise density levels the new proposed algorithm gives better performance as compare with other existing de-noising filters.

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