Asian Journal of Information Science and Technology (AJIST)
Vol.3.No.1. 2015 pp 7-11
available at: www.goniv.com
Paper Received :08-10-2015
Paper Accepted:22-10-2015
Paper Reviewed by: 1. R. Venkatakrishnan 2. R. Marimuthu
Editor : Prof. P.Muthukumar

A SURVEY ON IMAGE DE NOISING

K.Kishore Anthuvan Sahayaraj[1], G.Thamizharuvi[2], S.Vinothini[3], K.Kavithayeni[4]
[1]Associate Professor, (Dept. of CSE) [2,3,4]M.Tech, Dept. of CSE
[1,2,3,4]Christ College of Engineering & Technology, Pondicherry, India
aruvithamizh@gmail.com, vino.cs76@gmail.com, kavithayenikannan@gmail.com

Abstract

In Image Processing, the impulse noise reduction from images plays a very vital role. The digital images can be enhanced by improving the perceptibility or improving the structural features Image de noising is a technique used to remove noise through the manipulation of the image data to produce very high quality images. There are several such algorithms devised for denoising, each having their own merits and demerits. In this notion reviews the existing denoising algorithms and performs their comparative study.

Keywords: Salt and Pepper noise, Salt and Pepper noise decline, Cellular automata, Neighbourhood Structure

1. Introduction

Noise is a random variation of image Intensity and visible as grains in the image. It may arise in the image as effects of basic physics-like photon nature of light or thermal energy of heat inside the image sensors. It may produce at the time of capturing or image transmission. Noise means, the pixels in the image show different intensity values instead of true pixel values. Noise removal algorithm is the process of removing or reducing the noise from the image. The noise removal algorithms reduce or remove the visibility of noise by smoothing the entire image leaving areas near contrast boundaries. But these methods can obscure fine, low contrast details. The common types of noise that arises in the image are a) Impulse noise, b) Additive noise [1], c) Multiplicative noise. Different noises have their own characteristics which make them distinguishable from others.

2. Different Noise Types

Noise is the undesirable effects produced in the image. During image acquisition or transmission, several factors are responsible for introducing noise in the image. Depending on the type of disturbance, the noise can affect the image to different extent [2]. Generally our focus is to remove certain kind of noise. So we identify certain kind of noise and apply different algorithms to remove the noise. Image noise can be classified as

- Impulse noise (Salt-and-pepper noise)
- Amplifier noise (Gaussian noise)
- Shot noise
- Quantization noise (uniform noise)
- Film grain
- An-isotropic noise
- Multiplicative noise (Speckle noise)
- Periodic noise

`3. Image Denoising

Image denoising still remains a challenge for researchers because noise removal introduces artifacts and causes blurring of the images. This paper describes different methodologies for noise reduction (or denoising) giving an insight as to which algorithm should be used to find the most reliable estimate of the original image data given its degraded version [3].

It is classified into two types are

- Spatial Filtering
- Wavelet transform

3.1 Spatial Filtering

A traditional way to remove noise from image data is to employ spatial filters. Spatial filters can be further classified into non-linear and linear filters.

3.1.1 Linear Filter

Images are often corrupted by random variations in intensity values, called noise. Some common types of noise are salt and pepper noise, impulse noise, and Gaussian noise. Salt and pepper noise contains random occurrences of both black and white intensity values linear smoothing filters are good filters for removing Gaussian noise and, in most cases, the other types of noise as well. A linear filter is implemented using the weighted sum of the pixels in successive windows.[10]

3.1.1.1 Mean Filter

We can use linear filtering to remove certain types of noise. Certain filters, such as averaging or Gaussian filters, are appropriate for this purpose. For example, an averaging filter is useful for removing grain noise from a photograph. Because each pixel gets set to the average of the pixels in its neighbourhood, local variations caused by grain are reduced. Conventionally linear filtering Algorithms were applied for image processing. The fundamental and the simplest of these algorithms is the Mean Filter as defined in [4].The Mean Filter is a linear filter which uses a mask over each pixel in the signal. Each of the components of the pixels which fall under the mask are averaged together to form a single pixel. This filter is also called as average filter. The Mean Filter is poor in edge preserving. The Mean filter is defined by: International Journal of Computer Applications (0975 – 8887) Volume 9– No.4, November 2010 46 1 N Mean filter (x1…..xN) = ─ ∑ xi N i=1 where (x1 ….. xN) is the image pixel range. Generally linear filters are used for noise suppression.

3.1.1.2 Gaussian Filters

They are a class of linear smoothing filters with the weights chosen according to the shape of a Gaussian function. The Gaussian smoothing filter is a very good filter for removing noise drawn from a normal distribution. Gaussian smoothing filters are effective low-pass filters from the perspective of both the spatial and frequency domains, are efficient to implement, and can be used effectively by engineers in practical vision applications. Disadvantages are it takes more time and it reduces the details of an image.

3.1.1.3 Wiener Filter

The goal of the Wiener filter is to filter out noise that has corrupted a signal. It is based on a statistical approach. Typical filters are designed for a desired frequency response. The Wiener filter approaches filtering from a different angle. One is assumed to have knowledge of the spectral properties of the original signal and the noise, and one seeks the LTI filter whose output would come as close to the original signal as possible [5]

3.1.2 Non Linear Filter

3.1.2.1 Median Filter

The Median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image).

Median filter is a best order static, non- linear filter, whose response is based on the ranking of pixel values contained in the filter region. Median filter is quite popular for reducing certain types of noise. Here the centre value of the pixel is replaced by the median of the pixel values under the filter region [6] [17] the effect of median filter on different types of noise.

Median filtering is very widely used in digital image processing because under certain conditions, it preserves edges whilst removing noise. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighbouring entries. Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically.

For an even number of entries, there is more than one possible median. The median filter is a robust filter. Median filters are widely used as smoothers for image processing, as well as in signal processing and time series processing. A major advantage of the median filter over linear filters is that the median filter can eliminate the effect of input noise values with extremely large magnitudes. (In contrast, linear filters are sensitive to this type of noise - that is, the output may be degraded severely by even by a small fraction of anomalous noise values) [4]. The output y of the median filter at the moment t is calculated as the median of the input values corresponding to the moments adjacent to t: y(t) = median((x(t-T/2),x(t-T1+1),…,x(t),…,x(t +T/2)). where t is the size of the window of the median filter. Besides the one-dimensional median filter described above, there are two-dimensional filters used in image processing .Normally images are represented in discrete form as two-dimensional arrays of image elements, or "pixels" - i.e. sets of non-negative values Bij ordered by two indexes - i =1,…, Ny (rows) and j = 1,…,Ny (column). where the elements Bij are scalar values, there are methods for processing colour images, where each pixel is represented by several values, e.g. by its "red", "green", "blue" values determining the colour of the pixel.

3.1.2.2 Minimum Filter

The Minimum filter enhances dark values in the image by increasing its area. Similar to a dilate function each 3x3 (or other window size) is processed for the darkest surrounding pixel. That darkest pixel then becomes the new pixel value at the centre of the window.

$$\hat{f}(x,y) = \min_{(s,t)\in S_{xy}} \{g(s,t)\}$$

3.1.2.3 Max Filter

$$\hat{f}(x,y) = \max_{(s,t)\in S_{xy}} \{g(s,t)\}$$

Max filter is good for pepper noise and min is good for salt noise

3.1.2.4 Bilateral Filter

Bilateral filtering is one of the examples of nonlinear filtering. It is a no iterative method. It combines domain and range filters simultaneously. It preserves edge information while denoising.

Bilateral filtering is a technique to smooth images while preserving edges. The use of bilateral filtering has grown rapidly and is now it is used in image processing applications such as image denoising, image enhancement etc. Several qualities of bilateral filter are enlisted below which explains its success:

- It is simple to formulate it. Each pixel is replaced by a weighted average of its neighbours.
- It depends only on two parameters that indicate the size and contrast of the features to preserve.
- It is a non-iterative method. This makes the parameters easy to set since their effect is not cumulative.

3.2 Wavelet Transform

Wavelet image denoising has been well acknowledged as an important method of image denoising. This method reserves most wavelet coefficient that contains information, so it can preserve image detail. Image denoising by wavelet usually mainly has three steps: (1) Decomposition of image signal; Choose appropriate wavelet and right decomposition level (note N), then N levels decomposition and computation to 2D image signal. (2)Threshold quantification of high-frequency coefficient after level decomposition; [10] Choose an appropriate threshold to each decomposition level, and soft threshold quantification to high-frequency coefficient. The choose rule of threshold is equal to the prior part of signal processing. (3) Image reconstruction using 2-D wavelet. According to the nth level approximation (low-frequency coefficient) and all the detail (high-frequency coefficient) after threshold quantification, the wavelet of 2D signal is reconstructed.

3.5 Slicing Method

It consist of a three technique to improve to quality of an image. They are

- Socrates slice
- Arial slice
- Cornell slice

Socrates slice

It detect the boundary of an image by proving a particular binary value for each bit. It is more accurate to detect a boundary images.

Arial slice

It detect the edges of an image based on lower or upper approximations.

Cornell slice

It detect the shape of an image exactly .So the image quality will be more compared with others.

These three technique are combined to provide an effective method to remove noise in an MRI images. It is more effective compared with others. It will compare with a binary value provided. It automatically provide a virtual path that an image is exactly correct or not.

Advantages

- Time reduces
- More accuracy and no image loss.

4 Conclusion

In this paper, we have focused on the denoising of images using linear and nonlinear filtering techniques. Linear filtering is done using the mean filter and LMS adaptive filter while the nonlinear filtering is performed using a median filter. These filters are beneficial for removing noise that is impulsive in nature i.e. salt and pepper noise. The mean filters find applications where the noise is concentrated in the small portion of the image. Besides, implementation of such filters is easy, cost effective and fast. It can be observed from the output Images of Mean and LMS Adaptive filter that the filtered images are blurred [11]. The median filter overcomes this problem by providing a solution to this, in which the sharpness of the image is retained after denoising.

References

[1] Parminder Kaur and Jagroop Singh. 2011. A Study Effect of Gaussian Noise on PSNR Value for Digital Images International Journal of Computer and Electrical E ngineering.Vol. 3, No.2, 1793-8163

[2] Mr. Rohit Verma Dr. Jahid Ali.2013," A Comparative Study of Various Types of Image Noise and Efficient Noise Removal Techniques",lVolume 3, Issue 10, October 2013

[3] Mukesh C. Motwani Mukesh C. Gadiya Rakhi C. Motwani," Survey of Image Denoising Techniques"

[4]James C. Church, Yixin Chen, and Stephen V. Rice Department of Computer and Information Science, University of

Mississippi, "A Spatial Median Filter for Noise Removal in Digital Images", IEEE, page(s): 618- 623, 20

[5]Wavelet domain image de-noising by thresholding and Wiener filtering. Kazubek, M. Signal Processing Letters, IEEE, Volume: 10, Issue: 11, Nov. 2003 265 Vol.3.

[6]D. Maheswari et. al. noise removal in compound image using median filter. (ijcse) International Journal on Computer Science and Engineering Vol. 02, No. 04, 2010, 1359-1362

[7]Rafael C. Gonzalez," Image Restoration and Reconstruction", in Digital Image Processing, 3rd ed. India: Pearson Prentice Hall, 2011, pp. 322-330

[8]K. Dabov, A. Foi, V. Katkovnik, and K. Egiazarian, "Image denoising by sparse 3D transform-domain collaborative filtering," IEEE Trans. Image Process., vol. 16, no. 8, pp. 2080–2095, Aug. 2007.

[9]Aram Danielyan, Vladimir Katkovnik, and Karen Egiazarian, Senior Member, IEEE "BM3D frames and variational image deblurring" , Image Processing, IEEE Transactions on (Volume:21 , Issue: 4), ISSN: 1057-7149

[10] Rakesh Singh, Amandeep Kaur, "Comparative Analysis of Speckle Noise Reduction Techniques and their affect on Image Edge Locaization", IJCST, Vol.2 Issue 4, Oct-Dec 2011,pp 78-82

[11] Chi Chang-yanab, Zhang Ji-xiana , Liu Zheng-juna "study on methods of noise reduction in a stripped image"

[12] A.C. Bovik, Digital Image Processing Course Notes, Dept. of Electrical Engineering, U. of Texas at Austin, 1995