ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

A Review on Different Median based Filtering Techniques

Priya Kapoor*[1], Er Samandeep Singh[2]

[*1, 2] Deptartment of Computer Sc & Engineering, Global Institute Of Management And Emerging Technologies, Amritsar, (Pb.), India

priyakapoor91290@gmail.com

Abstract

This paper presents an evaluation on digital image filtering methods. The main objective is on median filtering and its improvements like hybrid median filtering, relaxed median filtering etc. It has been found that the still much research is required in median filtering demands certain sort of improvements as it is preeminent for salt and pepper noise only. The survey has shown the different short comings of earlier work.

Keyewords: Salt and pepper noise, Median filter, relaxed median filtering.

Introduction

In image processing, noise reduction and restoration of image is likely to recover the qualitative inspection of an image and the performance criterion of quantitative image scrutiny techniques. Digital image is inclined to a variety of noise which affects the quality of image. The main purpose of de-noising the image is to bring back the detail of original image as much as possible. The criteria of the noise subtraction problem depend on the noise type by which the image is corrupting In the field of reducing the image noise several types of linear and non linear filter techniques have been proposed. Different approach for reduction of noise and image enhancement [1] have been painstaking, each of which has their own limitation and advantages.

Image de-noising is a vital image processing task i. e. as a process itself as well as a element in other processes. There are many ways to de-noise an image or a set of data and methods exists. The important property of a good image de-noising model is that it should completely take out noise as far as possible as well as care for edges. habitually there are two types of models i. e. linear model and non-liner model. commonly, linear models are used. The benefits of linear noise removing models is the speed and the limitations of the linear models is, the models are not able to preserve edges of the images in a efficient manner i. e. the edges, which are recognized as discontinuities in the image, are smeared out. On the other hand, Non-linear models [2] can handle edges in a much better way than linear models.

Applications of filtering

There are various application of filtering that can help in image development and restoration. Some of them are described below

A. Noise Smoothing

Linear filters are good for smooth most types of noise; however this is at the expense of edge sharpness and fine detail. These precincts can be overcome by using trimmed filters. The MEDIAN filter is good for smooth noise while preserving edges.

B. Edge Enhancements

Edge enhancement is often achieve by steepening the edge slope. When linear filter are used for this, it results on edges which are already sharp. Nonlinear filter works more reasonably well in preserve edges with the help of various order information filters.

C. Edge Detection

Linear edge detection filters [3] can be made to detect edges in one fastidious direction or in all strategy at once. Many nonlinear filters have been planned to improve edge direction in the presence of noise.

Types of Noises

The main source of noise in digital images arises during image achievement (digitization) or during image transmission. The performance of image sensor is affected by variety of reasons such as ecological condition during image acquisition or by the quality of the sense element themselves. For instance, during acquire images with CCD camera, sensor temperature and light levels are major factors

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

that disturbing the amount of noise in the image after the ensuing. Images are corrupted while during programme of images. The principal reason of noise is due to interfering in the channel which is used for the images communication. We can model a noisy image as follows:

C(x, y) =A(x, y)+B(x, y)

Where A(x, y) is the original image pixel value and B(x, y) is the noise in the image and C(x, y) is the ensuing noise image [4]. There are a choice of types of noise models as shown in Figure 1.

A. *Uniform Noise*

The uniform noise cause by quantizing the pixels of image to a number of distinct levels is known as quantization noise. It has roughly uniform distribution. In the uniform noise the level of the gray values of the noise are uniformly strewn across a specified range.

B. Gaussian Noise or amplifier Noise

This noise has a Probability Density Function of the normal distribution. It is also known as Gaussian distribution. It is a major part of the read noise of an image sensor that is of the constant level of noise in the dark areas of the image.

C. Salt and Pepper Noise

The salt-and-pepper noise[4] are also called shot noise, inclination noise or spike noise that is usually caused by faulty memory locations playing up pixel elements in the camera sensors, or there can be timing errors in the process of digitization . For 8-bit image the typical value for 255 for salt-noise and pepper noise is 0.

D. Rayleigh Noise

Radar range and velocity images typically contain noise that can be modelled by the Rayleigh distribution.

E. Gamma Noise

The noise can be obtained by the low-pass filtering of laser based images.

Filters

Filter [5] in an image processing is a basis function that is used to achieve many tasks such as noise reduction, utterance, and re-sampling. Filtering image data is a standard process used in almost all image processing systems. The choice of filter is determined by the nature of the task performed by filter and behaviour and type of the data. Filters are used to remove noise from digital image while keeping the details of image preserved is a basic part of image processing. Filters can be described by different categories

1. Spatial Domain Filtering
2. Frequency Domain Filtering

A. Spatial Domain Filtering

The Spatial Domain [2]is a domain (the plane) where a digital image is amorphous by spatial coordinates of its pixels. The spatial domain processes can be represent by the following appearance g(x, y) =T [f(x, y)]where f(x, y) is the input image, g(x, y) is the output image and T is an machinist defined over a local neighbourhood of pixel with the coordinates(x, y). There are two types of spatial filters.

(a)*Low Pass Spatial Filtering [1]*

The simplest form of spatial filter is a uniform neighborhood averaging. This is accomplished using a spatial mask of all ones. The effect of low pass filtering is to make edges more diffuse and low disparity

(b)Median Filtering

Extremity filtering [6] is done one neighborhood at a time; however the mask that it uses is not a linear function. A middle filter [7] replaces the pixel with the median of the neighborhood. This is useful in removing noise from a single image. The median filter [11] does this by removing large noise spike from the image.

(c)High Pass Spatial Filtering

The effect that high pass filters have on an image is faithfully opposite that of low pass filters. The primary goal of low pass filtering is to show up detail or to enhance lost detail due to blurring or faults in image acquirement. This is achieved using a mask having a positive value in its center location and negative coefficients in the rest. A high pass [13] filtered image may be compute also as the difference between the original image and a low pass filtered version of the image.

(d)High Boost Filtering

In this a blurred image is subtract from original to get unsharp mask image, then we add a multiple of unsharp mask to original to get sharpen image. Example of high boost filtering is Unsharp Masking.

B. Frequency Domain Filtering

In this techniques are based on modify the spectral transform of an image. It transforms the image to its frequency illustration and performs image processing and after that it computes inverse transform back to the spatial domain. High frequencies keep up a correspondence to pixel values that change swiftly across the image (e. g. text,

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

texture, leaves, etc.). Strong low regularity components keep in touch to large scale features in the image (e. g. a single, homogenous object that dominates the image).

(a) Smoothing Frequency Domain Filters

smooth is achieved in the frequency domain by dropping out the high frequency components.

The basic model for filtering is:

G (u, v) = H (u, v) F (u, v)

Where F (u, v) is the Fourier convert of the image being filtered and H (u, v) is the filter transform function.

Low pass filters – only pass the low frequencies, drop the high ones.

(b)*Sharpening Frequency Domain Filters*

Edges and fine detail in images are coupled with high frequency components.

High pass filters – only pass the high frequencies, drop the low ones. High pass frequencies are specifically the reverse of low pass filters, so:

$$H_{hp}(u, v) = 1 - H_{lp}(u, v)$$

Median filter

Salt and pepper noise is one typical kind of image noises, resulting from image sensors, channel transmission and decode processing and so on. It notably reduces the image quality and its filtering performance has a direct impact on the ensuing image processing. A lot of filtering methods are proposed to eliminate salt and pepper noise.

One of the most successful method is median filter [17].The median filter is a nonlinear signal processing equipment based on statistics. The noisy value of the digital image or the progression is replaced by the median value of the neighbourhood (mask). The pixels of the mask are ranked in the order of their gray levels, and the median value of the group is stored to replace the noisy value. The median filtering [18] output is

$$g(x, y) = med\{f(x - i, y - j), i, j \varepsilon W\}$$

where f (x, y),g(x, y) are the original image and the output image correspondingly, W is the two-dimensional mask: the mask size is n * n(where n is universally odd) such as 3* 3, 5 * 5, and etc.; the mask shape may be linear, square, circular, cross, and etc.

In median filtering, the neighbouring pixels are ranked according to brightness i.e. greatness and the median value becomes the new value for the central pixel. Median filters can do an first-rate job of rejecting certain types of noise, in particular, shot or impulse noise in which some individual pixels have extremevalues.In the median filter procedure, the pixel values in the neighbourhood window are rank according to intensity, and the middle value (the median) becomes the output value for the pixel under evaluation.

A. Advantages of Median Filter

1. There is no decline in contrast across steps, since output values available consist only of those resent in the neighbourhood.
2. Median filtering does not shift limitations, as can happen with conventional smoothing filters.
3. Since the median is less sensitive than the mean to extreme values i.e. outliers, those extreme values are more successfully removed.
4. The median is more strong than the mean, as it is not affected by extreme values.
5. Since the output pixel value is one of the neighbouring values, new unrealistic values are not created near edges.
6. Since edges are minimally degraded, median filterscan be applied repetitively if necessary.

Hybrid median filter

Hybrid median filter is windowed filter of nonlinear class that easily removes impulse noise while preserve edges. In assessment with basic version of the median filter hybrid one has better corner preserve characteristics. The basic idea behind filter is to select any elements of the image and apply median statistics several times by varying window shape and then take the median of the got median values i.e. median of medians

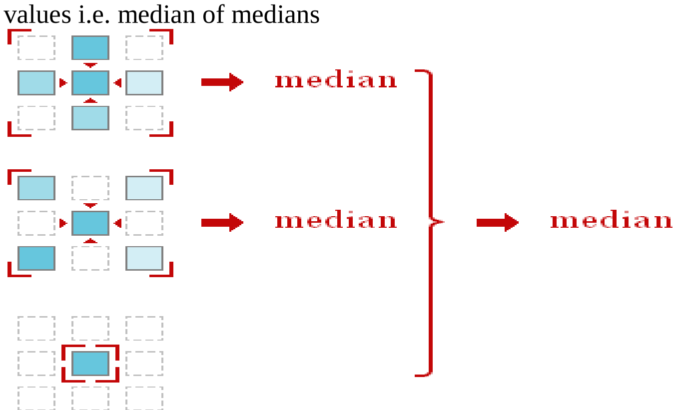

Figure 1 Hybrid Median Filters[5]

A. Advantages of Hybrid Median Filter

Hybrid Median filter [8] is of nonlinear class that easily removes impulse noise while preserve edges. The hybrid median filter plays a key role in image handing out and vision. In evaluation with basic version of the median filter, hybrid one has better corner preserving characteristics. This filter is defined as

A amalgam median filter preserves edges much better than a median filter. In hybrid median

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

filter the pixel value of a point p is replace by the median of median pixel value of 4-neighborhood of a point 'p', median pixel value of cross neighbours' of a point 'p' and pixel value of 'p'.

B. Working of Hybrid median Filter

The hybrid median filter be expansion of median filter. This filter is also called as spot preserving median filter is a three-step ranking operation. In a 5x5 pixel neighbourhood, pixels can be ranked in two different groups .The median values of the 45^0 neighbours form an "X" and the 90^0 neighbours forming a "+" are compare with the central pixel and the median value of that set is then saved as the new pixel value. The three step ranking operation does not impose a serious computational penalty as in the case of median filter. Each of the ranking perorations is for a much smaller number of values than used in a square region of the same size.

For example, the 5 pixel wide neighbourhood used in the examples contain either 25 (in the square neighbourhood) which must be ranked in the fixed method. In the hybrid method, each of the two groups contains only 9 pixels, and the final judgment involves only three values. Even with the additional logic and manoeuvring of values, the hybrid method is faster than the predictable median. This median filter overcomes the inclination of median and pruned median filters to erase lines which are narrower than the half width of the neighbourhood and to round corners.

Relaxed median filter

The median filter is far from being a wonderful filtering method as it removes fine details, sharp corners and thin lines. The main reason is that the ordering process destroys any structural furthermore spatial neighbourhood information. As an substitute to median filter, a version of median filter, the relaxed median filter is used. This filter is obtained by relaxing the order guide for pixel substitution. By using a relaxed median filter, more image details can be preserved than the standard median filter. This method will not commence any blocky effects in images and also preserve fine details, sharp corners and thin lines and curved The relaxed structures better than median filter.

- **Properties of Median Filter Relaxed**

Median filter is obtained by tranquil the order statistics for pixel exchange. Noise attenuation properties as well as edge and line safeguarding are analyzed statistically. The concert of the relaxed median filter should be describe by using some statistics of the output. However, this is not possible in general since accurate statistical metaphors of input images are difficult to obtain. But it is still possible to obtain the probability distribution function of the output by making simple assumption about the original image (before being corrupted by noise). In this sense, the noise attenuation can be well assessed from standardized originals andthe detail preservation can be access from pure edges and lines.

Related work

A [1] new algorithm adapted Decision Based Unsymmetrical trim Median Filter (MDBUTMF) which gives better performance in comparison with existing noise removal algorithms in terms of PSNR and IEF. Even at high noise density levels the MDBUTMF gives better results in association with other existing algorithms.

A novel sort Switching Median Filter (SSMF) [2] can effectively denoising extremely corrupted images while preserve the image details. The centre pixel is considered as ''uncorrupted'' or ''corrupted'' noise in the detecting stage. The corrupted pixels that possess more noise-free background will have higher processing priority in the SSMF sorting and filtering stages to rescue the profoundly noisy neighbours.

Augmentation of a noisy image [3] is necessary task in digital image processing. Filters are used best for removing noise from the images. Filters technique [3] are divided into two parts linear and non-linear techniques. After studying linear and non-linear filter each of have precincts and advantages. In the hybrid filtering schemes, there are two or more filters are not compulsory to filter a corrupted location. The conclusion to apply a particular filter is based on the different noise level at the different test pixel location or performance of the filter scheme on a filtering mask.

Adaptive Two-Stage Median Filter (ATSM) [4] is used to denoise the images contaminated by fixed-value impulse noise. ATSM is proved to be better in terms of Peak Signal-to-Noise Ratio and human ocular perception. This filter is capable in denoising the highly infected image.

New method [5] has used the concept of changeover of noisy pixels by linear calculation prior to belief. A novel beginner's linear predictor is developed for this purpose. The objective of the scheme and algorithm is the removal of high-density salt and pepper noise in images.

A novel switch median filter [6] incorporate with a authoritative impulse noise detection method can be used for effectively denoising extremely

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

soiled images. To determine whether the current pixel is corrupted, the algorithm first classifies the pixels of a restricted window, centring on the current pixel, into three groups-lower intensity impulse noise, virtuous pixels, and higher intensity impulse noise.

The adaptive median filter algorithm [7] is achieved by detecting the pollution level of the image, ascertain the specific location of the noise and shaping the size of the median filtering window adaptively. The algorithm has improved the precision of noise recognition and the fidelity of image filter, and has a better routine on different noise density.

An improved median filter algorithm [8] has used the parallel of the image to process the description of the filter mask over the image. It can adaptively resize the mask according to noise levels of the mask. The statistical histogram is also introduced in the pointed process of the median value.

A statistical filter [9] is a adapted version of Hybrid Median Filter for speckle fall, which computes the median of the crossways elements and ceiling of the horizontal and vertical elements in a moving window and finally the two values are compared with the central pixel and the median value of the three values will be the new pixel value. The filter is tested on apparition Ultrasound image.

Relaxed median filter[10] is obtained by tranquil the order statistic for pixel substitution. Noise shrinking properties as well as edge and line destruction are analyzed statistically. The trade-off between noise exclusion and detail maintenance is widely analyzed. It is shown that relaxed median filters preserve details better than the standard median filter, and remove noise better than other median type filters.

Gaps in study

The survey has shown that the most of existing researchers has disused at least one of the following.

a. The effect of the global mean in case of all the noisy pixels in a given mask has been ignored.
b. The noisy pixels 0 or 255 are considered in the input set while conniving the median; so centre pixel may be sometimes replaced by the noisy pixel again.
c. Most of the existing research has also uncared for the effect of the high density of the noise.

Conclusion & future work

The survey has shown that the still much improvement are mandatory in the filtering process. The effect of the global mean in case of all the noisy pixels in a given mask has been ignored by the most of existing researchers. As median base filtering smoothes even the edges of the regions. So in near future we will intention a new modified median filter to enhance the results further. Also to corroborate and verify the wished-for algorithm MATLAB simulator will also be used.

References

1. *S.Esakkirajan, T. Veerakumar, A. N. Subramanyam, and C. H. PremChand, "Removal of high density salt and pepper noise through personalized decision based unsymmetric trimmed median filter, " IEEE Signal Process. Letters, vol. 18, no. 5, pp. 287-290, May 2011.*
2. *Jian Wu, Chen Tang, "An efficient conclusion-based and edge-preserve method for salt-and-pepper noise removal," Science Direct Pattern appreciation Letters, vol. 32, pp. 1974–1981, 2011.*
3. *Shanmugavadivu P, EliahimJeevaraj P S, " Fixed–Value Impulse clatter inhibition for Images using PDE based Adaptive Two-Stage Median Filter," ICCCET-11 (IEEE Explore), pp. 290-295, 2011.*
4. *Shanmugavadivu, EliahimJeevaraj,"Laplace Equation based Adaptive Median Filter for Highly Corrupted Images" International Conference on Computer Communication and Informatics, pp.1-5, 2012.*
5. *V. Jayaraj and D. Ebenezer, "A new switching-based median filter scheme and algorithm for removal of high-density salt and pepper noise in image," EURASIP J. Adv. Signal Process, Article No. 50, pp. 1-11, 2010*
6. *Pei-Eng Ng and Kai-Kuang Ma, "A switch median filter with boundary discriminative noise detection for particularly corrupted images," IEEE business on Image dealing out, vol. 15, no. 6, pp.1506-1516, 2006.*
7. *R. Vijayarajan and S. Muttan, "persuade of Iterative Relaxed Median filter over FCM Clustering in MR Images," IEEE India Annual symposium on Engineering Sustainable solutions, (INDICON), pp. 1-4, 2011.*
8. *Jiafu Jiang, Jing Shen, "An Effective Adaptive Median Filter Algorithm for Removing Salt & Pepper Noise in Images," IEEE Photonics and Optoelectronic (SOPO), pp. 1-4, 2010.*

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

9. *Youlian Zhu, Cheng Huang, "An enhanced Median Filtering Algorithm for Image NoiseReduction," Science Direct domestic symposium on Solid State Devices and supplies Science, vol. 25, pp. 609-616, 2012.*
10. *K. Arulmozhi, S. ArumugaPerumal, K. Kannan, S. Bharathi, "disparity perfection of Radiographic Images in Spatial Domain by Edge Preserving Filters," intercontinental Journal of Computer Science and Network safekeeping, vol.10, no.2,pp. 233-240, 2010.*