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# A Preliminary study of denoising technique

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**ABSTRACT**

Denoising an image is a crucial issue as images are widely used in various fields. Denoising deals with noise estimation and removing noise from it. While removing the noise it should preserve the sharpness and clarity of an image. This paper provides the image enhancement techniques with the estimation techniques. Various filtering approaches are suggested to remove the Gaussian additive as well as Gaussian multiplicative noise.



## Introduction

Digital image processing is used to process the digital images as preprocessing, segmentation, and restoration. Recently use of digital image has been in object detection, target detection, recognition etc. So, to provide all the good results in each case image should be clean, clear and sharp. Sharpness, brightness, luminance, edges and curves give the each detail. These details may get corrupted when the image is captured through the CCD camera or CMOS sensors [4] [16]. When an image is captured through the camera it introduces Gaussian noise. This noise is caused because of random signals introduced into an image.

Noise is unwanted or random signal into an image. This degrades the quality of an image .Degradation cause blur and unpreserved edges in an image. Results as the unexpected outcomes of the researches .Degradation may be the cause of Gaussian additive noise or Gaussian multiplicative noise. To preserve these features how to remove such random and unwanted signals from the image. Initially noise estimation and then processing on that noisy image. This has resulted more suitable in visual in appearance. This is possible into either in spatial domain or in the frequency domain.

Section I contains spatial domain with filters in it and Frequency domain with a filter in it. Section II noise estimation techniques and section III contain work done to remove Gaussian additive white noise and Gaussian multiplicative noise by various researches with their various approaches.Paper ends with the conclusion.

## Section I

Spatial domain deals with pixels in an image. The principal approach in defining a neighborhood about the points. This approach is formulated on the basis of masks also known as filters, windows, kernel or templates. The spatial filters are categorized into Linear and nonlinear filters.

Linear spatial filters give a response by sum of products of the filter coefficients and the corresponding image pixels in the area spanned by filtering mask. Suppose that spanned the mask area is $m \times n$ of image size $M \times N$ , then the expression is

$$g(x,y) = \sum_{s=-a}^{a} \sum_{t=-b}^{b} w(s,t) f(x+s, y+t)$$

Linear filters are used for the smoothing purpose which removes noise as well as blur .This is also known as averaging filters or low pass filters.

Non-linear spatial filter computes the median in the neighborhood in which filter is located. Order statistical filters replace the center pixel value with the value determined by the ranking result. Median filters are in non-linear filter used to remove impulse noise.

Frequency domain filtering is a space defined by the Fourier transform and its frequency variable. Low pass filters are ideal, Butterworth, Gaussian filter. The high pass filters are Ideal High pass Filter, Gaussian High pass Filters, Butterworth High pass filter.

## Section II

The performance of a computer vision system is sensitive to peripheral parameters as noise levels; blur level resolution/image quality. To remove noise needs the estimation of the noise level. This estimation of the noise is possible through filtering approach, block approach and transformed approach.

Filter based approach, used for larger noise removal which suppresses the noise by using a low pass filter. In this technique estimate noisy by consideration of the variance in noisy images. Block based approach uses homogenous blocks to estimate noise in an image where images are divided into blocks. Transform based uses mean absolute deviation which uses wavelet coefficients [5].

**Filtering based Approach**:

The ordered filtering technique is used to remove the Gaussian multiplicative noise which avoids usage of bulky blocks [2].Bilateral filter used to remove Gaussian noise and retain sharpness of edges. The parameters are automatically estimated [3]. Unscented Kalman Filter is used to analyze nonlinear system corrupted by additive Gaussian noise [19].This gives improved results over ICP which doesn't returns correct

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results to match through closest point operation. The filtering technique gives faster performance using Polynomial filter [1] which is sophisticated in implementation. An ideal patch is used to remove Gaussian multiplicative noise where least square technique used [9]. Wiener filter provides the promising results in Multidimensional filtering for Hyperspectral images which is used for object detection and target detection [6]. Linear filter is used by in SAIF to recognize Guassian Additive White noise [16].

**Block based Approach:**

Lee and Hopel suggested block based noise estimation which estimates smallest standard deviation for threshold value more than 8. This block noise estimation provides the fast noise estimating technique [8] .To estimate the noise level less than 8 , Priyam and Milanfar, have suggested the patch based optimal denoising technique. In which parameters are calculated from the adjacent and overlapping patches and LMMSE is used for the noise level estimation [14].

The statistical approach provides the accurate estimation of noise present in an image. Kernel regression is a technique used to aggregate the noise variance. Linear adaptive kernel regression is used to calculate the noise which is a totally statical approach [13].

Kervarnn and Jerome, uses the point wise adaptive estimation with a patch based technique where the window size is suitably selected with small size. So that denoising will more accurate [10]. This improves quality of an image and preserve the edge structure under the noisy condition with window size as 5x5 [9].

Noise is signal-dependent noise in which amplitude of noise in proportion with the noise free signal. MLPF provides improved results on homogeneous areas over Lee's refined filter, Meer's filter [21].

**Transform Based Approach:**

The method suggested in [17], uses wavelet base noise estimation for the Gaussian multiplicative noise.Gaussian white additive noise is itself exists in Gaussian multiplicative noise. To reduce additive noise wavelet based reduction technique is used. MAP and MMSE nonlinear shrinkage / threshold are calculated using Laplace density [18]. Sharpness estimation is possible through the wavelet shrinkage which remove Gaussian noise [7]. Spatially adaptive multiplicative denoising algorithm improves the performance is increased by 2dB using wavelet transformation domain for variance estimation [20].

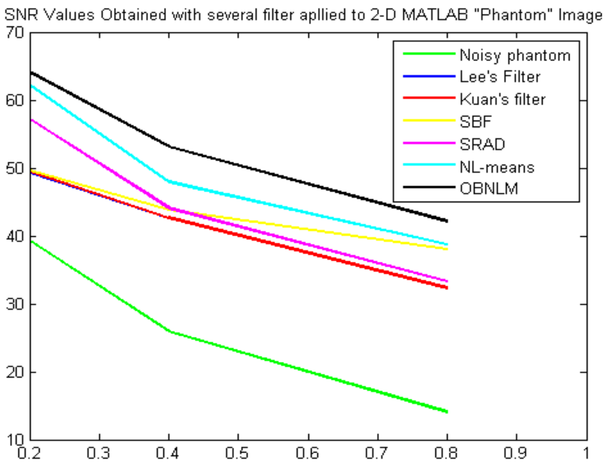


**Figure 1**

Bayesian Estimator for random noise estimation .This estimation is known as Bayesian Minimum Mean Square error estimator. Wavelet coefficients for the noise processing [22].

Collaborative filtering is a collection of homogeneous groups [11] .After collecting homogeneous groups than any filtering approach is applied to estimate noise where both approaches are used as filtering and block based. Denoising performance is improved after the estimating noise using Linear filtering and then kernel based approach [15].

Figure 1 represents the block based and filter based SNR comparisions of various filters [17].

**Conclusion:**

Suggested various denoising approaches .They are filtering, block and transformed based .There should not be any parameter tuning [12]. So that accuracy is obtained and observed .Low pass filters perform smoothing operations. To recover the image which is corrupted by Gaussian noise is filtered by the Wiener filter [6]. Suitable and improved results are found to be with Adaptive wiener filter. This gives the most optimal results in Gaussian noise.

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