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Performance Comparison of Image De-noising Techniques

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***Abstract* — Digital images are a major method of communication in the modern age, but the image received at other end is often corrupted with noise hence needs processing before it can be used in applications. In this paper a study will be made on the various de-noising techniques. This paper covers basics of image de-noising, their classification and various techniques. In order to quantify the performance, a high quality image is taken and some known noise is added to it. This would then be given as input to the de-noising algorithm, which produces an image close to the original high quality image.**

***Index Terms* –Image De-noising, SNR, filtering, image processing**

I. INTRODUCTION

Digital Images is corrupted with noise during transmission or in signal acquisition. In photographic images, there is noise within the light intensity signal, within the sensor or in subsequent processing. Image de-noising involves the manipulation of the image data to produce a visually high quality image. Therefore the goal of image de-noising is to recover the true or best approximation of images from the noisy images. Image de-noising is the technique of estimation of the uncorrupted image from the distorted or noisy image [1].

There are various methods to help restore an image from noisy distortions. In case of image de-noising methods, the characteristics of the degrading system and the noises are assumed to be known beforehand. The image s(x, y) is blurred by a linear operation and noise n(x, y) is added to form the degraded image w(x, y). This is convolved with the restoration procedure g(x, y) to produce the restored image z(x, y).

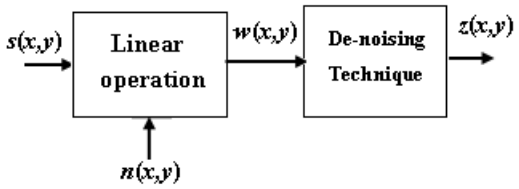

Figure 1: De-noising Concept

The "Linear operation" shown in Figure 1 is the addition or multiplication of the noise n(x, y) to the signal s(x, y). Once the corrupted image w(x, y) is obtained, it is subjected to the de-noising technique to get the de-noised image z(x, y).

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II. IMAGE DE-NOISING METHODS

There are many different kinds of image de-noising algorithms. They can be broadly classified into two classes (a) Spatial Domain Filtering (b) Transform Domain Filtering

(a) Spatial Domain Filtering

Spatial domain filtering refers to filtering in the spatial domain, while transform domain filtering refers to filtering in the transform domain [2, 3]. Image de-noising algorithms which use wavelet transforms fall into transform domain filtering [2, 3]. Spatial domain filtering can be further divided on the basis of the type of filter used: (i) Linear filters (ii) Non-Linear filters.

(i) Mean Filter

Mean filter is an example of a linear filter. This filter replaces each pixel value in the images with the average value of its neighbors including itself. We select an odd size window with center element as the processing pixel & then replace the processing pixel with the average of the window pixels. This filter is mainly used for removal of Salt & Pepper noise but results some blurring at the edges.

(ii) Median Filter

Median filter is an example of a non-linear filter. Median filtering is quite useful in getting rid of Salt and Pepper type noise. In median filter de-noising firstly select an odd size window with center element as the processing pixel & then store the elements in 1-D array. Then sorted the pixel value in ascending or descending order and then replace the processing pixel with the midpoint of the 1-D array. With Spatial filters tend to cause blurring in the de-noised image.

(iii) LMS Adaptive Filter

An adaptive filter does a better job of de-noising images compared to the averaging filter. 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, that is, images that have abrupt changes in intensity. Such filters are known for their ability in automatically tracking an unknown circumstance or when a signal is variable with little a prior knowledge about the signal to be processed. In general, an adaptive filter iteratively adjusts its parameters during scanning the image to match the image generating mechanism [4,5]. This mechanism is more significant in practical images, which tend to be non-stationary.

Compared to other adaptive filters, the Least Mean Square (LMS) adaptive filter is known for its simplicity in computation and implementation. The basic model is a linear combination of a stationary low-pass image and a non-stationary high-pass component through a weighting function. Thus, the function provides a compromise between resolution of genuine features and suppression of noise.

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(b) Transform Domain Filtering:

Wavelet Transform fall into the class of Transform Domain Filtering.

(i) Wavelet Transform:

All wavelet transform de-noising algorithms involve the following three steps in general [6, 7]

- Forward Wavelet Transform: Wavelet coefficients are obtained by applying the Wavelet transforms.
- Estimation: Clean coefficients are estimated from the noisy ones.
- Inverse Wavelet Transform: A clean image is obtained by applying the inverse Wavelet transforms.

III. Literature Survey of De-noising Methods

G.Venkateswara Rao and Satya P Kumar have proposed the gray scale method to remove impulsive noise based on the vector approach. Vector based approach separates color components before the application of the algorithm. Fuzzy logic distinguishes noise and image characteristics thereby filters the component pixels by preserving the edge sharpness and color. The authors introduced impulse noise generator for the estimation of the level of noise added to the image. This helps in calculating the percentage of PSNR for the introduced amount of noise in the required image.

Rajesh Kumar Rai, Jyoti Asnani, R.R.Sontakke are comparing different shrinkage methods like oracle shrink, smooth shrink, Neigh shrink, Bayes shrink, Sure shrink, Visu shrink, Bishrink and Probshrink. It is clearly proved that highest PSNR value is achieved at lowest standard deviation and lowest PSNR at highest Standard Deviation. Most of the real time and online applications require these types of filters with less execution time.

The sub band coding principle produced marvelous results compared to the other noise removing methods. S. Kalavathy and R. M. Suresh have designed the system for sub band thresholding and neighborhood pixel algorithm.

A new iterative algorithm proposed by G. L. V. Tata Rao, M. S. Madhan Mohan and Dr. G. M. V. Prasad uses pixels within window. The neighboring pixel size is increased by increasing noise density. A Detection map is constructed by assigning binary value 1 for each corrupted pixel and searching noise free pixels. Generally salt and pepper noise is removed using this algorithm.

Non-Parametric Bayesian Dictionary learning proposed by Mingyuan Zhou, Haojun Chen produces good result for incomplete images. Compressive, incomplete and noisy measurements require recovery of images using non-parametric Bayesian methods. Uniform random selection of image pixel subset is measured and defined based on the simpler measurements. Learned Dictionaries with respect to the standard orthonormal image expansions provide very good improvements in image recovery. For this, the appropriate dictionary is inferred along with the data under test by employing truncated beta-Bernoulli process.

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Yuan Q, Zhang L and Shen H introduced new noise removal technique called Hyper spectral. The Spectral-spatial adaptive total variation (TV) model seems to be the best method for noise reduction by considering spectral noise differences and spatial information differences. The adaptive adjustment of denoising strength with the noise intensity of different bands is essential to suppress the noise in high- noise intensity bands by preserving detailed information in low-noise intensity bands.

Bijalwan, Nidhi Sethi and R. P. Arora have proposed such an efficient algorithm based on multiresolution technique. Some special wavelet domain algorithms have been developed to suppress speckle noise in medical ultrasound images.

S.Sudha, GR.Suresh and R.Sukanesh have estimated threshold and multiscale product scheme involving calculation of thresholding coefficients using weighted variance. The authors suggest that the wavelet interscale dependencies are employed by adjacent sub band multiplication. An open source Cipeg encoders designed by Antonio Buemi, Arcangelo Bruna, Massimo Mancuso, Alessandro Capra and Giuseppe Spampinato can be used to generate the reference image for chroma blurring algorithms which are producing sound improvement in PSNR. The defined algorithm introduced here has achieved noticeable reduction of noise. Biao Hou, Xiaohua Zhang, Xiaoming Bu and Hongxiao Feng have introduced non sub-sampled shearlet Transform for SAR (Synthetic Aperture Radar) images. Initially the denoising algorithms should be capable of differentiating true SAR image and artificially de-speckled images. Non sub-sampled Shearlet Transform (NSST) is proposed to avoid the interpretation of speckle. This kind of de-speckling process suppresses the speckle by clearly realizing de-speckling and detail preservation. The NSST presents shrinkage of NSST coefficients by the NSST model for speckle variance estimation, thereby capturing the anisotropic information of SAR image and thus the directional sub bands are obtained. The multiscale local coefficient variation reduces undesired shrinkage ratio.

The Gabor feature based nonlocal means filter (GFNLM) proposed by Shanshan wang, provides good measures for denoised texture images. The GFNLM filter has achieved substantially improved performance in noise corrupted image restoration. The proposed filter is compared to the existing NLM filter and other image de-noising schemes. Less robustness, simplicity, self similarity measure based on pixel values are the few advantages of NLM filters which are mainly applicable for non-stationary image contents. GFNLM replaces each pixel value with weighted sum of pixel values in its search window to recover noise corrupted images.

IV. Results & Discussion

The Results of various image de-noising techniques are given in figure 2. The simulation results depict the performance of various techniques applied to noisy image. The noise taken for the result verification is salt and pepper noise and Gaussian noise. The Performance Comparison in terms of Signal to Noise Ratio (SNR) of various filters are shown in table 1.

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Table 1: SNR values for filtering approach

Method	Noise type	SNR of input Image	SNR of output image
Mean filter	Salt and pepper, 0.04	19.38	28.32
Mean filter	Gaussian, 0.04	14.19	22.10
Median filter	Salt and pepper, 0.04	19.48	48.27
Median filter	Gaussian, 0.04	14.28	23.27
LMS adaptive filter	Salt and pepper, 0.04	19.41	28.98
LMS adaptive filter	Gaussian, 0.04	14.21	23.10

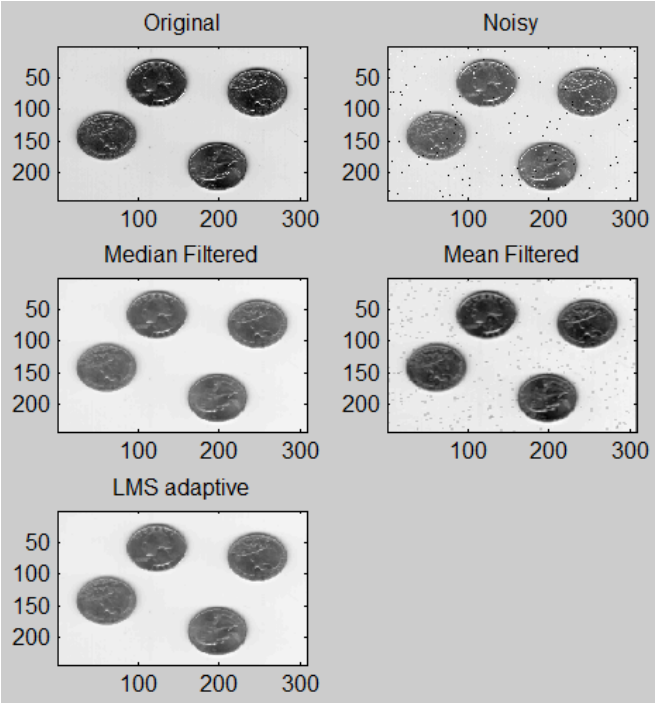

Figure 2: Various filters applied to noisy image.

V. CONCLUSIONS

In this paper we give basic of various de-noising techniques used in images. The performance of these techniques is evaluated in terms SNR. It is concluded that for salt and pepper noise, the median filter gives better results as compared to mean filter and LMS adaptive filter. The LMS adaptive filter gives better result than mean filter but has more time complexity. The image obtained from the median filter has very less noise present in it and is close to the high quality image.

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REFERENCES

[1] Kanika Gupta, S.K. Gupta, "Image Denoising Techniques – A Review paper", International Journal of Innovative Technology and Exploring Engineering (IJITEE), March 2013, Vol.2, Issue-4.

[2] M. Vijay, L. Saranya Devi, M. Shankaravadivu and M.Santhanamari "Image Denoising based on Adaptive Spatial and Wavelet Thresholding Methods", IEEE-International Conference On Advances In Engineering, Science And Management, (ICAESM -2012) March 30, 31, 2012.

[3] Shruti Bhargava, Dr. Ajay Somkuwar, Mini Gupta, "A survey Paper on Image Denoising Techniques" International Journal of Electronics Communication and Computer Engineering, Volume 3, Issue 3.

[4] R.C. Gonzalez and R.E. Woods "Digital Image Processing", 2nd ed. Englewood Cliffs, NJ: Prentice- Hall; 2002.

[5] Jappreet Kaur, Manpreet Kaur, Poonamdeep Kaur, Manpreet Kaur "Comparative Analysis of Image Denoising Techniques" International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Volume 2, Issue 6, June 2012.

[6] Sachin D Ruikar, Dharampal D Doye, "Wavelet based image denoising technique", International Journal of Advanced Computer Science and Applications, March 2011, Vol.2, No.3.

[7] Rupinderpal Kaur* Rajneet Kaur, "Survey of De-noising Methods Using Filters and Fast Wavelet Transform", *International Journal of Advanced Research in Computer Science and Software Engineering Research*, Volume 3, Issue 2, February 2013