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Comprehensive Study on Different Noises And De-Noising Techniques in Digital Imaging

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Abstract – In previous decay, denoising is a great idea in the digital image processing. It support various types of digital images that been taken from the digital cameras and CCTV cameras. In image denoising research work, various techniques play some important role in the geographical research and scientific research field. Digital cameras and CCTV cameras may be noisy and blur that degrade the quality of the vision image. Due to noisy and blur images come the problem of less information of the working object. This paper describes multiple techniques which are based on the denoising scheme for the better performance. These techniques will support to the satellite images, television pictures, medical images and natural digital images. These images may also suffering from imperfect old instrument, not proper sensing image of the object and some compression or natural disaster phenomena.
Keywords – Denoising, Digital Image, Quality, Sensing Image, Vision

I. INTRODUCTION

In the current scenarios, the research and technology are vast areas of digital images which play a vital role in human's daily life applications - satellite television, magnetic resonance imaging, computer tomography and other related areas geographical information systems and astronomy. Data sets taken by image devices are generally noisy and followed raw information. Imperfect old instruments, problems with the data acquisition process in sensing information of digital image, and interfering natural phenomena may arises the noisy data which increase degrade the data of interest. However, noise can be produced by transmission errors, compression and other natural disaster. So, denoising is important field of research for the quality of digital images and necessary to analyze the taken data from the various sources. It becomes more necessary to apply an efficient denoising scheme to compensating and enhancement for corrupt data. Image denoising still remains a challenging issue in research and scientific field because noise removal introduces artifacts and causes blurring effect of images. This paper describes various techniques for noise reduction (or denoising). For this an algorithmic techniques should be more reliable and estimate the better performance of the original image which has been taken data sets and its degraded version should be analyze in suitable forms. Noise modeling in images is highly affected through capturing instruments, sensing devices, data transmission media, image quantization and discrete sources of image radiation due to light.

II. RELATED WORK

Different algorithms are used depending on the noise model which follows digitalize and quality images through denoising. Most of the natural images have been assumed as additive random noise which is computed as a Gaussian noise, Speckle noise and rician noise. These noises may be observed in ultrasound images, MRI images. The scope of paper concludes and focuses on noise removal techniques for natural images in the geographical research areas. Magnetic resonance (MR) or CT images are generally corrupted by several artifacts and noise sources [1]. The existing region source of noise in the MR image and CT images are the patient's body. Now days, the body is being a conductive medium for the researchers, generates fluctuating fields for each image that will be picked up through the receiver coil [2] the whole measurement chain of the MR scanner (coil, electronics, etc.) has biggest contribution to the noise reduction. Computer aided analysis and visual inspection of the images became impossible due to presence of noise in MRI. Therefore, de-noising is required for better results. In the early days, many authors applied the conventional classical de-noising techniques to de-noise MRI. These methods assumed the noise in the MRI as Gaussian. The major problem of these techniques is that the biasing quality effects of Rician noise, which defines to the magnitude MR images, were not taken into account. This bias grows as decreasing of SNR. Later many methods were proposed to de-noise MR images. The most popular family of methods proposed for de-noising MR images are the non-local means (NLM), partial differential equations (PDE), wavelets and maximum likelihood (ML) estimation methods. NLM- based methods were proposed in [3–5] for de-noising

magnitude MR Images. Sijbers et al. [6] and Samsonov and Johnson in [7] proposed adaptive anisotropic diffusion methods for de-noising MR images. These methods were based on the classical second-order Perona–Malik [8] anisotropic diffusion. However [9] it is mentioned that the anisotropic diffusion Methods based on second-order Perona–Malik can cause staircase effects in the filtered images. To reduce this effect, a fourth-order PDE was invented by Lysaker et al. [10], thus main advantage of this method is its capability to compute signals with a little change in the intensity value of the signals. Basu et al. [11] used a data likelihood term and combined with Perona–Malik method that was related to anisotropic diffusion to effectively de-noise an MR image. Aja-Fernández et al. [12] proposed a linear minimum mean square error (LMMSE) approach to de-noise Rician distributed data. Recently, Krissian and Aja-Fernández proposed a noise-driven anisotropic diffusion used as a filter for de-noising MR images.ML-based methods were proposed in to de-noise magnitude MR images. In this paper, we propose an iterative bilateral filter for de-noising magnitude MR images. Bilateral filter is a popular nonlinear filter employed in spatial domain for edge-preserved de-noising. The proposed de-noising method accounts for the Rician characteristics of the data and also preserves the relevant edge features.

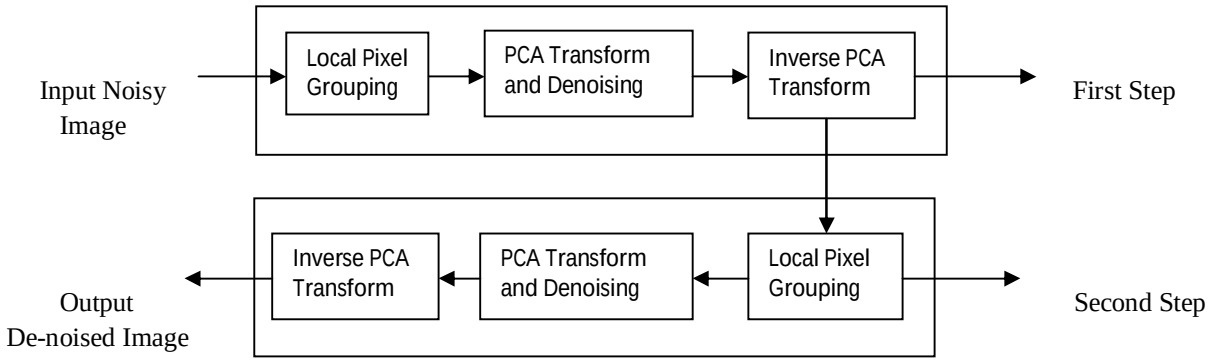

Fig. 1 Simple Block Diagram of Denoising

III. NOISE TYPES

A. Uniform Noise

Quantization of pixels at different levels in the images is considered as uniform noise. In these types of noise, the gray values are distributed in a specific range. This type of image is used to degrade images in image restoration algorithm. Uniform noise is a natural phenomenon.

B. Amplifier Noise

This type of noise required to measure the portability density function by normal distribution. In this type of image noise, sensor is needed to read noise in the dark areas of the noisy image. It is also known as Gaussian noise.

C. Salt & Peper Noise

This type of noise is caused by faulty memory locations, due to this timing errors affected to the pixel elements in digitalization. For salt & peper noise the probability function should be less than 0.2. In other hand if it is greater than numbers of noise will swamp out in the digital image and synchronization problem may arise.

D. Gamma Noise

This type of noise arises due to low pass filtering of the laser based images

E. Rayliegh Distribution Noise

This type of noise arises in radar images. Radar range and velocity images include rayliegh noise.

IV. DENOISING TECHNIQUES

Image denoising is a most popular area as a fundamental problem in the image processing to process the research work. Wavelet transform is used for multi resolution structure to gaining popularity in last few decades using various denoising algorithm that has been applied on the problem areas. The focus was more considered which changes the spatial and fourier domain to wavelet

transform. According to the more information, Donoho's wavelet based thresholding approach was published in 1995 for revolutionary. It was not suitable concept because it did not provide better correlation of the wavelet maxima and minima at the different scales. Therefore wavelet based denoising techniques was considered as more complicated problem.

A. Spatial Filtering

Traditional methods are used to remove noise from the images which are less successful to give the fine detailed information. Spatial filtering is divided in sub parts based on liner filtering and non-linear filtering.

B. Transform Domain Filtering

The transform domain filtering method is based on the basis function. These methods can be subdivided according to basis function – data adaptive and non-adaptive transforms.

C. Data Adaptive Transform Filtering

Adaptive filters are considered as digital filters with an impulse response, or transform function can be adjusted or changed over time to match desired system characteristics according to used digital images for denoising. Adaptive filter is a part non-linear filter of signal processing which deals to transform function. Now days, data adaptive transform is related to the independent component analysis (ICA) which is used to denoising the Non-Gaussian data. The drawback of this method is computational cost which is very high to estimate. This method provides the noise free data in denoising terminology.

D. Non Linear Filter

The non-linear filter removes the noise without any attempts to explicitly identify image. In this the noise occupies higher region of frequency spectrum. In the recent years, many non-linear filter has been developed such as – weighted median, rank conditioned rank selection and relaxed median that overcome to noisy image drawback

E. Median Filter

Median filter is most powerful and simple filter for smoothing. It is used to intensity variation reduction between one pixel to other pixel. In this filter we can't replace the pixel value of the image by mean.

F. Non Adaptive Transform

It is a type of non-linear threshold filtering. These techniques are subdivided in different parts:

1) VISUShrink :a non-adaptive universal threshold and tends to a number of points at global position to the applied filter surface. It measures the performance of each pixel at the infinity due to this provide the over smoothing pixel values.

2) SUREShrink : refers to hybrid threshold which is better to the visushrink to provide the better threshold.

3) BayesShrink : minimizes the risk at the time of yielding data adaptive threshold. It is more suitable as compared to SUREShrink.

4) CrossValidation : replaces wavelet coefficient with the weighted average of neighboring coefficient in image denoising to find the optimum threshold value.

G. Linear Filter

A linear filter is mostly applied on the corrupted images in denosing the signals. This filter does not allowed intra filtering in the digital images. It removes the disparities from the images. It is subdivided as follows:

H. Mean Filter

A mean filter is more related to optimal linear filter which sense to the Gaussian noise in forms of mean square error. It has properties such – blur sharp edges, destroy lines and other fine image details. The mean filter is used in spatial filtering in which sliding window replace the center value in the window. It replaces average values of all pixels from the kernel window.

I. Weiner Filter

The wiener filter is also related to the linear filter which is helpful to remove the spectral noise through smoothing. The wiener filter is more suitable in choosing the window size to remove the complexity from the images.

J. Wavelet coefficient model

Deterministic: Deterministic method creates levels such as tree structure of wavelet coefficients in transformation. This approach is optimal in hierarchical interpretation for wavelet decomposition to wavelet coefficient. This method is helpful to find the local maxima for the wavelet coefficient. Tree Approximation is a deterministic method for wavelet coefficient model.

Statistical Modeling of wavelet coefficient-

This technique determines multiscale correlation properties between wavelet coefficients, local correlation properties between neighborhoods coefficients. It provides exact position of image in wavelet transforms.

Marginal probabilistic model – Most of model has been used in local properties of the wavelet coefficient. But this model is used for images as wavelet domain in image denoising. Gaussian Mixture Model (GMM) and Generalize Gaussian Distribution (GGD) is used model in distribution of properties in wavelet for images. These methods are helpful to determine the zero mean Gaussian random variables and variance to the noise estimation in the images. Laplacian distribution can be estimated in the noisy images for denoising. A posteriori probability rule is used maximum approximation to estimate marginal distribution of wavelet coefficient variences.

Joint Probabilistic Model - Joint Probabilistic model is used to remove the complexity of inter-scale dependencies in wavelet coefficient. In this model, Random Markov Gaussian (RMG) and Hidden Markov Models (HMM) are used local and global coefficient of images in denoising respectively. This model provides the same correlation from different wavelet coefficient images.

K. Non orthogonal wavelet transform

Spatial frequency domain: Spatial filtering concept works for low pass filters such as Fast Fourier Transform. In the smoothing method are used more time consuming and depend on the cut-off frequency as well filter function behavior.

V. CONCLUSION

In this review paper, Denoising concept is more important criteria for the researcher. The denoising concept comes from the various quality techniques to detect better visualization. It gives more detailed information of the object. Denoising techniques plays a vital role in the human life and some other field. Since, the objective of the research must be clear for each researcher in the field of current technology. This paper describes the advancement of each technique in the field of digital image processing for better performance and analysis.

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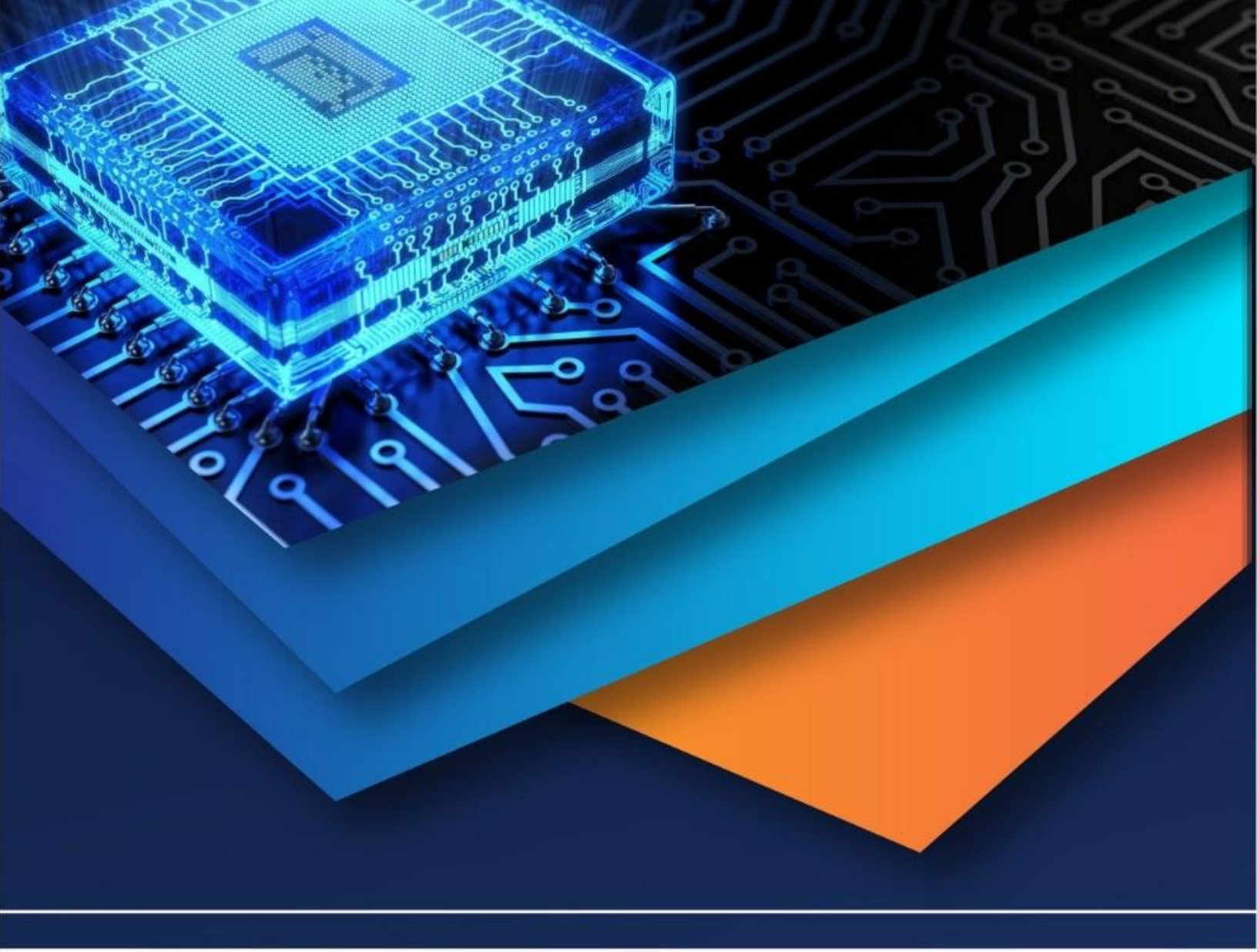

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