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SURVEY ARTICLE

Image De-noising and its Methods: A Survey

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Abstract- An image is considered as a collection of information stored as intensities and the occurrence of noises. The occurrence of noise present in the image causes degradation in the quality of the image. The basic idea behind image processing is how we estimate the correct pixel values. Image De-noising is one of the fundamental problems which is faced in image processing and computer vision .There are various de-noising methods that have been employed to remove noise from the existing image. There are many researches which are still going on to find the best method to remove noise from the image while preserving its fine details. In this paper we are going to discuss different noise models and methods to remove these noises with their various advantages and disadvantages.

Keywords — Noise models; Image de-noising methods; Mean filter; Median filter; Gaussian noise.

I. INTRODUCTION

Removal of noise from the image to make it corrupt free is known as de-noising in Digital Image Processing. In image processing we divide the image into small units called pixels and then various operations are performed on it. Noise decreases the quality of the image. Image becomes unpleasant to view. For example, if we are sending our data to a person at remote place through electronic media then the noise is added to the data during the process of transmission. Here, we can conclude that one person's signal can become other person's noise. The main purpose of image de-noising is to remove noise from the image and preserving the fine details of the image.

II. Noise Models

Noise in the image can be presented either in additive or multiplicative form [1].

A) Additive Noise Model

Noise signal that is additive in nature is called additive noise. It gets added to the original signal to produce a corrupted noisy signal and follows the following model:

$$W(x, y) = S(x, y) + N(x, y) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

The example of additive noise is Gaussian noise and it evenly distributes itself over the signal. This type of noise has a Gaussian distribution [2].

B) Multiplicative Noise Model

The model in which noise signal gets multiplied to the original signal is called multiplicative noise model. The multiplicative noise model follows the following rule [1]:

$$W(x, y) = S(x, y) \times N(x, y) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where, W(x, y) is intensity of original image and S(x, y) denotes the noise introduced at W(x, y) .

III. TYPES OF NOISES

The noise is represented by its character and probability distribution. There are various types of noises in Digital Image Processing but we will discuss few important noise types, Gaussian noise, salt and pepper noise, poison noise, impulse noise and speckle noise.

A) Gaussian Noise

Gaussian noise is a statistical noise. The probability density function of Gaussian noise is equal to that of the normal distribution. Gaussian noise is evenly distributed over the image and it corrupts all the pixels in the image. De-noising such type of noise is very much difficult. White Gaussian noise is the special case.

B) Salt and Pepper Noise

Salt and pepper noise is the common type of noise that can be seen in the images. It has only two types of values either 0(representing black) or 255(representing white).The image is corrupted by either 0 or 255 values giving appearance of salt and pepper on it. Median filter is one of the method used for removing it.

C) Poison Noise

Poison noise is induced due to non linear response. This type of noise is data dependent. It has a distribution with a mean response value[3].

D) Impulse Noise

Impulse noise is one in which there is unwanted level of impulse and contains sharp noise level. These noises are caused by electromagnetic interference, scratches on the disks, and ill synchronization in digital recording and communication. High levels of such a noise (200 + Decibels) may damage internal organs of the body, while 180 Decibels are enough for destroying or damaging human ears [3].

E) Speckle Noise

Speckle noise is a complex type of noise and makes it difficult for the observer to remove it. The speckle noise follows a gamma distribution [4].Thus removing noise from the image to improve its quality is a major concern now. For removing noise and to increase the visibility of the image we take into considerations different noise removal techniques.

IV. Image De-noising methods

Two approaches to image de-noising are spatial domain filtering and transform domain filtering.

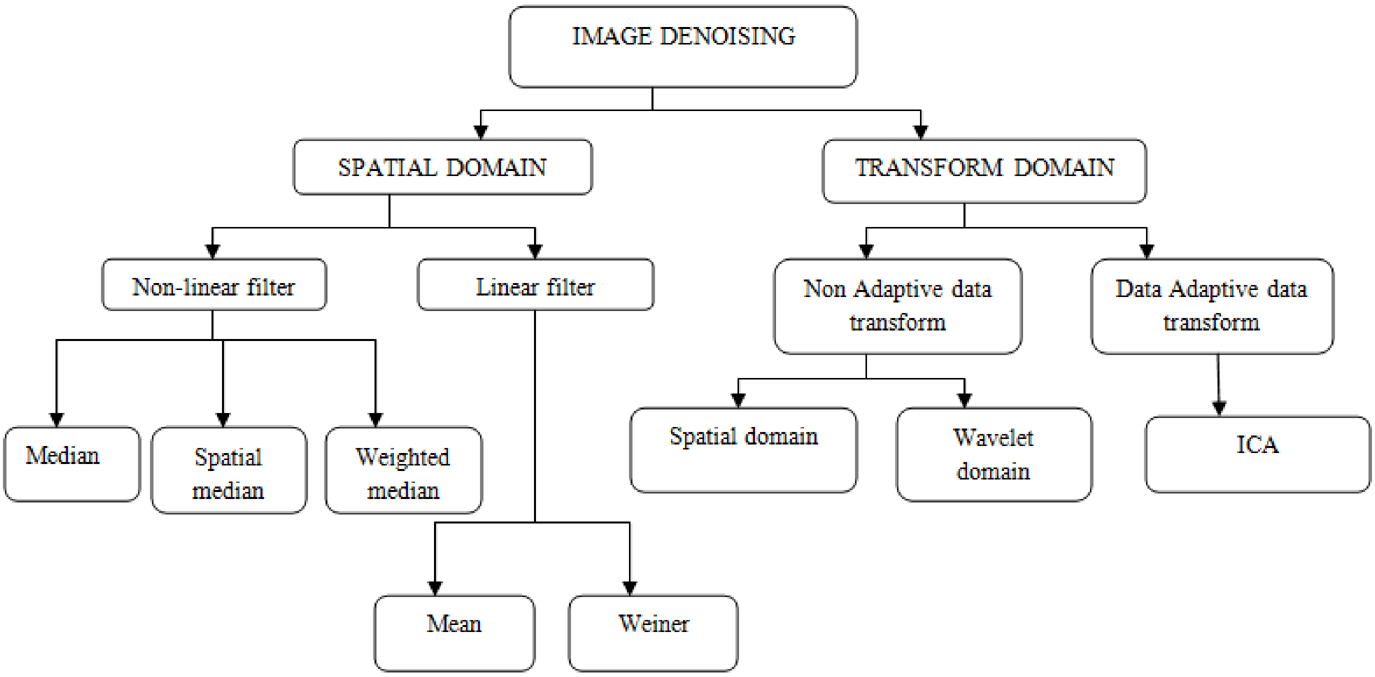

Figure: 1 Classification of Image De-noising Method

A) Spatial Domain Filtering

This method is a traditional way to remove the noise from the corrupted image. Spatial filters are used to remove such type of noise. There are basically two filters used in spatial domain filtering, they are linear filters and non-linear filters:

1) Linear Filters

- *Mean Filter:* It is a simple method of de-noising as it smoothen the image by lowering the intensity value of the pixel one after the other. In mean filter, we usually replace the value of corrupted pixel by the mean average of the neighboring pixel values. In this way we use mean filter to de-noise. It reduces the intensity values between the adjacent pixels.

- *Wiener Filter:* This method requires the spectral information about the noise and the original signal. Wiener method is used to implement spatial smoothing and it model complexity controls correspond to choosing the window size [5]. Wiener filtering significantly removes the noise when the variance of noise is low. It causes blurring and smoothening of the sharp edges of the image [6].

2) Non-Linear Filters

- *Median Filter:* Median filter is a famous non-linear filter. In this type of filter the noisy pixel value is replaced by taking the median of all the neighboring pixels of that noisy one. This filter is mainly used for reducing noise without blurring edges of the image [7].
- *Spatial Median:* The spatial median filter is also noise removal filter where the spatial median is calculated by calculating the spatial depth between a point and a set of point. This spatial depth is defined by [8]

$$S_{depth} = 1 - \frac{1}{N-1} \qquad \frac{X-x_i}{\|X-x_i\|} \qquad \text{……………. (3)}$$

In this filter we find the spatial depth which helps us to find whether the pixel is corrupted or not. If the pixel at the center is not corrupted then we will make no change to the pixel value. After that we find the spatial depth of each pixel in the mask and arrange them in descending order. The spatial median is defined by the pixel with the greatest depth. This spatial median then replaces the corrupted pixel.

- *Weighted Median Filter:* Same as median filter except it cannot have empty mask. Some average or weight would be present.

B) Transform Domain Filtering

The transform domain filtering can be subdivided into data adaptive transform and non-adaptive data transform filters. Transform domain mainly includes wavelet based filtering techniques [9]. Data adaptive transform consists of Independent component analysis (ICA).

1) Data-Adaptive Transform

Data Adaptive Transform consists of Independent Component Analysis (ICA).It is an emerging technique which has gained wide spread attention. The ICA method was introduced in [10] in de-noising Non-Gaussian data. It's exceptional merit is assuming signal to be Non-Gaussian which helps to de-noise images with Non-Gaussian as well as Gaussian distribution [5].

2) Non-Adaptive Data Transform

- *Spatial Domain:* It is a kind of Non-Adaptive Transform Domain, filtering where low pass filters (LPF.) is used by using Fast Fourier Transform (FFT). A cut-off frequency is designed to de-noise an image. One disadvantage of these methods are time consuming and it may produce artificial frequencies in processed image.

- *Wavelet Domain:* Wavelet approach for removing noise is very well known to all of us. It has seen that the use of wavelets removes noise while preserving the fine details, regardless of its frequency content [11]. Wavelet transformation takes advantage of its multi-resolution representation of signal and image in two dependant domains, which decompose the signal into multi-scale domain. The local neighbors of the wavelet basis functions in both time and frequency domain leads to multi-resolution analysis and effective filter designs for specific applications. These properties of the wavelets make it popular for de-noising. Wavelets gain popularity in the area of biomedical image de-noising due to its sparsity and multi-resolution properties.

V. CONCLUSION

We have discussed various noise models, types of noises and de-noising methods. The non-linear models show very good results as compared to linear models in image de-noising. Wavelets are best suited for its properties like sparsity, multi-resolution and time-frequency domain. It is a fast technique for removing noise and takes less memory in use. Non-linear filters are preferred over linear filters because linear filters produce blur effect in the image.

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REFERENCES

[1] Motwani, M.C., Gadiya, M. C., Motwani, R.C., Harris, F. C Jr. *"Survey of Image Denoising Techniques".*
[2] Pan, Q. 1999, Two denoising methods by wavelet transform, *IEEE Trans Signal Processing*, vol. 47, pp. 3401-3406.
[3] Rupinderpal et al., International Journal of Advanced Research in Computer Science and Software Engineering 3(2), February - 2013, pp. 133-136
[4] Jaspreet 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.
[5] Anjali Malviya*," Fractal Based Spatial Domain Techniques for Image De-Noising".*
[6] MALLAT, S., S. ZHONG, Characterization of signals from multiscale edges, *IEEE Trans.Pattern Anal. Machine Intell*, 1992, **14**(7), 710–732.
[7] Mariana Carmen Nicolae, Luminiţa Moraru, Laura Onose," Comparative Approach For Speckle Reduction In Medical Ultrasound Images**".**
[8] James C Church, Yixin Chen, and Stephen V Rice , "A Spatial Median Filter for noise removal in digital images" ,IEEE Southeast Conference 2008,3-6 April 2008.
[9] Motwani, M.C., Gadiya, M. C., Motwani, R.C., Harris, F. C Jr. *"Survey of Image Denoising Techniques".*
[10] Florian Luisier, Thierry Blu, Brigitte Forster and Michael Unser, "Which Wavelet bases are best for Image Denoising", SPIE Proceedings, Vol. 5915, Sept. 17 ,2005.
[11] A. K. Jain. Fundamentals of digital image processing. Prentice Hall, Englewood Clis, NJ, c1989.

