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# Classification of Image Denoising Techniques

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**Abstract:** ***Image denoising plays important role in image processing because of noise is introduced during transmission and acquisition. Technique which reduces the noise called as image denosing. Removing noise from digital image is big challenge for researchers .Several noise removal techniques have been proposed till date. This technique dependent on the type of noise present in the image. All technique has its own assumptions, advantages and limitations. This paper describes the different types of noise and classification of noise reduction technique.***

**Keywords:** image denoising, noise reduction technique

## 1. Introduction

In an increasingly application of digital world, Digital Images play an important role in day to day applications such as Digital Cameras, Magnetic Resonance Imaging, Satellite Television as well as in areas of research and technology including Geographical Information System [1][2]. Generally noise is introduced in the image during image transmission and acquisition. Different types of noises were added like Gaussian noise, salt and pepper noise, Brownian noise etc. The degradation of the image will vary on the type of noise. The noise removal techniques must be chosen according to percentage of image quality degradation [3].This paper describes different types of noise and noise reduction technique.

## 2. Models of Noise

Additive or multiplicative noises are present in image.

### 2.1Additive Noise Model-

Noise which gets added to the original signal to produce a corrupted noisy signal is called as additive noise and model follows the following model [4]-

$$w(x, y) = s(x,y) + n(x,y) \quad \ldots\ldots\ldots \quad (1)$$

### 2.2 Multiplicative Noise Model-

Noise which gets multiplied to the original signal is called as multiplicative noise and model follows the following rule:

$$w(x, y) = s(x,y) \times n(x,y) \quad \ldots\ldots\ldots \quad (2)$$

Where, the original image intensity is denoted by s(x,y) and the noise is denoted by n(x,y) to produce the corrupted signal w(x,y) at (x,y) pixel location[4].

## 3. Types of Noise

### 3.1 Gaussian Noise-

Evenly distributed over the signal is called as Gaussian noise [5]. This means that each pixel in the noisy image is the sum of the true pixel value and a random Gaussian distributed noise value. Gaussian distribution is a bell shaped probability distribution function given by,

$$F(g) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-(g-m)^2/2\sigma^2}, \quad \ldots\ldots\ldots \quad (3)$$

Where, the gray level denoted by g, the mean or average of the function is denoted by *m* and standard deviation of the noise is denoted by σ.

### 3.2 Salt and Pepper Noise

An impulse type of noise is called as salt and pepper noise [5]. Due to errors in data transmission this type of noise is introduced. For an 8- bit image, typical value 0 for pepper noise and 255 for salt noise. The corrupted pixels are set to the minimum or to the maximum value alternately, giving the image a "salt and pepper" like appearance.

### 3.3 Speckle Noise

Speckle noise [6] is a multiplicative noise. These types of noises caused by the signals from elementary scatters, gravity capillary ripples. A gamma distribution of speckle noise is given as

$$F(g) = \frac{g^{\alpha-1}}{(\alpha-1)!a^{\alpha}} e^{-\frac{g}{a}}, \quad \ldots\ldots\ldots \quad (4)$$

Where variance is $a^2\alpha$ and *g* is the gray level.

### 3.4 Brownian Noise

Brownian noise [7] comes under the category of fractal or 1/*f* noises. The mathematical model for 1/*f* noise is fractional Brownian motion [8]. Fractal Brownian motion is based on a non-stationary stochastic process which follows a normal distribution. A special case of 1/*f* noise called as Brownian noise and it is obtained by integrating white noise.

## 4. Classification of Image Denoising Techniques

Image denoising area is broadly classified into three domains.

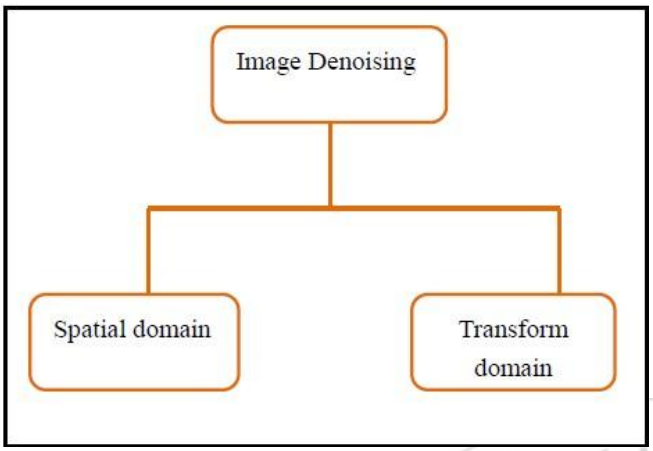


**Figure 1:** Classification of Image Denosing

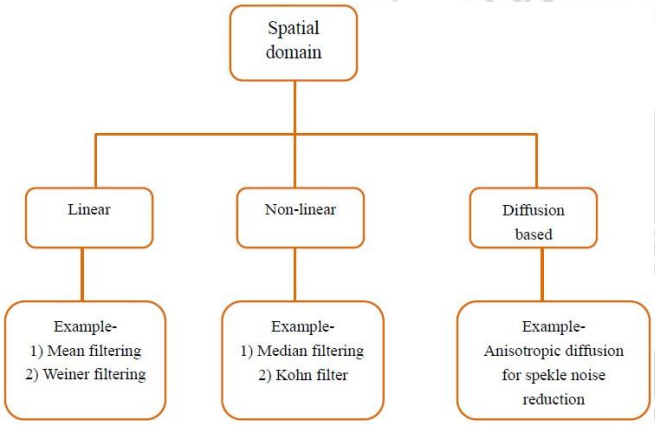


**Figure 2**: Classification of Spatial Domain Based Image Denosing Techniques

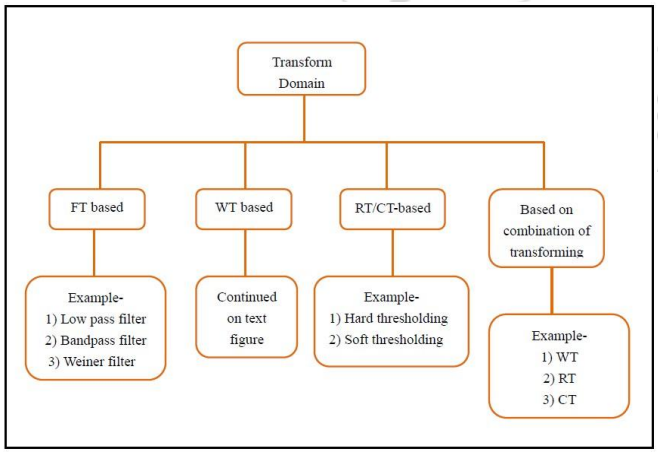


**Figure 3:** Classification of Transform Domain Based Image Denoising Techniques

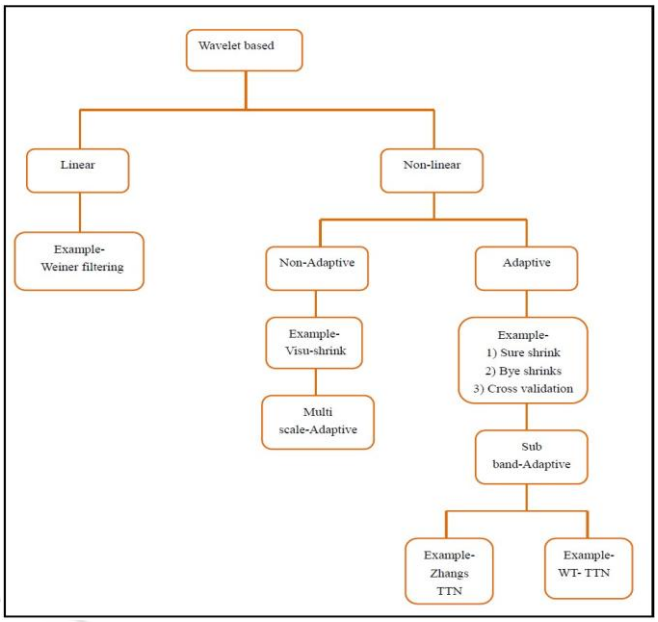


**Figure 4**: Classification of Wavelet Based Image Denoising Techniques

## 5. Discussion

This paper describes types of noise and their models. Also describes only classification of image denosing techniques on the basis of spatial domain, Transform domain, wavelet based domain. This paper not included detail of each technique.

## 6. Acknowledgment

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