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Survey On Image Denoising Using Various Techniques

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Abstract - *Noise removal is an important task in an image processing. In the field of image noise reduction several techniques have been proposed. The idea of this paper is to analyse different methods to produce the better results interms of PSNR, SNR, SSIM. Different denoising techniques are discussed in this paper.*

Key Words: Denoising, PSNR, SNR, MSE, AWGN,.

1.INTRODUCTION

Digital images are playing very important role in research and technology which are used in face recognition, automatic license plate recognition, finger print recognition, signature recognition, satellite television, magnetic resonance imaging, computer tomography etc. Images are used in various fields like medical and education but images often degraded by noise. Noise can occur during image acquisition, transmission, reproduction etc. Noise can be produced by sensor, digital camera or scanner. If the images are corrupted by noise then the quality of images will be reduced. To retain the original image from the noise corrupted image denoising techniques are used. Denoising means removal of unwanted information from an image. Image denoising model is used to remove the edges when preserving the edges. Different images are denoised with different technologies. Image denoising method is used to improve the quality of image.

2. METHODOLOGY

2.1 Image Denoising Using Wavelet Soft Thresholding

Wavelet transform is the mathematical tool for image denoising.Wavelet denoising has many applications in signal processing, medical, data mining etc. In all fields image denoising is the first step. In this method wavelet soft thresholding is used to denoise the image. Noisy image is preprocessed after that wavelt denoising and wavelet thresholding is applied. Then the image is post processed to get the denoised image [4].

2.2 Image Denoising Using Hard Thresholding

Wavelet transform is the powerful tool for image denoising. In wavelet transform hard thresholding method is used to remove the noisy coefficients. In this method, the original image is mixed with noise which will produce the noisy image. Then, wavelet coefficients are determined by applying discrete wavelet transform. These wavelet coefficients are denoised with wavelet threshold. Each wavelet coefficients is compared with wavelet threshold. If the coefficients are smaller than threshold level which is set to zero otherwise it is kept as it is or it is modified. Then, inverse wavelet transform is applied to the modified coefficient inorder to get the denoised image [1].

2.3 Image Denoising Using Curvelet Transform

Curvelet transform is an extension of wavelet transform. In this paper, image denoising is based on ridgelet and curvelet transform. Curvelets are based on multiscale ridgelets combined with a spatial bandpass filtering operation. In curvelet transform variable width have a variable length. The length and width at fine scales are related by a scaling law width approximately equal to width [5].

2.4 Image Denoising Using Genetic Algorithm

In this method image denoising is done through thresholding and optimization using genetic algorithm. The original test image is mixed with Gaussian noise then the corrupted image will be produced. To produce the denoised image genetic algorithm is used. The objective of genetic algorithm is to minimize the mean square error and to maximize the peak signal to noise ratio [3].

2.5 Image Denoising Using BM3D-SAPCA

In this method shape adaptive grouping is done using 8 directional LPA-ICI. The neighbourhood is enclosed within a fixed size and non-adaptive square block which is called as reference block. Similar block are finded by using block matching algorithm. Then transform is determined for the adaptive shape neighborhoods along the third dimension of third group. Hard thresholding is performed on the 3-D spectrum. Then inverse 3-D transform is applied for adaptive shape neighborhoods [11].

2.6 Image Denoising Using Curvelet Transform and Weiner Filter

The input for this method is noisy image which can be obtained by adding Additive White Gaussian

Noise(AWGN) with the original image. Then, the noisy image is passed through the weiner filter. After passing through the weiner filter curvelet transform is applied. Curvelet transform includes 2-D wavelet transform, 2-D fast transform, Random transform and Ridgelet transform. Then, invert curvelet transform is applied to produce the denoised image [10].

2.7. Image Denoising Using HOSVD

In this method similar image patches are grouped together from a noisy image into Three-dimensional (3-D) stack. From three dimensional stack, higher order singular Value Decomposition(HOSVD) coefficients are computed, then invert HOSVD transform is applied to produce the filter output [8].

2.8. Image Denoising Using Median Filter And IQR

In this paper noise is suppress by median filter and reduced by using interquantile range(IQ) which is also used to preserve the edge sharpness then the dispersion is calculated for variation of elements. The window size must be KxK, and permission procedure is used to check whether the image is noisy or noiseless [9].

2.9 Image Denoising Using Non-Local Means Algorithm

This method is used to remove the impulsive noise and Gaussian noise from an image. The input image for this algorithm is noisy image, the pixel value is found for the noisy image. If the noise is impulsive then the noisy pixel is determined. The noisy pixel is replaced by applying NLM filtering. This process is repeated until all pixels are noisy free. Then we can get denoised output [12].

3. EXPERIMENTAL RESULTS

3.1 Image Denoising Using Wavelet Soft Thresholding

An alternative approach to hard thresholding is soft thresholding which leads to less severe distortion of signal. The signal may be one-dimensional, two-dimensional and three-dimensional. Denoised signals performance are compared based on mean square error measured [4].

Table 1
PSNR value for variance = 0.01, 0.03

Paper	PSNR Variance=0.01
Color Image Denoising Using Wavelet soft Thresholding	31.993

3.2 Image Denoising Using Hard Thresholding

In this method the noisy image is first decomposed into five levels to obtain the different frequency bands. Then hard thresholding method is applied to remove the noisy coefficients by fixing the optimum thresholding value. From the denoised image the performance parameters such as PSNR, SNR, MSE [1].

Table 2
Parameters of denoised image for variance=0.02

Paper	PSNR	SNR	MSE
Analysis of Wavelet Denoising of a Colour ImageWith Different Types of Noises	30.0746	28.087	4.8359e+05

3.3 Image Denoising Using Curvelet Transform

In this paper, both curvelet and ridgelet transform are implemented. Curvelet transform uses ridgelet transform as a component step. Curvelet transform produce higher quality than wavelet based reconstruction. Curvelet obtains small MSE error than wavelet [5].

Table 3
PSNR value for variance = 20

Paper	PSNR Variance=20
The Curvelet Transform for Image Denoising	34.51

3.4 Image Denoising Using Genetic Algorithm

In this paper, image is denoised through thresholding and optimization using genetic algorithm. Wavelet parameters such as threshold value and optimization values are determined. .Denoising technique is applied to whole image or each sub band of the image. Genetic Algorithm procedure is used to remove the additive white Gaussian noise and to remove the mean square error [3].

Table 4
PSNR value for variance = 10, 20

Paper	PSNR Variance=10	PSNR Variance=30
Genetic Algorithm Based Medical Image Denoising Through Sub Band Adaptive Thresholding	34.51	29.80

3.5 Image Denoising Using BM3D-Shape Adaptive Principal Component Analysis

In this paper, first image patches are determined which have data-adaptive shape. Then, principle component analysis are proposed to these adaptive shape neighbourhoods. By using shape-adaptive PCA we can improve the performance of BM3D algorithm, mean structural similarity index map (MSSIM), peak signal to noise ratio (PSNR), and reconstructed the fine details using this methods [11

Table 5
PSNR value for variance = 5, 15

Paper	PSNR Variance=5	PSNR Variance=15
BM3D Image Denoising with Shape-Adaptive Principal Component Analysis	34.16	24.61

3.6 Image Denoising Using Curvelet Transform and Weiner Filter

Weiner filter is used to minimize the mean square error, which is used to remove the additive noise. In this method PSNR value is better than curvelet transform and wavelet transform. PSNR value increases as variance value decreases [10].

Table 6
PSNR value for variance = 10, 20

Paper	PSNR Variance=10	PSNR Variance=20
Image Denoising Method Using Curvelet Transfform And Weiner Filter	36.9005	31.5529

3.7. Image Denoising Using HOSVD

In the noisy images if the group of patches are similar then we do not denoise independently in the three dimensional stack. HOSVD can obtain the fine textures[8].

Table 7
PSNR value for variance = 20,30

Paper	PSNR Variance=20	PSNR Variance=30
Image Denoising using the Higher Order Singular Value Decomposition	32.015	30.079

3.8 Image Denoising Using Median Filter With Edge Detection Using Canny Operator

In this method all the pixel values are stored in ascending order, from that the suspected pixels are calculated. Then permission procedure is applied to check the image. By using this median filter can remove the outlier from window size KxK [9].

Table 8
PSNR value for different window size

Paper	Window Size	Median Filter	IQR Filter
Image Denoising Using Median Filter with Edge Detection Using Canny Operator	3x3	35.0945	38.9235
	5x5	30.9786	36.7854
	7x7	28.6724	37.3126

3.9 Image Denoising Using Non-Local Means Algorithm

This method is used to the performance by minimize difference between degraded image and original image [12].

Table 9
PSNR value for noise densities

Paper	Noise Density(%)	NLM
Image Denoising and Deblurring Using Non-Local Means Algorithm in Monochrome Images	5	38.26
	10	34.19
	15	32.01

4. CONCLUSION

BM3D-SAPCA(Shape Adaptive Principal Component Analysis) is the new proposed method for image denoisng. A literature survey for various image denoising process was done. BM3D-SPCA provide better results when compare with all other methods interms of peak signal to noise ratio.

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