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Improvement of image denoising using curvelet method over dwt and gaussian filtering

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Abstract

Image de-noising is a process for removal of noise in digital image processing where image may be corrupted during its acquisition or transmission. As noise addition reduce the visual performance and computerized analysis so de-noising is applied that helps to retain its quality of the original image after removal of noise. This procedure is traditionally performed in the spatial or frequency domain by filtering. The process of removing noise from the original image is still a demanding problem for researchers. Recently, a lot of methods have been implemented that perform de-noising such as Filtering techniques, Wavelet Transform (DWT) domain, Curvelet transform method.

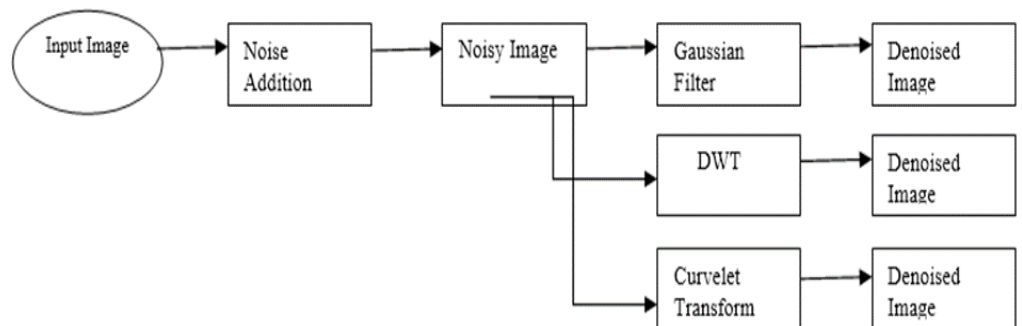
The prime focus of this paper is related to the preprocessing of an image done by de-noising before it can be used in applications. In order to achieve these de-noising algorithms, filtering technique and wavelet based de-noising technique are used and performs their comparative study. Noises in form of Gaussian noise, speckle noise, salt pepper noise are used. The curvelet based approach has been proved to be the best among all filtering and Dwt based approach of de-noising. A quantitative measure of comparison is provided by the parameters like Peak signal to noise ratio, mean square error of the image.

Keywords: de-noising, filtering technique, dwt, curvelet

1. Introduction

Visual perception has become an essential part of communication in today's world. Because of which it is important to ensure that transmitted data is not corrupted by any kind of unwanted signals called noise. Noises are generated due to the improper modeling of production and/or capturing system of the signal. In real time scenario the obtained signal/ image deviates from ideal signal that is expected. The pre-processed task of further image processing such as Edge-detection or Image-Segmentation are done for such reason. Gaussian-filtering, Discrete-Wavelet-Transform and Curvelet -Transform are the most prominent methods to de-noise an image. The image features are preserved along with the reduction in the noise levels by the help of the de-noising algorithm. PSNR and MSE values have been compared individually for Gaussian-filtering, Discrete-Wavelet-Transform and Curvelet-Transform.

2. Flow Chart for the Proposed Work-



3. Gaussian Filter-

The Gaussian filters are the filters which are used to give no overshoot to the input function which is a step function, and it minimizes rise and fall time. Hence a minimum group delay is caused by the Gaussian filters due to the above reasons. Gaussian filters are used for smoothening the image. In a Gaussian filter the input signal is modified by convoluting it with Gaussian function. It is a very good filter for eliminating noise from normal distribution. Gaussian filters are usually non causal, due to which they are unrealizable physically.

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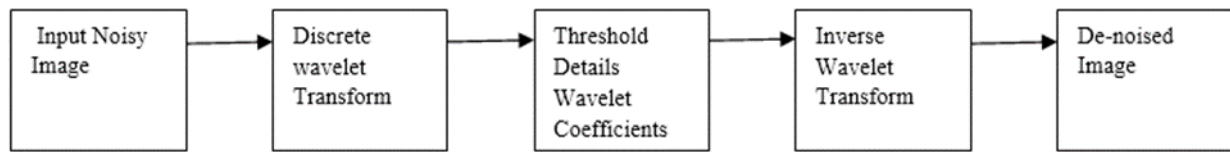
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4. DWT-

The wavelet uses the multi-resolution concept .It helps in studying a signal in different windows or resolutions. DWT stands for discrete wavelet transform. It represents the transformation of the sampled data. A finite scale multi-resolution representation of a discrete function is called as

discrete wavelet transform. In the DWT method we performed the following technique:- (i) Calculate Discrete wavelet transform. (ii)Threshold wavelets. (iii)Calculate inverse wavelet transform.

Block Diagram-

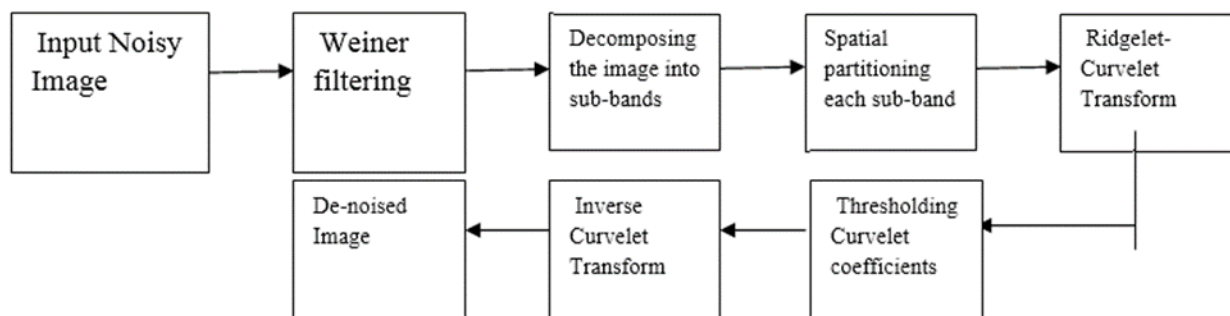


In this method of de-noising the input noisy image is first decomposed into different sub-images for obtaining the Wavelet coefficients. Then the detailed Wavelet coefficients are compared with a given threshold value then accordingly these coefficients are minimized close to zero in order to remove the effect of noise in the data .At the time of Thresholding a wavelet coefficient is compared to the given Threshold and is set to zero, if its magnitude is less than Threshold otherwise it is then retained or modified depending on the Thresholding rule. In this method of de-noising we have implemented Soft Thresholding. Then the image is reconstructed from modified coefficients which is done by the Inverse Discrete Wavelet transform to get the de-noised image.

5. Curvelet Transform-

Curvelet transform is a new multiscale representation most suitable for objects with curves. The Curvelet transform is a higher dimensional generalization of the Wavelet transform designed to represent images at different scales and different angles. The curvelet transform is a special member of the multiscale geometric transforms. This method involves decomposing the original image into sub-bands, then spatial partitioning of each sub-band. Then applying Ridgelet-Radon transform and calculating the curvelet coefficient. Then Thresholding the Curvelet coefficients. Then reconstruct the image by Inverse Curvelet Transform to get the de-noised image.

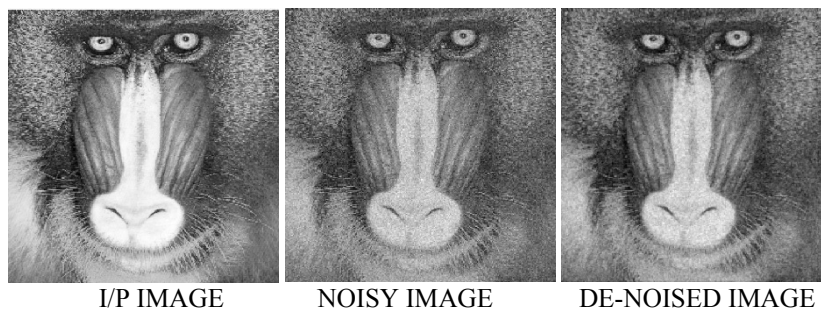
Block Diagram-



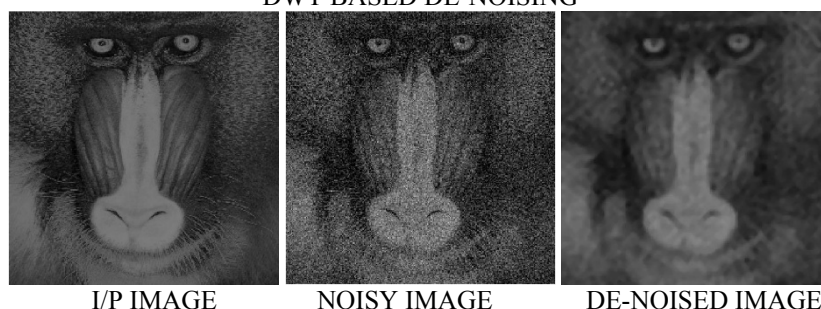
6. Results & Discussion

Matlab Based Results for Image Denoising

Sample Image 1(Baboon.Bmp):
Gaussian Filtering:



DWT BASED DE-NOISING



CURVELET BASED DE-NOISING

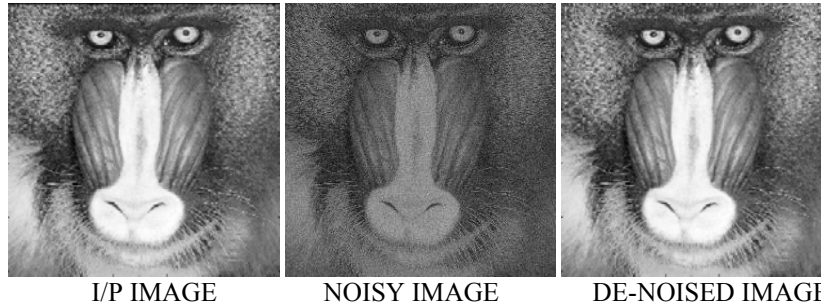
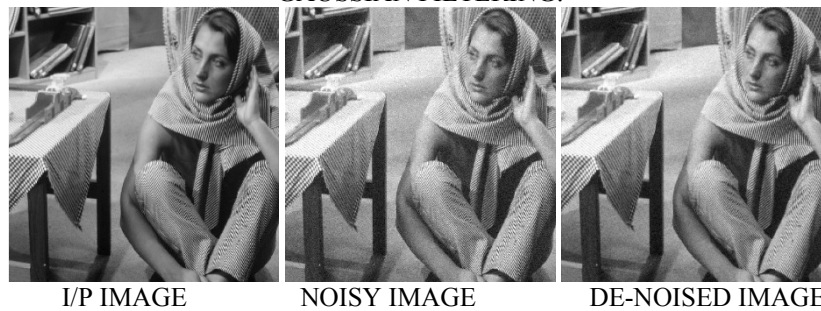
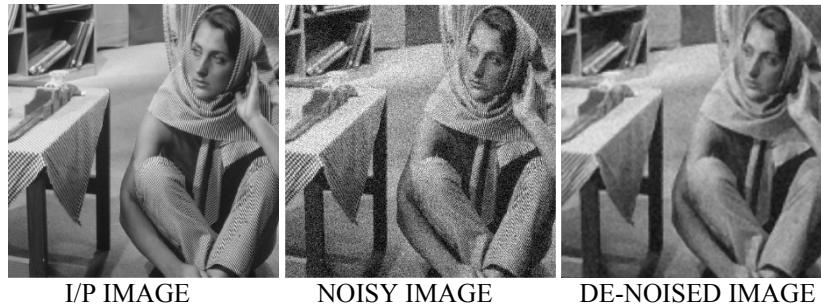


Image Name	Denoising Technique	Psnr Values	Mse Values
Baboon.bmp	Gaussian	19.6560	703.8485
	DWT	26.1069	159.3628
	CURVELET	26.6880	41.9120

SAMPLE IMAGE 2(BARBARA.BMP):
GAUSSIAN FILTERING:



DWT BASED DE-NOISING:-



CURVELET BASED DENOISING:-

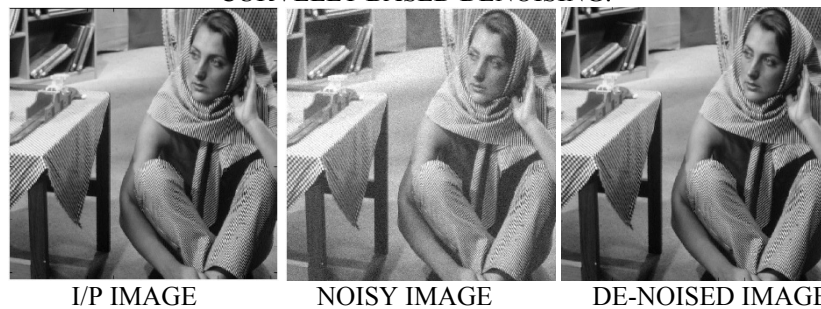
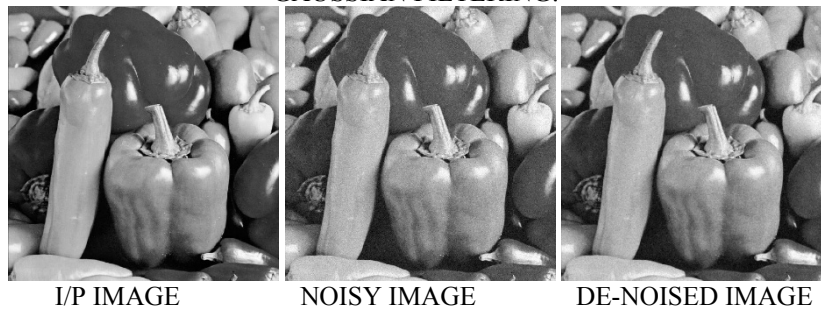
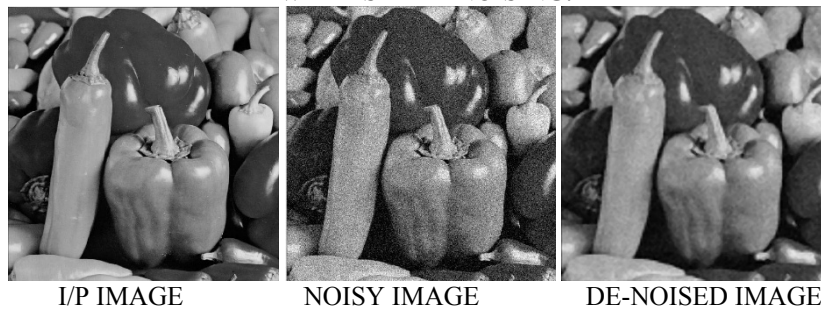


Image Name	Denoising Technique	Psnr Values	Mse Values
Barbara.bmp	Gaussian	19.5964	713.5810
	DWT	23.3320	301.9098
	CURVELET	36.5078	45.29026

SAMPLE IMAGE 3(PEPPERS.BMP)
GAUSSIAN FILTERING:-



DWT BASED DENOISING:-



CURVELET BASED DENOISING

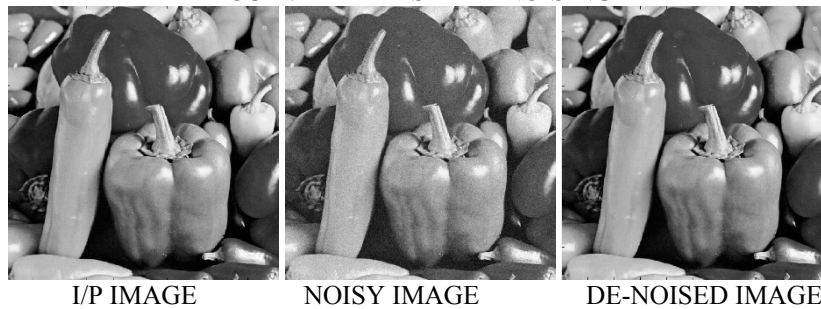


Image Name	Denoising Technique	Psnr Values	Mse Values
Peppers.bmp	Gaussian	19.7201	693.5442
	DWT	27.5757	113.6340
	CURVELET	35.3756	34.42123

7. Conclusions

Our proposed de-noising algorithm has de-noised image and the PSNR value have been found to better than the gaussian filtering and the wiener filtering.

The dwt and curvelet showing better results in terms of psnr and mse.

The curvelet de-noising technique can be tested for different medical image processing works in the future works like MRI (Magnetic Resonance Imaging) for brain tumor detection.

The edge wrapping technique can be applied in future work.

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