

# IMAGE DENOISING USING WAVELET AND CURVELET TRANSFORM

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**Abstract**— The images usually bring different kinds of noises in process of receiving, coding and transmission. This paper describes a comparison of the discriminating power of the various multiresolution based thresholding techniques i.e. wavelet, Curvelet for image denoising. The Thecurvelet transform is new multiscale transform after 1999 that is based on wavelet transform, whose structural elements include the parameters of dimension and location, and orientation parameter more, which let curvelet transform has good orientation characteristic. Therefore, curvelet transform is superior to wavelet in the expression of image edge, such as geometry characteristic of curve and beeline, which has already obtained good research results in image denoising. This paper puts forward an improved method based on curvelet transform because certain regions of the image have the ringing and radial stripe after curvelet transform. The experimental results indicate that the improved curvelet transform has an abroad future for eliminating the noise of images. It suits not only the ordinary visual image, but also remote sensing image.

**Index Terms**— Denoising, Curvelet Transform, Wavelet Transform, Orientation.

## I. INTRODUCTION

Image processing technique also corrupts image with noise, leading to significant reduction in quality. Traditionally, linear filters (mean, median, and wiener filter) are used for removing noise from images, but it blurs data [1]. It is well known that wavelet transform is a signal processing technique which can display the signals on in both time and frequency domain. Wavelet transform is superior approach to other time-frequency analysis tools because its time scale width of the window can be stretched to match the original signal, especially in image processing studies. This makes it particularly useful for non-stationary signal analysis, such as

noises and transients. For a discrete signal, a fast algorithm of discrete wavelet transform (DWT) is multi resolution analysis, which is a non-redundant decomposition. One of the most popular method consists of thresholding the wavelet coefficient (using hard threshold or the soft threshold) as introduced by Donoho. Elyasi and Zarmehi proposed several methods of noise removal from degraded images with Gaussian noise by using adaptive wavelet threshold (Bayes Shrink, Modified Bayes Shrink and Normal Shrink).

Our main objective is to decrease a mean square error (MSE) and to increase a peak signal to noise ratio (PSNR) in db. To Design and implement a model for image denoising using wavelet transform and curvelet transform using multilevel decomposition approach. Quantitative analysis would be performed by checking attained Peak Signal to Noise Ratio (PSNR) and Mean Square Error estimation of the denoised image. Random noise reduction is another main criterion for determining the image quality objectively.

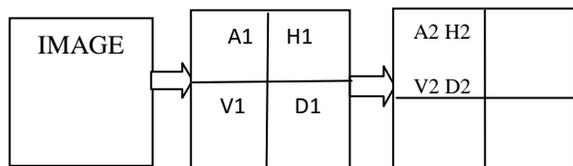
## II. MULTIREOLUTION TECHNIQUES

An image can be represented at different scales by multiresolution analysis. It preserves an image according to certain levels of resolution and blurring in images and also improves the effectiveness of any diagnosis system.

### 2.1 WAVELET

Wavelet transform can achieve good scarcity for spatially localized details, such as edges and singularities. For typical natural images, most of the wavelet coefficients have very small magnitudes, except for a few large ones that represent high frequency features of the image such as edges. The

DWT (Discrete wavelet transforms) is identical to a hierarchical sub band system. In DWT, the original image is transformed into four pieces which is normally labelled as A1, H1, V1 and D1 as the schematic depicted in fig.1. The A1 sub-band called the approximation, can be further decomposed into four sub-bands. The remaining bands are called detailed components. To obtain the next level of decomposition, sub-band A1 is further decomposed.



**Fig.1 DWT based Wavelet Decomposition to various levels**

### 2.2 CURVELET

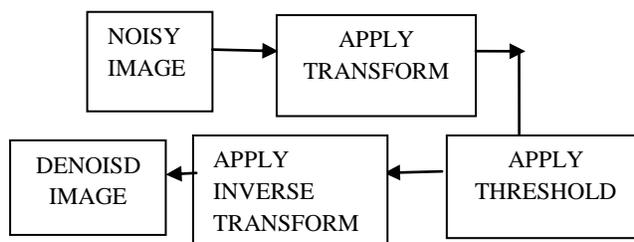
The curvelet transform is a very young signal analyzing method with good potential. It is recognized as a milestone on image processing and other applications.

Unfortunately, global straight-line singularities are rarely observed in real applications. To analyze local line or curve singularities, a natural idea is to consider a partition of the image, and then to apply the ridgelet transform to the obtained sub-images. This block ridgelet-based transform, which is named curvelet transform, was first proposed by Candes and Donoho in 2000. Apart from the blocking effect, however, the application of this so-called first generation curvelet transform is limited because the geometry of ridgelets is itself unclear, as they are not true ridge functions in digital images. Later, a considerably simpler second-generation curvelet transform based on frequency partition technique was proposed. The second-generation curvelet transform has been shown to be a very efficient tool for many different applications in image processing. The overview of the curvelet transform is shown below for four step: 1. Subband Decomposition, 2. Smooth partitioning, 3. Renormalization, 4. Ridgelet Analysis.

### III. IMPLEMENTATION

In this paper, we report initial efforts at image denoising based on a recently introduced family of transforms- Wavelet transform and Curvelet. A wavelet

transform and curvelet transform and we will see which transform is better for the image denoising



**Figure 2. Block Diagram of System**

Our main objective is to decrease a mean square error (MSE) and to increase a peak signal to noise ratio (PSNR) in db. By adding a white noise like Gaussian noise, Poisson noise and Speckle noise. During this configuration, we will use Threshold estimator. Thresholding is the simplest method of image segmentation. From a greyscale image, thresholding can be used to create binary images. Thresholding is a simple non-linear technique, which operates on one wavelet coefficient at a time. In its most basic form, each coefficient is threshold by comparing against threshold. If the coefficient is smaller than threshold, set to zero, otherwise it is kept or modified. On replacing the small noisy coefficients by zero and inverse wavelet transform. In both case (Soft thresholding and hard thresholding) the coefficients that are below a certain threshold are set to zero. In hard thresholding, the remaining coefficients are left unchanged. In soft thresholding, the magnitudes of the coefficients above threshold are reduced by an amount equal to the value of the threshold. In both cases, each wavelet coefficient is multiplied by a given shrinkage factor, which is a function of the magnitude of the coefficient. In our thesis, we will use a curvelet transform as well as wavelet transform for removing an additive noise which is present in our images and we will also compare between both the techniques i.e. Curvelet transform and Wavelet transform which we are using & we'll see which one is better for image denoising. Image from MIA's database was denoised using wavelet and curve let transforms. Various types of noise like the Random noise, Gaussian noise, Salt&Pepper and speckle noise were added to this image

IV. RESULT

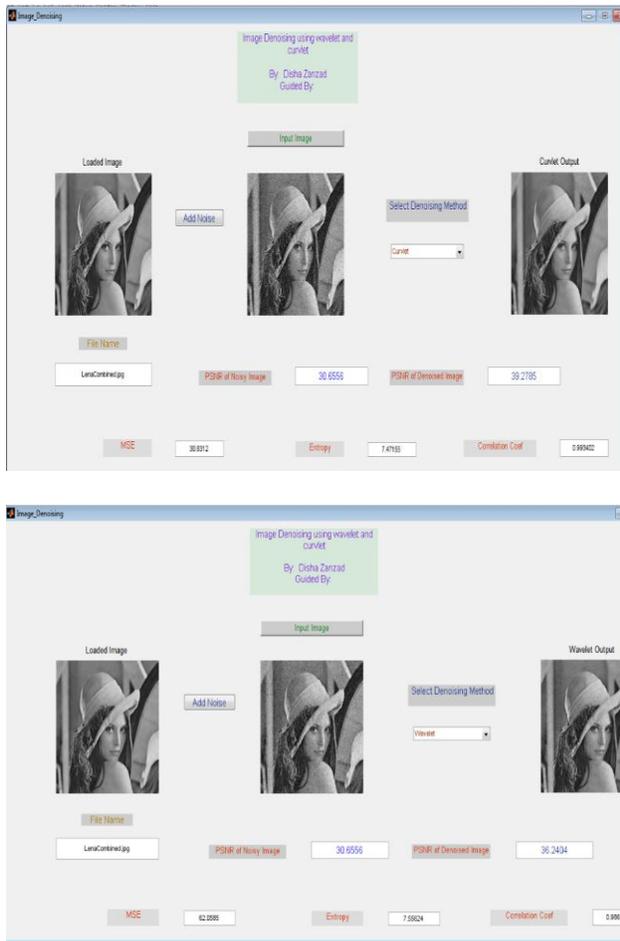


Figure 3. Image of lena showing comparison between noisy, wavelet & curvelet image

Table 1 Comparison of wavelet and curvelet in MSE, PSNR, CC, and Entropy

PARAMETER	NOISY IMAGE	WAVELE	CURVELET
MSE	95.198696	62.058510	<b>30.831219</b>
PSNR	30.6556	36.240405	<b>39.278511</b>
Cc	0.979591	0.986923	<b>0.993402</b>
ENTROPY	7.523002	7.556245	<b>7.471549</b>

V. CONCLUSIONS AND FUTURE WORK

The comparison of wavelet transform and curvelet transform technique is rather a new approach, and it has a big advantage over the other techniques that it less distorts spectral characteristics of the image

denoising. The experimental results show that the curvelet transform gives better results/performance than wavelet transform method. The primary goal of noise reduction is to remove the noise without losing much detail contained in an image. To achieve this goal, we make use of a mathematical function known as the wavelet transform to localize an image into different frequency components or useful sub bands and effectively reduce the noise in the sub bands according to the local statistics within the bands.

The main advantage of the wavelet transform & curvelet transform is that the image fidelity after reconstruction is visually lossless. Image accessing task, both as a process itself and as an image denoising is an important component in other processes. Very many ways to denoise an image or a set of data exists. The main propertied of a good image denoising model is that it will remove a noise while preserving edges.

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