ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2017; 3(5): 221-223
www.allresearchjournal.com
Received: 01-03-2017
Accepted: 02-04-2017

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Analysis of curvelet and contourlet transform for removing noises in ultrasound renal images

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Abstract
Imaging has become an essential component in many fields of bio-medical research and clinical practice. Medical Imaging helps in therapeutic and diagnosis process. The major problem in medical images is noises that may lead to a wrong diagnosis and treatment. There are several noises such as Poisson noise, Gaussian noise, Salt and pepper noise, speckle noise. The aim of the proposed approach is the reduction of the noise in ultrasound kidney image by using Curvelet and Cantourlet transform. etc

Keywords: Curvelet, Contourlet, PSNR, MSE, Transform, Ultrasound, etc

1. Introduction
Image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image. Image processing is especially to the improve quality of image.
Digital image processing is the use of computer algorithms to perform image processing on digital images. It is a sub-category or field of digital signal processing.
Medical image processing is the technique and process of creating visual representation of medical images for better analysis and treatment. It also reveals the internal structure hidden by bones and skin and helps in better diagnosis and treatment.
In medical image processing, medical images are corrupted by different type of noises. Noise may arise in the process of image acquisition, its transmission and also in the reproduction of an image. Removing of noise from medical images is now a very challenging issue in the field of medical image processing. Ultrasound imaging is most widely used imaging technique compare to x-ray, MRI and CT scan because of its noninvasive nature, low-cost and capability of forming real time imaging. There are different types of images such as Salt and pepper noise,Gaussian noise, Poisson noise, sobel noise, speckle noise etc….
Filters are used to remove noises to get the clear image. The different types of filtering technique include average, disk, mean median, Gaussian, Laplacian, motion, Perwitt, Sobel, Gabor filter, Homomorphic filter, Curvelet and Contourlet filter. Among these filters we use Curvelet and Contourlet filter technique for de-noising the noise in medical images. The curvelet transform is very efficient in representing curve-like edges. The contourlet expansions are defined on rectangular grids, and thus offer a seamless translation to the discrete world, where image pixels are sampled on a rectangular grid.

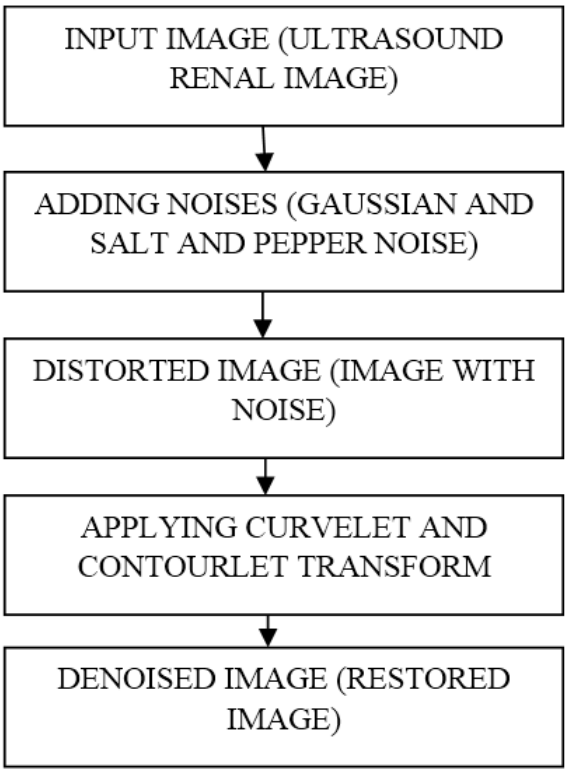
2. Literarure Survey
The title of this paper is Speckle Reducing Contourlet Transform for Medical Ultrasound Images. It is based on a speckle reduction method based on the contourlet transform for denoising medical ultrasound images. The performance evaluation of the proposed method is done in terms of MSE, PSNR are computed from despeckled image [1].
This paper describes and analyses an algorithm for cleaning speckle noise in ultrasound medical images. Mathematical Morphological operations are used in this algorithm. This algorithm is based on Morphological Image Cleaning algorithm (MIC) designed by Richard Alan Peters II.
This paper proposes an approach to obtain the renal calculi image clearly from ultrasound machine using MATLAB software. They used several filters method and make a calculation process includes Mean Square Error (MSE), Root Mean Square Error (RMSE),Signal to

Noise Ratio (SNR), Power Signal to Noise Ratio (PSNR), Average Difference (AD), Speckle Index(SI) to see the quality of images after filtering process.

This paper presents a fast and easy method to implement denoising of ultrasound images.

3. Proposed System

The following figure explains the steps involved in denoising the ultrasonic renal image.



The above figure shows the step by step process of denoising image. As a first step ultrasonic renal image is given as an input. The second step involves the addition of noises. Here we are adding Gaussian noise and salt and pepper noise. Thus now we can get an distorted image i.e., image with noise. To remove the noises in an image we are applying Curvelet and Contourlet Transform.

The Curvelet transform is higher dimensional generalization of the wavelet transform which is used to represent the images at different scales and different angles. It is also used to overcome the missing directional selectivity of 2D wavelet transforms. It is also called as multiresolution geometric analysis (MGA). Curvelet has two unique qualities they are:

Curvelets remain coherent waveforms under the action of the wave equation in a smooth medium.

Curved singularities can be well approximated with very few coefficients and in a non-adaptive manner-thus the name “curvelet”.

Contourlet is a real represent method of 2D image. This transform consist of two-layer-filter:Laplacian pyramid transform is used to realize multi-scale decomposition and multi direction decomposition can be implemented by directional filter bank. Contourlet transform can realize multi-resolution and multi direction decomposition flexibly and grasp.

4. Simulation Results

Fig (a): The figure (a) shows the original ultrasonic renal image.

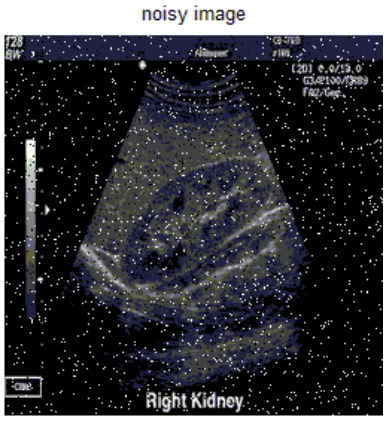


Fig (b): The figure(b) shows the image with salt and pepper noise.

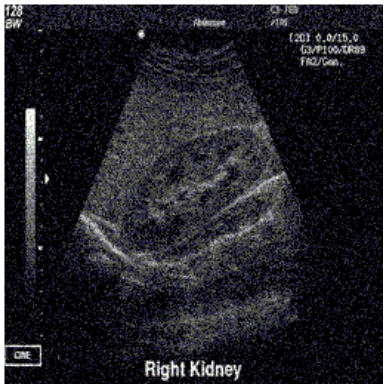


Fig (c): Gaussian noise

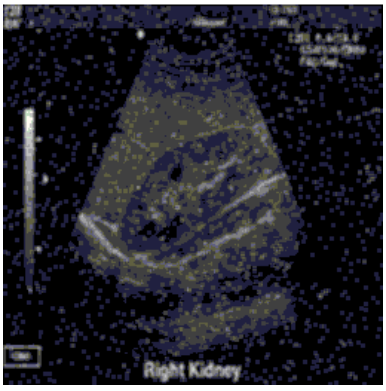


Fig (d): Denoised Salt and Pepper noise

5. Performance Evaluation Metrics and Comparison

The Mean Square Error (MSE) and the Peak Signal to Noise Ratio (*PSNR*) are the two error metrics used to compare image compression quality. The MSE represents the cumulative squared error between the compressed and the original image, whereas *PSNR* represents a measure of the peak error [2].

PSNR is most easily defined via the mean squared error (*MSE*). Given a noise-free *m*×*n* monochrome image *I* and its noisy approximation *K*, *MSE* is defined as:

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

The PSNR (in dB) is defined as:

$$\begin{aligned} PSNR &= 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right) \\ &= 20 \cdot \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right) \\ &= 20 \cdot \log_{10}(MAX_I) - 10 \cdot \log_{10}(MSE) \end{aligned}$$

S. No.	Parametres	Curvelet	Contourlet
1.	PSNR	36.2791	39.8472
2.	MSE	0.5719	0.2476

6. Conclusion

Denoising of image has become the one of the recent research area in image processing. This paper has proposed denoising ultrasound kidney image by using curvelet and contourlet transforms. contourlet transform has better denoising capabilities compared to existing methods.

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