RESEARCH ARTICLE OPEN ACCESS

Review on Speckle Noise Reduction Techniques for Medical Ultrasound Image Processing

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Abstract:-

In medical image processing, for Ultrasound images, the noise can restrain information which is valuable for the Medical practitioner . Ultrasonic devices are frequently used by healthcare professionals. The use of ultrasound imaging in medical diagnosis is well established because of its noninvasive nature, low cost, capability of forming real time imaging and continuing improvement in image quality . The main problem during diagnosis is the distortion of visual signals .These distortions are termed as 'Speckle Noise', this makes the image unclear. In the medical literature, speckle noise is referred as "texture". The success of ultrasonic examination depends on the image quality which is usually retarded due to speckle noise .Therefore, noise reduction is very important. In medical image processing, image denoising has become a very essential exercise all through the diagnose. In this review paper several techniques for effective suppression of speckle noise present in ultrasound images has been studied.

Keywords:- medical imaging, ultrasound, speckle noise, wavelet thresholding

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INTRODUCTION:-

Each of the medical imaging devices is affected by different types of noise. For example, the x-ray images are often corrupted by Poisson noise, while the ultrasound images are affected by Speckle noise. Speckle is a complex phenomenon, which degrades image quality with a back scattered wave appearance which originates from many microscopic diffused reflections that passing through internal organs and makes it more difficult for the observer to discriminate fine detail of the images in diagnostic examinations[1]. Thus, denoising or reducing these speckle noise from a noisy image has become the predominant step in medical image processing.

METHODS:-

Speckle reduction can be divided roughly into two categories:

1)processing techniques
2)post processing

The first one recovers the image by summing more than a few observations of the same object which suppose that no change or motion of the object happened during the reception of observations. These techniques do not require any hardware modification in the image reconstruction system, and hence have found a growing interest. In this the images are obtained as usual and the processing techniques are applied on the image obtained.

Image post processing is an appropriate method for speckle reduction which enhances the signal to noise ratio while conserving the edges and lines in the image.

1)WAVELET THRESHOLDING:

All the wavelet filters use wavelet thresholding operation for denoising .Speckle noise is a high-frequency component of the image and appears in wavelet coefficients. One widespread method exploited for speckle reduction is wavelet thresholding procedure. The basic Procedure for all thresholding method is as follows:

1)Calculate the discrete wavelet transform (DWT) of the image.

2)Threshold the wavelet coefficients. (Threshold may be universal or sub band adaptive)·

3)Compute the Inverse Discrete Wavelet Transform (IDWT) to get the denoised estimate.

2)IMAGE DENOSING PROCEDURE :

This section depicts the image-denoising algorithm, which achieves near optimal soft thresholding in the wavelet domain for recovering original signal from the noisy one. The wavelet transform employs Daubechies' least asymmetric compactly supported wavelet with eight vanishing moments with four scales of orthogonal decomposition. It has the following steps.

1)Transform the multiplicative noise model into an additive one by taking the logarithm of the original speckled data.

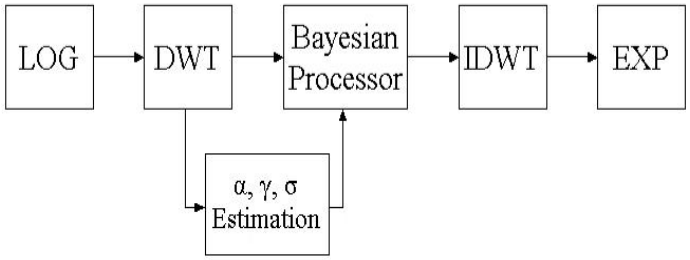
2) Log I(x, y) = log S(x, y) + log η(x, y).

3) Perform the DWT of the noisy image up to 2 levels (L=2) to obtain seven sub bands, which are named as LL1, HH1, LH1, HL1, HH2, LH2, HL2 and LL2.

4) Obtain noise variance using 6.

5) Calculate the weighted variance of signal δ by 4.

6)Compute the threshold value l for each pixel by 5.



7) Threshold all sub band coefficients using Soft thresholding by substituting the threshold value obtained from 5.

8) Perform the inverse DWT to reconstruct the denoised image.

9) Take Exponent.

3)STANDARD DESPECKLING TECHNIQUES:

There are many speckle reduction filters available, some give better visual interpretations while others have good noise reduction or smoothing capabilities. Some of the best known speckle reduction filters are Median, Lee, Kuan, standard Frost, Enhanced Frost, Weiner, Gamma MAP and SRAD filters.

Some of these filters have unique speckle reduction approach that performs spatial filtering in a square-moving window known as kernel. The filtering is based on the statistical relationship between the center pixel and its surrounding pixels. The typical size of filter window can range from 3-by-3 to 33-by-33, but the size of window must be odd. If the size of the filter window is too large, important details will be lost due to over smoothing. On the other hand, if the size of the window is too small, speckle reduction may not yield good results. Generally a 3-by-3 or 7-by-7 window is used giving good results

CONCLUSION :-

The comparative study of various speckle reducing filters for ultrasound images shows that although all standard speckle filters perform well on ultrasound images but they have some constraints regarding resolution degradation. These filters sometimes causes over smoothing. Wavelet transform is best suited for performance because of its properties like multiresolution and multiscale nature. Thresholding techniques used with discrete wavelet are simplest to implement.

The use of filter in Digital Image Processing improves the image to a great extent. Mainly in the case of presence of Speckle noise, filtering is very much required in order to improve the diagnostic

examination and also to improve the efficiency of post processing techniques like segmentation this work proposed method yields significantly improved visual quality as compared to the other techniques in the denoising literature.

Speckle Reducing Anisotropic Diffusion(SRAD) is a nonlinear smoothing filter . This filter is edge-sensitive, has the ability to preserve edges while smoothing the rest of the image to reduce speckle noise . The anisotropic diffusion has been used by several researchers in image restoration and image recovery by homomorphicfiltering.

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