Speckle Noise Removal in Medical Images using Various Filters

S. Pradeep, K. Ribana

Abstract*: *Speckle noise removal is still a challenging task for removal which occurs due to returning waves from laser, Synthetic aperture radar, ultrasound etc. In this proposed work combination of various filters has been used for the removal of speckle noise and various parameters like SNR, PSNR, MSE, SSIM has been measured and results are compared for different medical images.

Index Terms*: *Filter, Medical Images, Speckle noise, Thresholding

I. INTRODUCTION

Ultrasound is medical technology for imaging the various internal organs of the human body. It is still a challenging task for the researchers to remove the noise occurs, speckle for removing from the image obtained. Speckle occurs due to repeating waves that occurs between the transmitter and receiver. Speckle also occurs in the SAR, like Remote sensing, etc, Laser imaging also suffers from the speckle noise and it needs a perfect combination of filters for the noise removal with high PSNR value.

Basic filters like mean filter, median filter, adaptive filter, frost filter, Lee filter, Wavelet transform filters are used previously for the removal of speckle.

Problem associated:

Ultrasound is a technique in which high frequency waves are passed in deep to view the internal organs and blood vessels. It is a non invasive technique and harmless. Transducer is placed over the human body and gel is applied to pass the waves. Reflection by the organs will give the standing waves measured by the transducer of the sonography. The ultrasound wave can be both transmitted and gotten by a piezo electric transducer. The piezoelectric transducer can change electrical signs in to mechanical waves, that is, transmitting ultrasound (= turn around piezo-electric impact), and the other way around to change mechanical weight (reflected ultrasound waves, "echoes") into electrical signs (= direct piezoelectric impact). Ultrasounds in the MHz extend (high-recurrence) can be radiated as a directional pillar, similar to a light shaft, from transducers of useful estimate.

Ultrasound is much affected by speckle noise. Speckle noise occurs due to the image acquisition process, image sensor used. These noises affect the pixel quality of the image by distorting the pixel value by adding error information. Majority of the techniques were introduced like lee filter, median filter, mean filter, SUSAN filter, patch-based locally optimal wiener (PLOW) filter, wavelet thresholding methods, soft thresholding techniques etc.

Speckle noise in medical images is difficult for the physician to diagnose it and removal f speckle or despeckling is essential. Speckle noise is given by

$$n(u,v)=i(u,v)*s(u,v) \rightarrow (1)$$

where, n(u,v) is the noisy image
i(u,v) is the original image
s(u,v) is the speckle noise.

Speckle noise is a multiplicative noise found in the sonography given in equation (1).

II. PROPOSED METHOD

Modified Gen filter Algorithm

Wavelet change is widely utilized by the analysts for noise expulsion since it spreads commotion among every one of the coefficients and packs the fundamental picture subtleties into less quantities of coefficients. Henceforth, fine subtleties and edges can without much of a stretch be recognized, regardless of whether there is an expansive sum of commotion present in the pictures. The method for wavelet denoising calculation can be outlined by, registering the 2D wavelet change, thresholding the coefficients and recreating the picture utilizing backwards wavelet change. In the wavelet space, the bigger size coefficient is said to be a critical picture information also, a littler size coefficient to be an immaterial picture information. Likewise, little picture subtleties are uncovered at better scales. Safeguarding of fine subtleties in a picture is practiced by misusing the conditions between two nearby scales called entomb scale reliance and furthermore by the relationship among the coefficients in a similar scale called intra scale reliance. To ponder the bury scale reliance, the subbands at different scales ought to have a similar size. This property of move invariance is deficient in discrete wavelet change. Hence, a Stationary Wavelet Change (SWT) which acquires the property of interpretation invariance is utilized in this paper. The initial phase in the proposed calculation is to decide a cover for each detail subband to recognize the noteworthy pixels of the picture. The cover contains an estimation of either 0 or 1, contingent upon the level of noteworthiness of every pixel. The level of importance is resolved utilizing a standard. The veil for each sub band picture with M number of coefficients is meant as I(i,j) . The cover is assessed utilizing a basic arrangement strategy dependent on the accompanying experimental perceptions: at places of critical picture subtleties the wavelet coefficients increment in extent over the scales and at places

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of noise, their esteem will in general reduction as the goals scale increments.
Median filter is a simple filter which is for removing noise by finding the mean of pixel values for various masks used like 3x3, 5x5, etc. Standard median filter is used in spatial noise reduction for the image window. Median filter is used for noise reduction with replacement of noisy pixel with median value of various windows like 3x3, 5x5.etc.

We propose an economical methodology to estimate the noise-free image by combining patch grouping with the LRA of SVD that ends up in an improvement of denoising performance. The most motivation to use SVD in our methodology is that it provides the best energy compaction within the least sq. sense, which implies that the signal and noise can be better distinguished in SVD domain. Grouping similar patches, as a classification problem, is an important and fundamental issue in image and video processing with a wide range of applications. While there exist many classification algorithms available in, e.g., block matching, K-means clustering, nearest neighbour clustering, and others, we exploit the block-matching method for image patch grouping due to its simplicity.

The input image is abdomen image of ultrasound in which the wavelet transform is used to do the first level decomposition and then the LH, LL, HL, HH values are obtained along with the original image. It is of the size 716x 537 pixels. It is resized to 255 x 255. Resized image has to be added noise value of 0.05 variance of speckle. For the noisy image, the histogram is calculated and then Modified Gen filter algorithm is added and then the Mean Square Error (MSE), PSNR value is calculated along with SNR value.

$$PSNR = 10\ X\ log\ \frac{255^2}{MSE} \quad \rightarrow(2)$$

$$MSE=\frac{1}{MXN}\ \sum_{i=1}^{N}.\sum_{j=1}^{M}[I(i,j) - I'(i,j)]^2 \quad \rightarrow(3)$$

Figure 1: Input image of Ultrasound – Abdomen

The Haar wavelet transform may be thought of to combine up input values, storing the distinction and spending the total. This method is recurrent recursively, pairing up the sums to prove consequent scale, that results in variations and a final total.

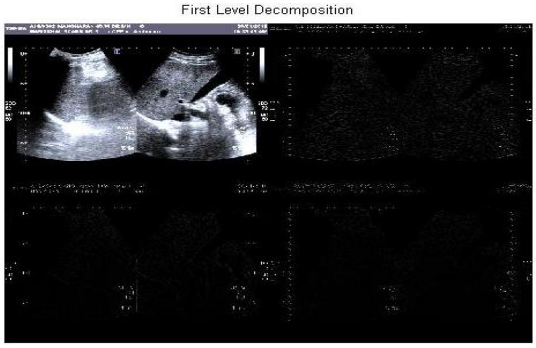

Figure 2: First level decomposition of Abdomen image

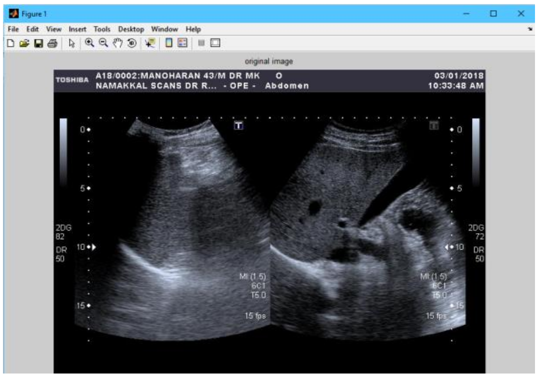

Figure 3: Original Image

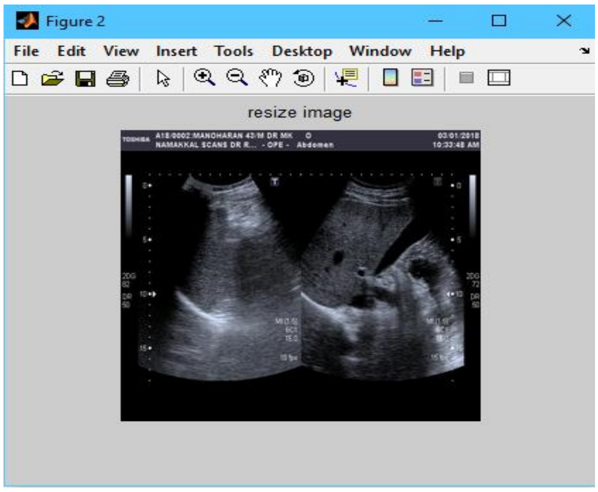

Figure 4: Resized Image

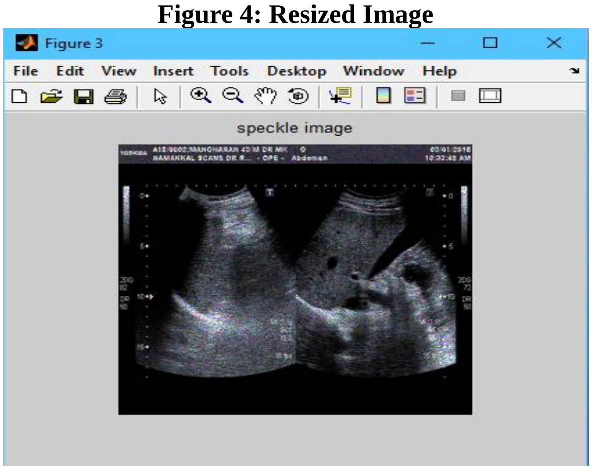

Figure 5: Speckle image

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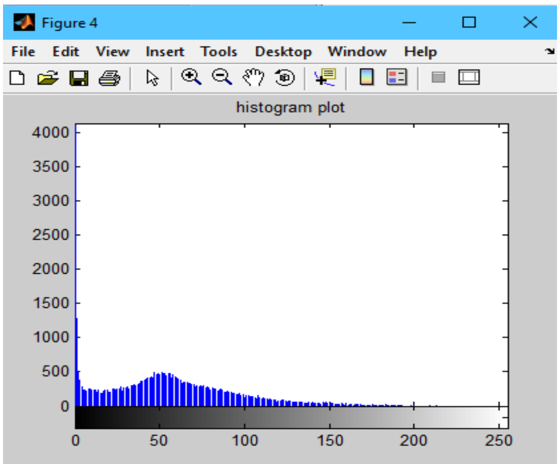

Figure 6: Histogram of abdomen

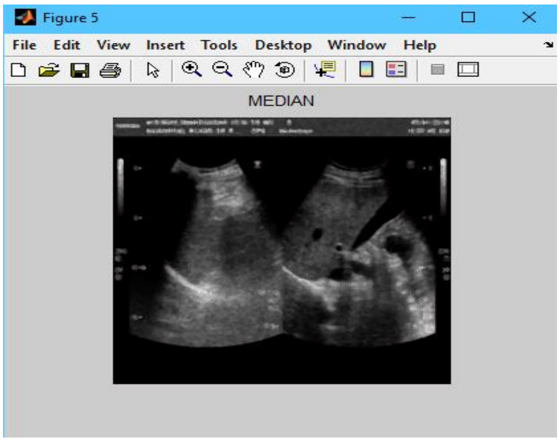

Figure 7: Denoised image

III. RESULTS

Table 1 : Comparison of MSE value

Variance	MSE	
	Median filter	Proposed filter
0.05	26.75	15.33
0.10	27.05	17.45
0.15	27.36	17.88
0.20	28.50	19.75

Table 2: PSNR comparison for Lee and Levy Shrink filters of ultrasound image

Noise σ^2	**Lee**	**Levy Shrink**	Proposed filter
0.05	21.75	26.37	30.17
0.10	26.905	32.153	42.1
0.15	27.436	32.742	40.42
0.20	28.32	33.844	43.44

IV. CONCLUSION

The proposed filter shows better performance in terms of MSE and PSNR value. Thus the speckle noise can be reduced if this filter is used. The MSE value shows that for the variance increase the MSE value also increases. Depending upon the noise value the MSE value will give the better results. For 20% variance PSNR is 43.44. Better results can be shown from this Proposed filter.

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