Biomedical Images denoising using Symlet Wavelet with Wiener filter

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ABSTRACT
Various medical modalities like MRI, CT scan, Ultrasound Imaging have been widely used in medical diagnosis. From all these ultrasound imaging is most popular due to its non-harmful nature and lost cost. But there is a problem in ultrasound images that is speckle noise which effects diagnosis based on the ultrasound images by disappearing low contrast lesions in tissues. Many techniques like Filtering, Morphology, Histogram equalization and wavelets have been developed. From these wavelets based techniques performed better and give superior results. In this paper we discuss Symlet wavelet with Wiener filter technique to reduce speckle noise in ultrasound images. This technique gives better results than previous techniques by minimizing mean square error.

KEYWORDS- Ultrasound Imaging, Speckle, Wavelet Transform, Symlet and Wiener filter.

I. INTRODUCTION
Ultrasound imaging plays an important role in medical diagnosis. It is non-invasive, non-expansive, fast, forming real time imaging. But it suffers from a problem that is speckle noise that degrades image quality [1]. Speckle noise is a multiplicative noise. It is a random mottling of dark and bright spots appear in image which effect diagnosis [2]. But it is difficult to remove speckle noise because removing speckle may also remove important information useful in diagnosis [3]. So, we analyze various techniques among these wavelet transform provide superior results along with filtering technique.

II. WAVELET TRANSFORM
In Recent years, many studies have been made on wavelets. An excellent overview of what wavelets have brought to the fields as diverse as biomedical applications, wireless communications, computer graphics or turbulence, is given in [4]. Image Denoising is one of the most visible application of wavelets. Wavelet analysis is a windowing technique with scale and time aspects in variable- sized regions. Discrete wavelet transform is one of wavelet transform for which wavelets are discretely sampled. It has both frequency and location information. DWT (Discrete wavelet transform is used for signal coding. DWT procedure decompose an image into several Sub-bands like HH, HL, LH, and LL. HH gives diagonal information, HL gives horizontal representation, LH gives vertical information and LL consisting of low frequency components means important information. In next step, LL is further divided at the higher levels of decomposition [3]. The level of decomposition in our technique is 3.

III. TECHNIQUES USED FOR SPECKLE REDUCTION
In this paper we use wavelet family like Symlet wavelet with wiener filter and level of decomposition is 3

3.1 Symlet Wavelet: Symlet wavelets are a family of wavelets. They are a modified version of Daubechies wavelet with increased symmetry. The properties of the two wavelet families are similar. There are 7 different Symlet functions from sym2 to sym8. In *symN*, *N* is the order.

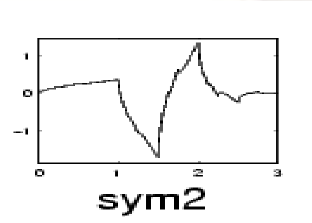

Figure 1: sym2 Wavelet Function Waveform

3.2 WIENER FILTER: Wiener filter is proposed by Norbert wiener in 1940 and published in 1949. It is used to reduce noise in signal. When the image is blurred by a known low pass filter, it is possible to recover the image by inverse filtering. But inverse filtering is very sensitive to additive noise. The Wiener filtering executes an optimal trade-off between inverse filtering and noise smoothing. It removes the additive noise and inverts the blurring simultaneously. The wiener filter minimizes the mean square error between the estimated random process and the desired process. It minimizes the overall mean square error in the process of inverse filtering and noise smoothing. The Wiener filtering is a linear estimation of the original image [2].

ALGORITHM FLOW CHART

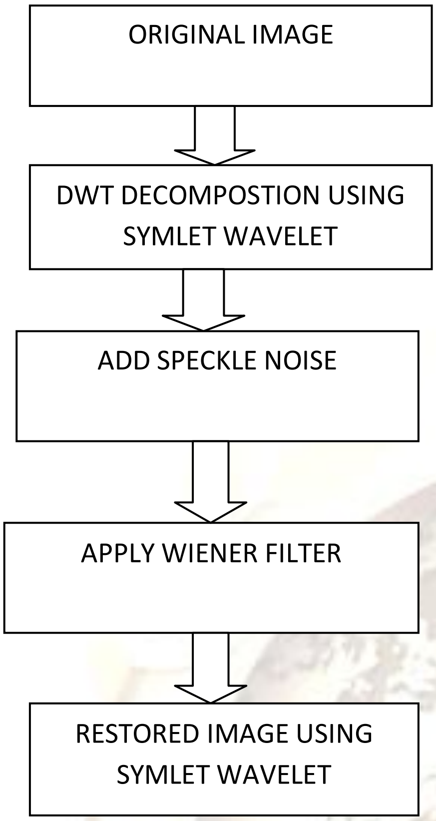

Figure 2 Flowchart of speckle reduction technique using Symlet wavelet wavelet with wiener filter

IV. RESULTS

Results would be both Qualitative and Quantitative analyses by obtaining the denoised version of the input image by DWT Technique and comparing it with the input image used. Analysis would be performed by checking attained Processing Time, Mean Square Error estimation of the denoised image and PSF.

USING SYMLETS WAVELET AND WEINER FILTERS

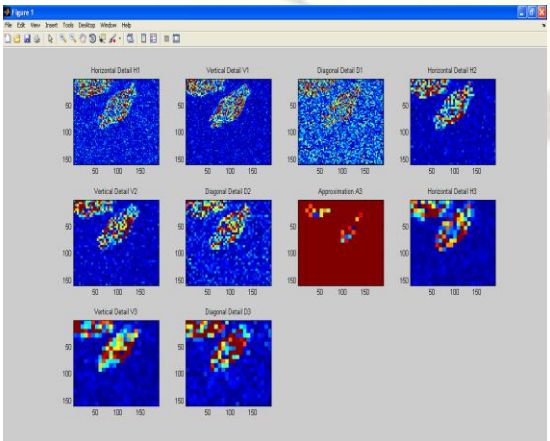

Figure 3: Approximation and Detail Coefficients using Symlet Wavelet

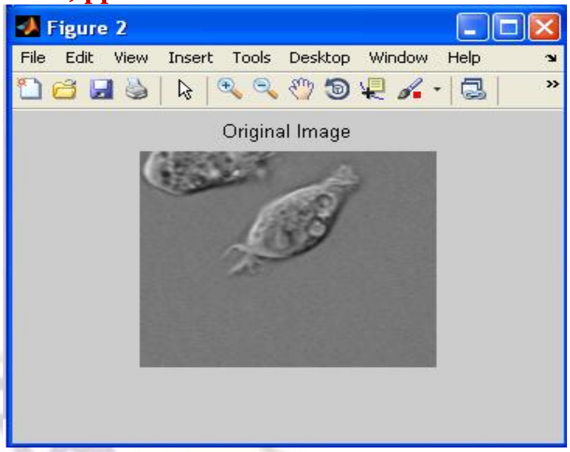

Figure 4: Original Cell Image

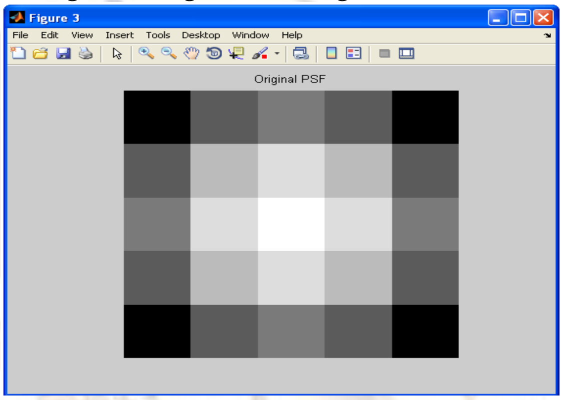

Figure 5: PSF (Point Spread Function) of Original Image

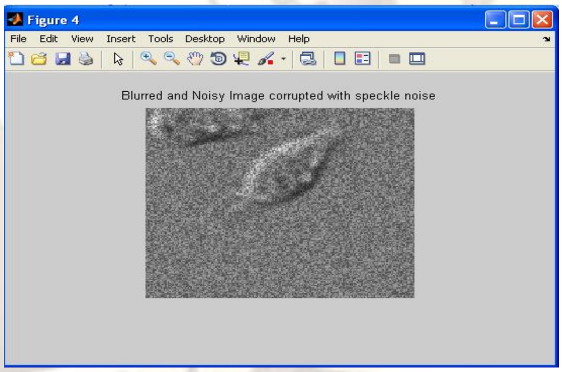

Figure 6: Blurred and Noisy Image with multiplicative speckle Noise

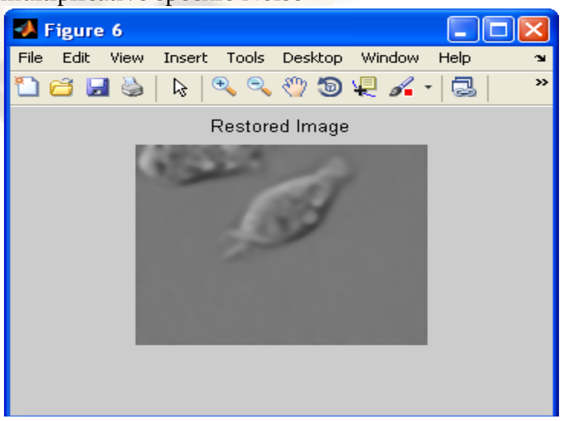

Figure 7: Enhanced and Restored Image using Wiener filters and Symlet wavelet

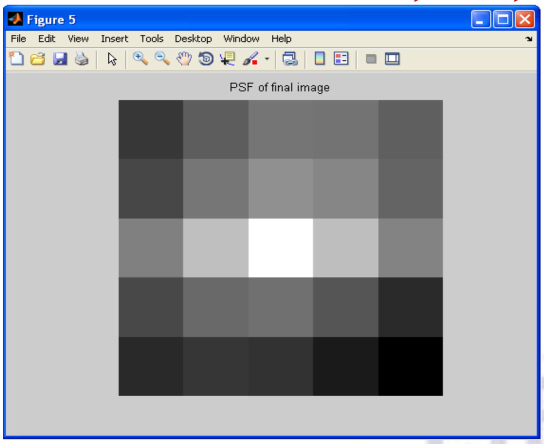

Figure 8: PSF of final image

	MEAN SQUARE ERROR (MSE)	ELAPSED TIME
SYMLET WAVELET WITH WIENER FILTER	0.2359	5.669997 seconds

Table 1: **VALUES OF MSE AND ELAPSED TIME**

V. CONCLUSION

We concluded that Symlet wavelet with wiener filter provide superior results than filtering techniques. This technique minimizes the mean square error and from PSF we concluded that restored image is closer to original image. We also used this technique to reduce another types of noise like Gaussian noise, salt and pepper noise.

REFERENCES

[1] Sivakumar .R and Nedumaran .D, " Implementation of Wavelet Filters for Speckle noise Reduction in Ultrasound Medical Images: A Comparative Study" *International Conference on Signals, Systems and Communication*, December 21-23, 2009.

[2] Asmaa Abass Ajwad , " Noise Reduction of Ultrasound Image Using Wiener filtering and Haar Wavelet Transform Techniques" *Diyala Journal of Medicine*, Vol. 2, Issue 1, April 2012.

[3] Dhrub Kumar, Maitreyee Dutta, Parveen Lehana, " A Comparative Analysis of Different Wavelets for Enhancing Medical Ultrasound Images", *International Journal of Computer Applications (0975 – 8887)* ,Volume 66– No.7, March 2013.

[4] N.K. Ragesh, A.R. Anil, DR. R. Rajesh, "Digital Image Denoising in Medical Ultrasound Images: A Survey", *IGCST AIML – 11 Conference, Dubai, UAE,* 12-14 April 2011.

[5] R. Sivakumar, D. Nedumaran, "Comparative study of Speckle Noise Reduction of Ultrasound B-Scan Images in Matrix Laboratory Environment", *International Journal of Computer Applications, IJCA,* Vol. 10 – No. 9, November 2010.

[6] Haryali Dhillon, Gagandeep Jindal, Akshay Girdhar, "A Novel Threshold Technique for Eliminating Speckle Noise in Ultrasound Images", *International Conference on Modelling, Simulation and Control, IPCSIT,* vol.10 (2011) IACSIT Press, Singapore.

[7] R.Vanithamani, G.Umamaheswari, "Performance Analysis of Filters for Speckle Reduction in Medical Ultrasound Images", *International Journal of Computer Applications (0975 – 8887),* Volume 12– No.6, December 2010.

[8] J. Li and S. Lei, "Rate-distortion optimized embedding", in *Proc. Picture Coding Symp., Berlin, Germany*, pp. 201-206, Sept. 10-12, 1997.

[9] Rakesh Kumar , B. S. Saini, "Improved Image Denoising Technique Using Neighboring Wavelet Coefficients of Optimal Wavelet with Adaptive Thresholding", *International Journal of Computer Theory and Engineering,* Vol. 4, No. 3, June 2012.

[10] Andy Milkowski, MS, Yadong Li, PhD, David Becker, MS, Syed O. Ishrak, PhD. "Speckle Reduction Imaging", *GE Medical Systems Ultrasound.*

[11] E. Ordentlich, M. Weinberger, and G. Seroussi, "A low-complexity modeling approach for embedded coding of wavelet coef_cients", *in Proc. IEEE Data Compression Conf., Snowbird, UT*, pp. 408-417, Mar. 1998.

[12] W.A. Pearlman, "Performance bounds for subband codes", Chapter 1 in *Subband Image Coding*, J. W. Woods and Ed. Klvwer. Academic Publishers, 1991.