

INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION & MANAGEMENT

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COMPARATIVE EVALUATION OF ULTRASOUND BREAST CANCER IMAGE AND DESPECKLING

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ABSTRACT

Breast cancer is the common form of cancer with 81% of cases occurring in women aged 50 years and over in world wide. In Ethiopia the majority (55.2%) of the patients was in the 30-49 age groups. The modalities like Mammography cause severe pain and producing ionizing reactions which causes hazard for the health. By using Ultrasound, the safest imaging modality can be used in the developing countries like Ethiopia and enhance the images and reducing noises which will helps society to increase the awareness about the breast cancer.

KEYWORDS

breast cancer image, despeckling.

1. INTRODUCTION

Breast cancer is one of the most common cancers affecting women throughout the world. Millions of women are diagnosed with the disease every year and hundreds of thousands die needlessly. Breast cancer is the second leading cause of death among African American women in the U.S., according to the Komen for the Cure organization. There is little reliable data on the incidence and prevalence of breast cancer in Africa because of the absence of reporting, diagnostic and treatment processes. Breast cancer cases in Africa are likely to be documented only when patients come to hospitals, health centers, clinics and laboratories for diagnostic and treatment services. Facilities with mandatory reporting requirements are far and few between in the rural areas of Africa where the vast majority of women live.

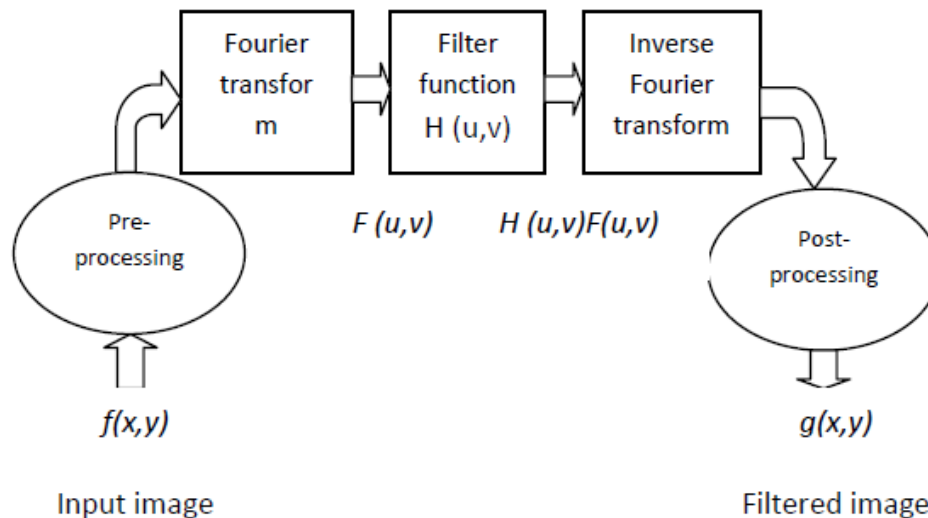
Breast cancer development increases with age, beginning to rise at approximately age 30 years, and most breast cancers occur during the postmenopausal years. The Mammography is the specialized imaging system using X-ray to view the nodes of breast cancer. In the growing countries like Ethiopia the limited availability of mammogram and lack of awareness which increase the volume of breast cancer.

To overcome this problem Ultrasound (US) imaging has become one of the most preferred imaging techniques in today's medical practice as it is inexpensive, widely available and comparatively safe to the users as well as the operators. To create awareness mobile Ultrasound can be used and the images enhanced by various enhancement techniques.

2. US IMAGE ENHANCEMENT TECHNIQUES**2.1.1 FILTERING IN FREQUENCY DOMAIN**

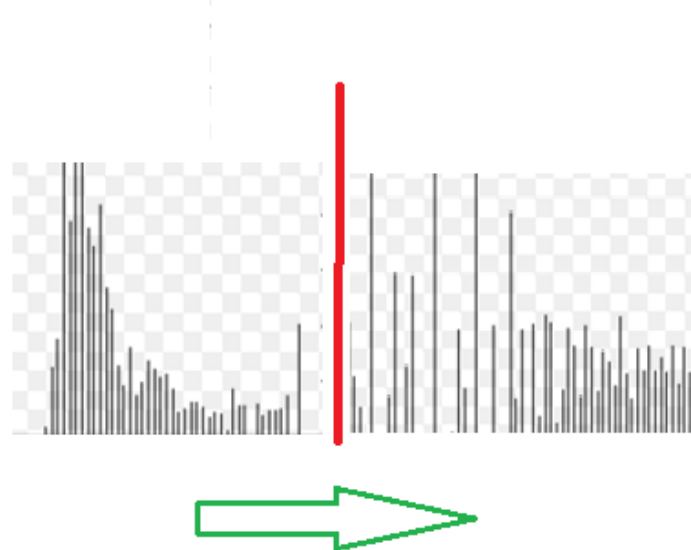
The image operation by preprocessing and using Fourier transform, filter function and taking the Inverse Fourier transform of the result to obtain the processed image.

FIG. 1: BASIC STEPS IN FREQUENCY DOMAIN FILTERING

**2.1.2. HISTOGRAM EQUALIZATION**

Histogram equalization is a technique for adjusting image intensities to enhance contrast. The distributing of image pixels which causes improve visual appearance.

FIG. 2: ADJUSTING THE INTENSITIES BY EQUALIZATION



2.1.3 WAVELET TRANSFORM FILTERS

When digital images are to be viewed or processed at multiple resolutions, the discrete wavelet transform (DWT) is the mathematical tool of choice. In wavelet-based filtering, the basic steps for removing the noise are

- 1) Decomposing the original image data into l-level of wavelet transform.
- 2) Performing thresholding of the resultant wavelet coefficients for noise suppression.
- 3) Performing wavelet reconstruction technique based on the original approximation coefficients.

3. REMOVING OF SPECKLE NOISE

In Ultrasound the high frequency sound waves which are emitted from a probe and the echoes that bounce back from structures in the body are shown on a screen as image. The structures can be much more clearly seen when moving the probe over the body and watching the image on the screen. The main problem in these scans is the presence of speckle noise which reduces the diagnosis ability.

3.1.1 DESPECKLING BY ADAPTIVE WAVELET

Wavelet denoising attempts to remove the noise present in the signal while preserving the signal characteristics, regardless of its frequency content. As the discrete wavelet transform (DWT) corresponds to basis decomposition, it provides a non-redundant and unique representation of the signal.

Wavelet thresholding (first proposed by Donoho) is a signal estimation technique that exploits the capabilities of wavelet transform for signal denoising. It removes noise by killing coefficients that are insignificant relative to some threshold.

3.1.2 WAVELET THRESHOLDING

Standard wavelet thresholding can be performed by following steps.

1. Compute a linear forward discrete wavelet transform of the noisy signal.
2. Perform a nonlinear thresholding operation on the wavelet coefficients of the noisy signal
3. Compute the linear inverse wavelet transform of the threshold wavelet coefficients.

The most traditional wavelet thresholding methods apply the conventional hard and soft thresholding operators.

3.1.3 ADAPTIVE WAVELET THRESHOLDING

VisuShrink is thresholding by applying the Universal threshold proposed by Donoho and Johnstone. This threshold is given by

$$\sigma\sqrt{2\log M}$$

where σ is the noise variance and M is the number of pixels in the image.

For denoising images, VisuShrink is found to yield an overly smoothed estimate.

SUREShrink is a thresholding by applying subband adaptive threshold. It is based on Stein's Unbiased Estimator for Risk (SURE), a method for estimating the loss in an unbiased fashion. Let wavelet coefficients in the j th subband be $\{X_i : i=1, \dots, d\}$ For the soft threshold estimator

$$SURE(t; X) = d - 2\# \{i: |X_i| \leq t\} + \sum_{i=1}^d \min(|X_i|, t)^2$$

Select threshold t^S by

$$t^S = \arg \min SURE(t; X)$$

FIG. 3 INPUT IMAGE

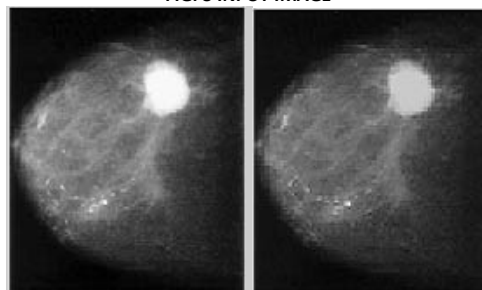


FIG. 4: WAVELET DECOMPOSITION ENHANCED IMAGE

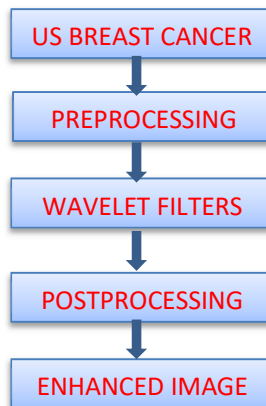


BayesShrink is an adaptive data-driven threshold for image denoising via wavelet soft-thresholding. We assume generalized Gaussian distribution (GGD) for the wavelet coefficients in each detail subband. We then try to find the threshold T which minimizes the Bayesian Risk.

4. RESULTS AND DISCUSSION

The ultrasound breast cancer image has been enhanced by using wavelet filters. By using the programme Matlab the input image (preprocessed image) has been enhanced by using the wavelet filters results to obtain the processed image output. The enhanced breast cancer image is obtained by the following steps.

FIG. 5



4.1 ADAPTIVE WAVELET THRESHOLDING

In the modified bayes shrink the speckle noise has been reduced as compared with other methods.

OBTAINED PSNR FOR DIFFERENT NOISE INTENSITIES BY USING MATLAB

TABLE 1

| Noise | 5 | 10 | 20 | 30 | 40 | 50 |
|----------------------|------------------------|------|------|------|------|------|
| Method | US BREAST CANCER IMAGE | | | | | |
| Average filter | 35.9 | 31.3 | 25.5 | 22.2 | 20.2 | 18.4 |
| VisuShrink | 34.3 | 28.2 | 22.1 | 18.7 | 16.4 | 14.6 |
| SureShrink | 25.1 | 25.1 | 25.1 | 25 | 24.8 | 26.5 |
| Modified BayesShrink | 37.1 | 32.5 | 30.5 | 30.5 | 27.5 | 27.1 |

FIGURE 6: ORIGINAL IMAGE

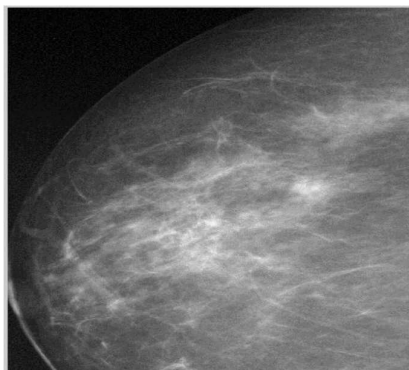


FIGURE 7: SURE SHRINK

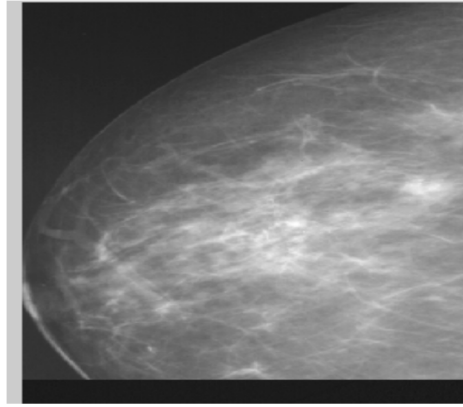
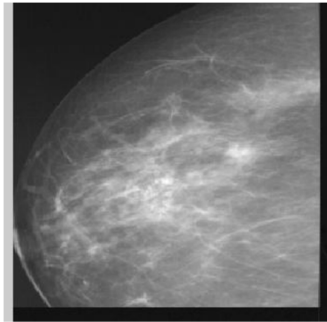


FIGURE 8: MODIFIED BAYESSHRINK



5. CONCLUSION

Thus we have enhanced and denoised the ultrasound breast cancer image using Adaptive wavelet transforms and enhanced by wavelet filters, and experimental results shows that this technique is accurate and effective in low resolution ultrasound images. The ultrasound imaging modalities are easier and safer technique to evaluate the breast cancer. In the developing countries need to adapt this type of techniques increase the awareness among the public by mobile ultrasound diagnostic in every places particularly in the rural areas.

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