

# Comparative Analysis of Image Enhancement Algorithms in Mammogram Images

K.K. Kavitha, K. Satheesh  
Department of Computer Science,  
Selvamm Arts & Science College,  
Namakkal, India.  
kavithakkcs@gmail.com

Dr. A. Kangaiammal  
Department of Computer Science,  
Government Arts College  
Salem, India.  
indurath2002@yahoo.co.in

**Abstract**— Mammography is the primary imaging technique for detection and diagnosis of breast cancer; however, the contrast of a mammogram image is often poor, especially for dense and glandular tissues. In these cases the radiologist may miss some diagnostically important microcalcifications. In order to improve diagnosis of cancer correctly, image enhancement technology is often used to enhance the image and help radiologists. This paper discusses three image enhancements: Median Filter, Average Filter and Wiener Filter.

**Keywords**—Mammography, microcalcifications, median filter, average filter, Wiener Filter.

## I. INTRODUCTION

Breast cancer is the second leading cancer in women [2]. 1 in 8 women is affected by breast cancer in their lifetime [1]. As per American Cancer Society Survey Report in 2013. The main established strategies for breast cancer control are based on prime prevention along with early detection. Indian Council of Medical Research (ICMR) has concluded that in the last two decades, breast cancer diagnosis statistic has increased. So grave is the scenario in India, breast cancer is the most common form of cancer like other cancer diseases.

Early detection and proper medical check-up are compulsory but at the same time proper diet and food also helps to fight with malignant cancer cells. In human body, new cells are formed and old cells are dying out day-to-day. Sometimes new cells are produced, grow uncontrollably and form abnormal cell structure called tumor cells. Breast cancer diagnosis has become the need of the hour and research works in this area is highly challenging [3].

Mammogram is the basic test to detect breast cancer. During the mammogram test, the Ion Radiation that goes into the breast shows internal parts of the body and also the suspicious region [4]. It shows tissues of breast and veins.

## II. IMAGE ENHANCEMENT TECHNIQUES

### A. Image Enhancement

Image enhancement is the basic step in image processing. Main purpose of image enhancement is to produce better and quality image. Image enhancement helps to enlarge the intensity value between object and background. Image enhancement is divided into two types, Global method and Local method [5].

### B. Smoothing

Smoothing is used to decrease the noise, less blurring, produce a less pixelated image cleaning for the same size without any image size modification in the data. Smoothing is done through density estimates [5]. Smoothing is used in two ways;

1) Extract more information from data as long as assumption of smoothing is reasonable.

2) Provide analyses that are flexible and robust.

### C. Filtering

Filter is used to remove some unwanted signal or component in the image. Filters remove certain frequencies to suppress interfering signals and reduce background noise. Filters do not play in frequency domain. Filters have some demerits, sometimes it loss the information in the image during filter process. Filters may be linear or non-linear, time variant or time invariant, analog or digital, discrete time or continuous time, passive or active, infinite impulse response or finite impulse response.

### D. Denoising

Noise is unwanted signals in the image. Noise is not always random and randomness is an artificial term Number equations consecutively. To overcome these problems we use Denoise. Denoise is to rectify the problem of visually unpleasant, bad compression and bad analysis.

## III. PROPOSED METHOD

In this paper, we have given a comparison analysis of three standard filters namely: (1) Average Filter (2) Median Filter and (3) Wiener Filter.

### E. Average Filter

One method of reducing noise is pixel averaging. Replace each pixel by the average of pixels in a square window surrounding this pixel [6]. But there are some problems with Averaging Filter. It blur the edges and details in an image and also not effective for impulse noise (Salt and pepper). So, one can remove noise by average filter but it will blur the image with some degree of level.

*F. Median Filter*

In the window sort all the neighborhood pixels in an increasing order, take the middle one as median pixel [7]. Instead of a local neighborhood pixel's average or weighted average, compute the median of the neighborhood pixels in the window. It removes outliers and doesn't average (blur) them into result and also preserve edge, but slow to compute. When the amount of noise is large in input image data and the magnitude is low, in that case a linear low-pass filter is preferred. Conversely, if amount of noise is low but with relatively high magnitude, in that case a median filter may be more appropriate.

*G. Wiener Filter*

The goal of the Wiener filter is to compute a statistical estimate of an unknown signal using a related signal as an input and filtering that known signal to produce the estimate as an output. For example, the known signal might consist of an unknown signal of interest that has been corrupted by additive noise. The Wiener filter can be used to filter out the noise from the corrupted signal to provide an estimate of the underlying signal of interest [6].

IV. IMAGE ENHANCEMENT EVALUATION

Image quality assessment points to measure the degradation in digital images in order to improve the quality of the resultant image.

*H. Pixel Difference Measurement*

The mean square error (MSE), signal-to-noise ratio (SNR) and peak signal-to-noise ratio (PSNR) [8]. These measures are easy to evaluate.

(i) Mean Square Error (MSE), MSE is computed by averaging the squared intensity of the original (input) image and the resultant (output) image pixels as in (1).

$$MSE = \frac{1}{NM} \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} e(m,n)^2 \quad (1)$$

Where e (m, n) is the error difference between the original and the distorted images.

(ii) Peak Signal-to-Noise Ratio (PSNR), Signal-to-noise ratio (SNR) is a mathematical measure of image quality based on the pixel difference between two images [3]. The SNR measure is an estimate of quality of reconstructed image compared with original image. PSNR is defined as in (2).

$$PSNR = 10 \log \frac{s^2}{MSE} \quad (2)$$

Where s = 255 for an 8-bit image. The PSNR is basically the SNR when all pixel values are equal to the maximum possible value. .

V. EXPERIMENTAL RESULTS

*I. Image Acquisition*

In previous days researchers collected the real time image from various places and hospitals and it was difficult to collect. Nowadays medical image data are available

online, which can be easily fetched and used for research purpose. In this paper, we acquired images from Mini MIAS (Mammogram Image Analysis Society).

Mammographic image analysis society is organised by UK research groups. MIAS contains digital mammogram images. The images are digitized 50 micron pixel edge with Joyce-Lobel scanning micro densitometer. MIAS contains 322 digitized films, reduced to 200 micron edge radded, hence the images are 1024 X 1024. Images are available through Pilot European image processing archive (PEIPA) University of ESSEX [9].

*J. Filtering*

An experiment is carried out at MATLAB; which is software computing tool. An experiment is focused on noise removal and enhancement of image. The experimental work and image enhancement result can be summarized as follows:

1. To remove the noise from the original mammogram image, different filters are used: Average Filter, Median Filter and Wiener Filter.
2. Compare the efficiency of these filters using Pixel Difference Measurement.

*K. Results*

In this paper, we have implemented filtering code for first five images in Mini MIAS Database downloaded from University of ESSEX and their SNR and PSNR Values are tabulated in Table 1, Table 2 and Table3.

Table 1: Average Filter

| Original Image | Filtered Image | SNR      | PSNR     |
|----------------|----------------|----------|----------|
| mdb001         | average001     | 23.42861 | 33.02734 |
| mdb002         | average002     | 24.70593 | 33.44428 |
| mdb003         | average003     | 24.57367 | 32.6558  |
| mdb004         | average004     | 25.91496 | 33.46561 |
| mdb005         | average005     | 25.17682 | 33.26051 |

Table 2: Median Filter

| Original Image | Filtered Image | SNR         | PSNR        |
|----------------|----------------|-------------|-------------|
| mdb001         | median001      | 39.34562368 | 48.94435367 |
| mdb002         | median002      | 36.63359177 | 45.37194236 |
| mdb003         | median003      | 28.6173605  | 36.69948554 |
| mdb004         | median004      | 39.86718133 | 47.4178322  |
| mdb005         | median005      | 32.89869595 | 40.98237998 |

Table 3: Wiener Filter

| Original Image | Filtered Image | SNR      | PSNR     |
|----------------|----------------|----------|----------|
| mdb001         | wiener001      | 12.69187 | 22.2906  |
| mdb002         | wiener002      | 14.56554 | 23.30389 |
| mdb003         | wiener003      | 15.18701 | 23.26914 |
| mdb004         | wiener004      | 15.9266  | 23.47725 |
| mdb005         | wiener005      | 15.63102 | 23.71471 |

From the table 1,2, and 3, we have represented these values in diagramatic representation in Fig. 1. and Fig.2

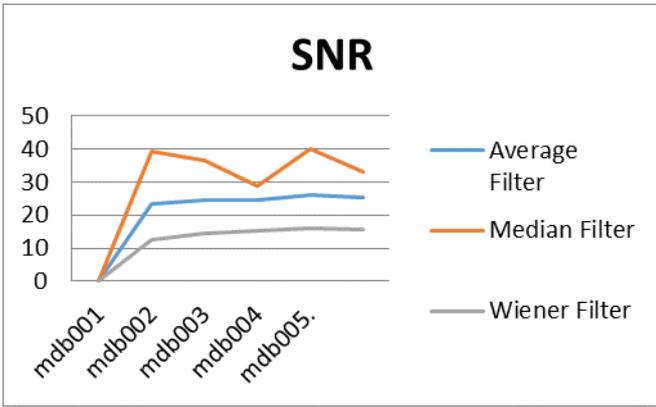


Fig. 1. SNR Values for implemented Filters

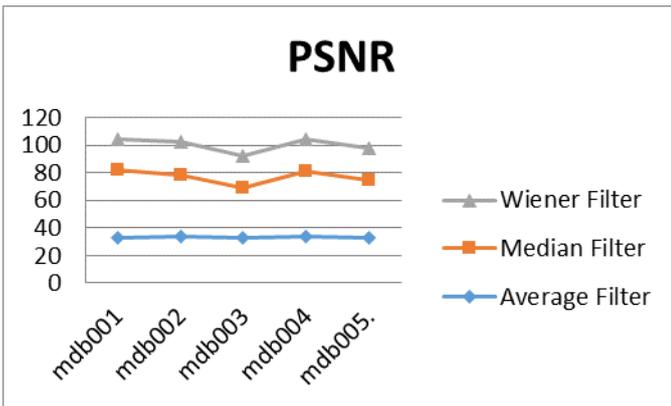


Fig. 2. PSNR Values for implemented Filters

From Fig.1 and Fig. 2, we showed that Wiener Filter shows better results than Average Filter and Median Filter.

**Conclusion**

The image processing is the first step in overall Processing for cancer detection. . Image processing is done by some operations such as image enhancement, filtering and segmentation that are performed to make the image with better quality and to extract the region of interest for feature extraction. The result shows that Wiener Filter is suitable for preprocessing Mammogram Images efficiently. In future, we have to implement segmentation and feature extraction in rough set concepts.

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