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Statistical Measures in Pre-processing of Detection of Microcalcification in Mammograms

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ABSTRACT

Breast cancer is a cancer that develops from breast tissue and it is considered one of the deadly diseases for women. Mammography is the most successful method for the early phase detection of breast diseases. Micro-calcifications in mammogram have been targeted as earliest symptom of breast cancer and their detection is very important to improve its prediction. X-ray mammography is the common method used by radiologists in the screening and analysis of breast cancer. For micro calcifications, the interpretation of their presence is very tricky because they are very small, typically in the range of 0.1 mm- 1.0 mm and average is about 0.3 mm. Micro-calcification is a tiny bit, which may not be clearly visible because of low contrast in the mammogram image. This paper presents statistical measures of different preprocessing techniques and selecting filter for accurate detection of microcalicifications.

***Index Terms*:** CAD, Microcalcifications, Statistical measures

1. INTRODUCTION

Breast cancer is the increasing common disease in American women; it continues to be major public health problem in United States. According to the National Cancer Institute estimates that one out of eight women in the United States will develop breast cancer at some end during her life span. Primary expectancy seems impossible because the causes of this disease still remain unknown. Density of micro calcifications may be high, low, or variable. And if in a cluster, the homogeneous or non-homogeneous nature of the mass is noted. Distribution refers to the overall placements of the microcalcifications within the breast image. Micro calcifications can be in single clusters or multifocal, unilateral or bilateral, diffuse, segmental, linear, or regional. The suitable method used for early discovery of pre-cancerous symptoms is screening mammography, which has to be conducted as a standard test for women. Calcification clusters are said to be an early indication of breast cancer. Microcalcifications are small bits of calcium deposits present within the breast tissue. To provide confirmation for the radiologists in detecting the apprehensive regions in mammogram images and to get better accuracy and sensitivity of interpretation, a variety of Computer Aided Diagnostic (CAD) systems have been proposed. But, designing an effective diagnosis system to detect the occurrence of micro calcification still remains as a challenge due to the fuzzy nature and low contrast of the mammogram. Micro calcification is a tiny bit, which may not be clearly visible because of low contrast in the image. To increase the contrast of mammograms in a preprocessing stage can give the more accurate results for detecting microcalcifications by statistical approach. The analysis of statistical properties of images is dictated by the concern of adapting secondary treatments such as filtering, restoring, and coding and shape recognition to the image signal. The various statistical measures [10] are mean, mode, median, variance, standard deviations, covariance, skewness and kurtosis. All of these measures are used in a wide range of scientific research. Few are calculated in this paper for selecting filter.

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2. METHODOLOGY

The paper gives the preprocessing stage for microcalcification detection by statistical way.Fig.1 is the statistical model for the preprocessing step. Matlab toolbox is used for execution of this statistical model of preprocessing. Fig.1 shows the block diagram of statistical model of used for preprocessing of mammogram images. Input image dataset collected from DDSM and MIAS. These two dataset are online available for researchers. 320 images dataset is created including database from local hospitals. Input image is converted in gray scale, this image has labels, tags which needs to remove as well as resizing the image requires for further processing. Now image is ready for filtering. Filter is used for removing noise present in the image.

Here, two filters we have used. Median, weiner. Statistical analysis applied on normal and calcified images with four datasets of each. Based on this statistical analysis, filter is decided.

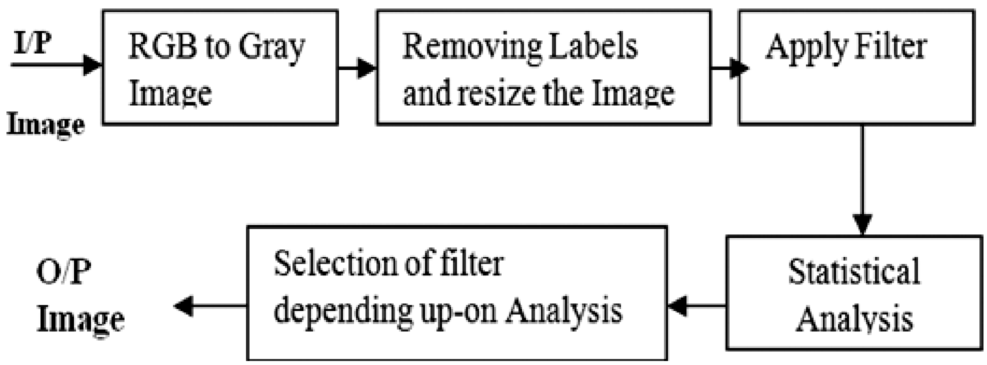

Figure 1: Block Diagram of Statistical Model

3. EXPERIMENTATIONS AND RESULT

Although research has already been done on few of these measures at moderately advance stage, we have proposed a simple statistical model in Fig.1 for image processing to optimize it features. Depending upon necessities, for the image filtering we can choose from a very fundamental filter to any multi parameter complex filtering. In this paper, we discussed three parameters; mean squared error, peak signal to noise ratio and standard deviation. To show the difference between normal to calcified image, we have used four images for normal and calcified. After filtering these statistical parameters are applied. Following is the description and their corresponding results. For a long time, mean square error (MSE) is widely used to measure the degree of image distortion. One problem with mean-squared error is that it depends strongly on the image strength scaling. The Mean Square Error (MSE) and the Peak Signal to Noise Ratio (PSNR) are the two error metrics used to compare image compression quality. The standard deviation reveals something about the contrast of image. Following is the description and their corresponding results.

3.1. Weiner Filter

Wiener 2 low pass-filter filters a grayscale image that has been despoiled by steady power additive noise. Wiener 2 uses a pixel wise adaptive Wiener method based on statistics predictable from a local neighborhood

Table 1
Weiner Filter Statistic for Normal Image

Sr. No.	*Normal Images*	*Mean*	*Standard Deviation*	*PSNR*
1	mdb024	3.2	69.5	43.11
2	mdb 020	3.67	71.06	42.52
3	mdb014	3	74.58	43.06
4	mdb018	3.55	81.44	42.66

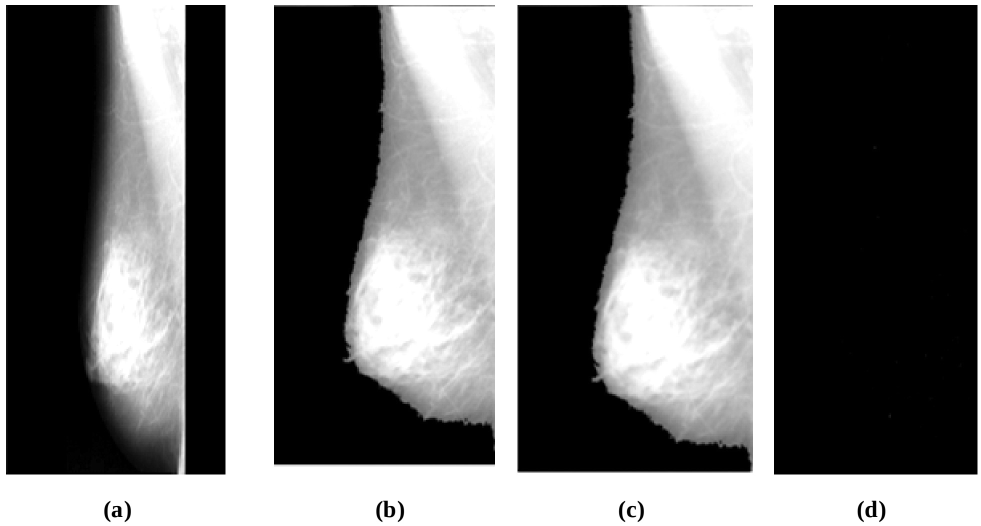

Figure 2: Weiner filter output (a) Calcified image (b) Dark column free image (c) Weiner filter output (d) Standard deviation image

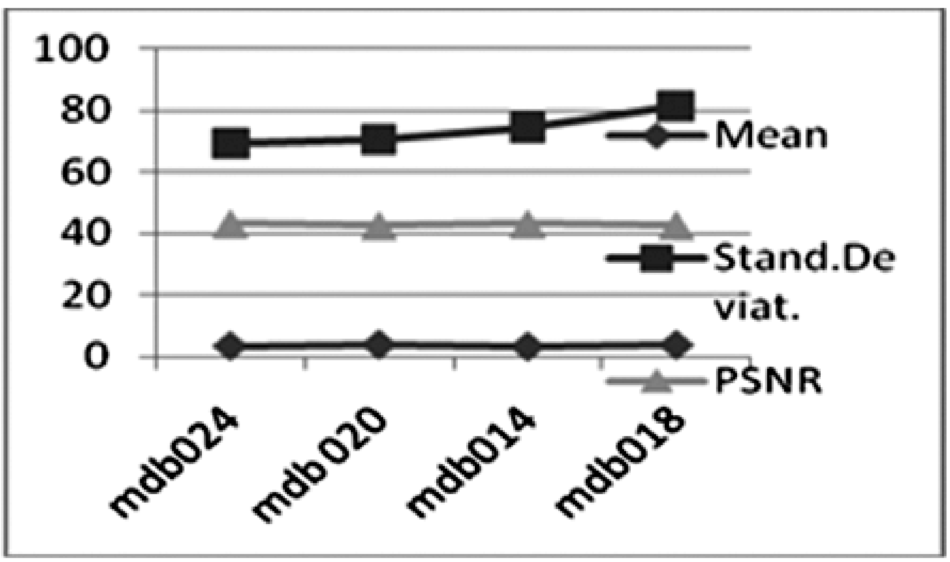

Figure 3: Statistical Representation of Weiner Filter For Normal Images

Table 2
Weiner Filter Statistic for Calcified Image

Sr. No.	*Calcified Images*	*Mean*	*Standard Deviation*	*PSNR*
1	mdb211	2.69	84.91	43.86
2	mdb213	2.31	85.61	44.52
3	mdb227	4.2	78.42	41.93
4	mdb233	5.17	69.72	41.03

of every pixel. The Wiener filtering executes a best possible tradeoff between inverse filtering and noise smoothing. Image is enhanced in weiner filtering but standard deivation image is not clearly visible.The statstics of weiner filter with normal and calcified is as follows.

For a long time, mean square error (MSE) is widely used to calculate the level of image distortion because they can characterize the overall gray-value error contained in the entire image, and are mathematically tractable as well. We observed that difference between normal to calcified images for

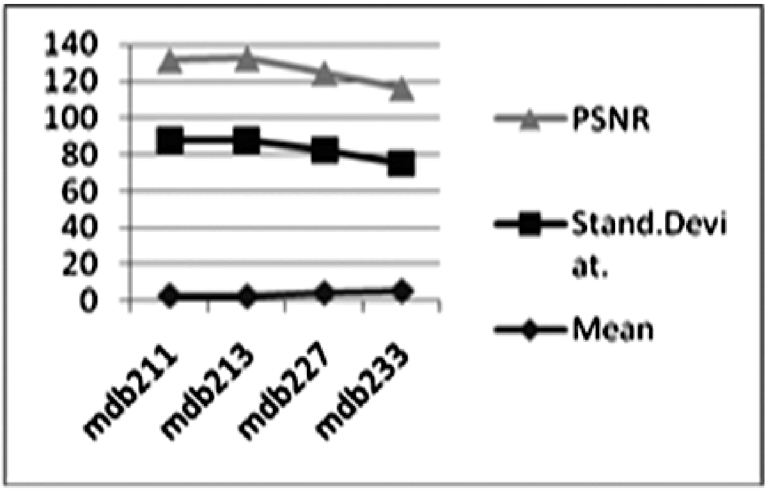

Figure 4: Statistical Representation of Weiner Filter For Calcified Images

MSE, PSNR and standard deviation is very less. The value of PSNR is quite high in case of calcified images.

3.2. Median Filter

The median filter is a nonlinear digital filtering method used to remove noise. It is widely used as it is very effective at removing noise while preserving edges. Following are the results of median filter.

Median filter enhanced the image and like weiner filter standard deviation image is not visible.More accurate information we can get by statistical parameters as shown and discussed below.

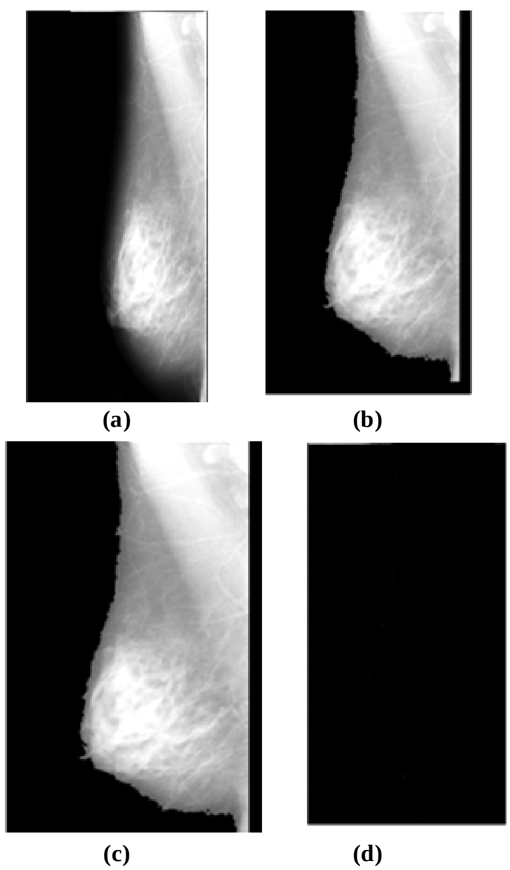

Figure 5: Median filter output(a) Calcified image (b) Dark column free image(c) Median filter output(d) Standard deviation image

Table 3
Median Filter Statistic for Normal Image

Sr. No.	*Normal images*	*Mean*	*Standard Deviation*	*PSNR*
1	mdb024	12.95	69.55	37.04
2	mdb 020	11.59	71.13	37.52
3	mdb014	14.04	74.65	36.69
4	mdb018	12.33	81.57	37.25

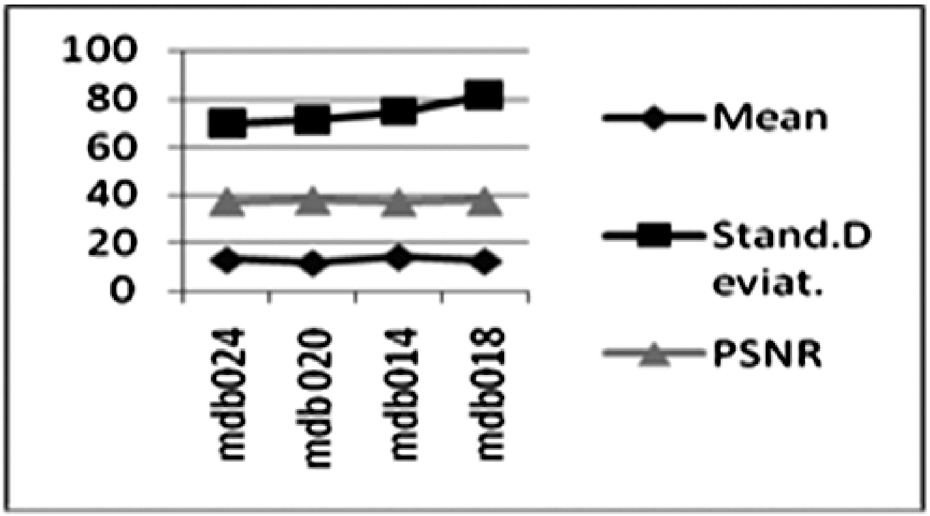

Figure 6: Statistical Representation of Median Filter for Normal Images

Table 4
Median Filter Statistic for Calcified Image

Sr. No.	*Calcified Image*	*Mean*	*Standard Deviation*	*PSNR*
1	mdb211	2.69	84.91	43.86
2	mdb213	2.31	85.61	44.52
3	mdb227	4.2	78.42	41.93
4	mdb233	5.17	69.72	41.03

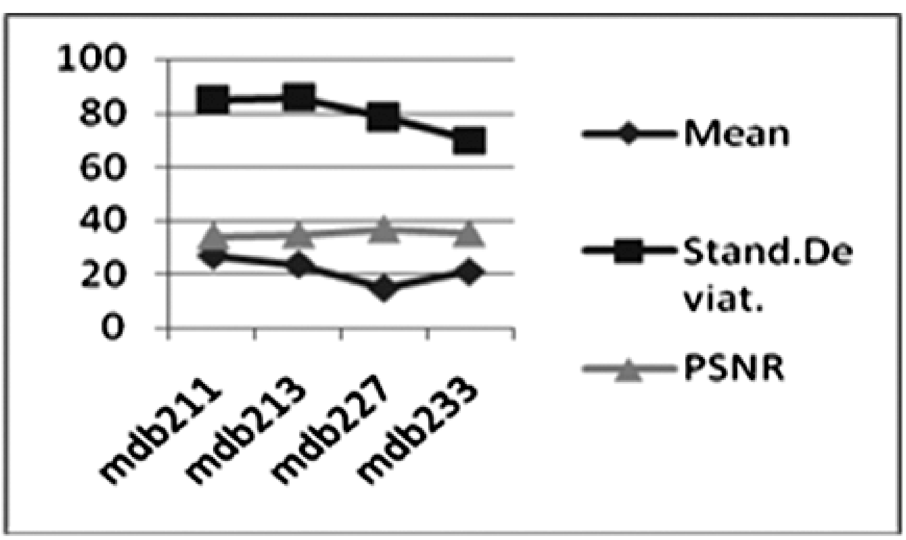

Figure 7: Statistical Representation of Median Filter for Calcified Image

As per fig. 1.6 and 1.7 shows the statistical representation of median using normal and calcified images. We observed that there is huge difference in mean values for normal and calcified images.

4. CONCLUSION

The idea of automatic processing by computer, statistical illustration is quite useful as it instantly feeds algorithms that are more or less elaborate and that influence pixels, the basic components of the image. Here, three parameters are used for selection of filters MSE, PSNR and standard deviation. We observed that median and wiener filter statistics calculation can be used for filtering. Calcified images output clearly shows median filter performs best as compared to wiener. We concluded that as per statistics median filter is best and we also observed that there is very small difference in statistical values of normal and calcified images because micro calcified in the range of 0.1mm to 0.3mm and it is hardly noticeable.

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