Available online at www.elixirpublishers.com (Elixir International Journal)

Digital Processing

Elixir Digital Processing 79 (2015) 30686-30692

ISSN: 2229-712X

Automatic detection of micro calcifications in a small field digital mammography using morphological adaptive bilateral filter and radon transform based methods

B.Sridhar[1,*], K.V.V.S.Reddy[2] and A.M.Prasad[3]

[1]Department of ECE, Lendl Ins. of Engg. &Technology, Vizianagaram, India.

[2]Department of ECE, Andhra University, Visakhapatnam, India.

[3]Department of ECE, JNT University, Kakinada, India.

ARTICLE INFO

Article history:

Received: 15 September 2014;

Received in revised form:

15 February 2015;

Accepted: 24 February 2015;

Keywords

Mammograms,

Micro calcifications,

Edge detection,

Adaptive bilateral filter,

Mathematical morphology,

Radon transform like methods.

ABSTRACT

We proposed a new algorithm for detection of micro calcifications using mathematical morphology, adaptive bilateral filter and radon transform. The Adaptive bilateral filter is able to smooth the noise, while enhancing edges and textures in the image. Morphology operations such as dilation, erosion, opening and closing are offering a quality extraction of Shapes. In this method the radon transform based methods is applied to extract the micro calcifications. The performance of the segmentation of micro calcification is to be improved by including the mathematical morphology operations along with Radon transform. Radon transform based methods are used in computer tomography which efficiently produced random projections and give a simultaneous translational rotational alignment in two and three dimensions. The size and shape of the lesions are measured by using canny edge detection methods and segmented results are generated. The proposed method evaluated with usefulness of the system with help expert radiologists.

Introduction

Mammogram image analysis is used to detect the cancer in the breast of suspicious women. It can produce an in depth structures of breast tissues. In order to identify these structures the radiological studies are chosen only mammograms than other modalities images [1-3]. The small tissue structures in the mammogram also known as micro calcifications [4-6] shown in the fig: 1. Micro calcifications are to be detected and analyze the shape, which allows identifying the lesions is either benign or malignant. These deposits consist of calcium at thickness of small tissue and are symbolized as little white dots. These are clearly indicating an initial sign of the cancer. Some of the micro calcifications are malignant appears a size is less 2mm, other appears as cluster also called benign and the size is more than 2mm. Malignant are grouped in near distance [8]. The malignant normally heterogeneous in structure and irregular shape where as benign is homogenous structure appears clear centre. Radiologist also considered age of lesions time over certain period. If the size of the calcifications is vary continuously after regular checkups of woman. It suspects a malignant otherwise constant in size is considered as benign. Also it is noted that segmental distribution is not a random. This can be checked through analytic biopsy.

The main features of micro calcifications are small size and surrounded tissue appears brighter than these lesions. It is necessary an accurate image processing operators is required to detect them, also, extract these areas from contrast brightness at small below certain level. Then the detected calcifications analyzed through it shape and size.

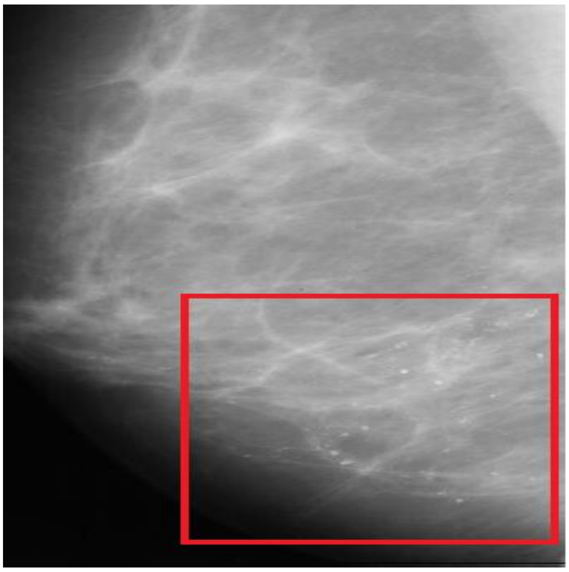


Fig: 1 mammogram shows micro calcification shown Region of interest (ROI)

In recent times, a noise equalization technique was developed by McLaughlin et al [27], in this method estimated a dominant noise superimpose on digital mammography due to low frequency X-rays. The technique was improved square root law and extracted MC. Linguraru et al [26] developed a model with anisotropic diffusion filter. A common conclusion is made to generate a standard outputs that the pre- processing is necessary for extraction of lesions and also desirable real-time clinical applications. Selection of enhancement technique should be précised otherwise important features must be removed.

Tele:

E-mail addresses: Srib105@gmail.com

V.Alarcon-Aquino et.al [9] proposed an approach to detect the micro calcifications in digital mammograms using the dual-tree complex wavelet transform. They were experimental shown that denoising algorithm and morphological transformation is applied along with the wavelet transform and top-hat filtering. Tomasz Avod et.al [6] proposed a computer aided system for radiologist in a small field digital mammography for micro calcifications. The method approached the algorithm with different phases. The results are tested with radiologist manual results. Stelios Halkiotis et.al [10] proposed the detection of micro calcification using morphological filters they achieved the best calcification result with true positive detection rate of 94.7 % and false positive 0.7 per image.

Buyue Zhang et.al [11] is generated the adaptive bilateral filter (ABF) than the ordinary form of the bilateral filters. But it has two important changes. One, an offset value is included along with range filter. Next both width and range of the adaptive filters are adaptable with respective output value. The output of the edge preserved with Laplacian of Gaussian (LOG) operation is improved the sharpness. It is purely depend on the image structure. They shown MSE between the original and reconstructed images is minimized for each class of pixels.

Alexander Wong [12] introduced a different perceptually based process for noise removal of image signals represented by low signal to noise ratios. Results are shown that the process is effective at removing signal noise, while enhancing both qualitatively and quantitatively. Jinshan Tang et.al [13] were developed a new bilateral filter method to reduce speckle noise reduction in ultrasound images for the purpose of segmentation and Measurement. H.W. Kang et.al [14] were introduced an adaptive bilateral filter to adaptive preserve the curve strokes and reduced superimpose noise on the image. This method is make easy automatic generation of artistic illustration in order to adaptively guide the curved stroke directions based on the importance map. The experimental results shown that scheme facilitates automatic production of artistic illustrations in a broad range of rendering styles.

Mathematical morphology is one of the emerging areas in image processing. Now it is quite popular because a simple set operations technically called dilation, erosion, remain operations is a combinations these operations [17]. Yoshinori ITO [6] proposed an impulse noise removal filter using mathematical morphology. Xiaoping Linet.al [15] given attempts on Mathematical Morphology techniques is implementation process based on SCILAB toolbox. The toolbox is openly used software and makes connection with mathematical morphology tool box. Joseph M. Reinhard et.al [16] described an adaptive search-based approach for morphological Shape enhancement. This method also used other applications purpose such as image recognition, coding, object detection. Patrick Guidotti [18] proposed a fourth order diffusion partial differential equations (PDE) is investigated on a smoothing technique, also it reduces processing time and improves the performance of this model.

Rozenn dahyo et.al [29] proposed a general relaxed radon transform (GR^2T) along with probability density functions based method applied on lines detection in images and volume reconstruction from silhouettes captured from multiple views. Michael Radermacher et.al [8] presented reconstruction of projections and provides the rotational alignment in two and three dimensions using Radon based methods. It shown the radon transform gives the high accuracy, with additions of other operations these operations becoming efficient process. Ritwik Kumar et.al [21] presented novel classes of radon like features which allows spatially distributed image statics into feature descriptors. Radon like features was applied on cell segmentation process. Randa boukhris et.al [22] presented feature extraction from a medical images using radon transform. The proposed method is given the better effective and reliable results on hand vein images

The present proposed method is to detect the micro calcifications of the breast image based on adaptive filtering, mathematical morphology and radon transform. The proposed method consist three stages. Those are preprocessing, detection and calcifications of lesions. Pre processing is to remove the noise from image. In mammogram image process the X-ray is effected is random fluctuations in the reaction of the detector in mammogram process. Noise will produce unwanted information on image and difficult to detect the lesion. The x-ray source produces with variation frequency of the x-ray photons and produces the noise on the image. Most important requirement is here for preprocessing to reduce the noise and improve the sharpness of the edges of region in the image. So, we are using an adaptive bilateral filter to get qualitative sharpness enhancement. Mathematical morphology operators are used to mark the various regions separated with different intensity levels. Narrow level marking is possible to choose a right structure element of the operation. Micro calcification extracted from image using radon transform.

The paper is organized as follows in section 2, a review of the necessary background required to effectively implement our algorithm is presented. The proposed algorithm is described in Section 3. After that, application of the proposed algorithm and discussion is described in section 4, and conclusions are drawn in section 5.

Back ground

Mathematical morphology (MM) Operations:

The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image. In the morphological dilation and erosion operations, the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbors in the input image. The rule used to process the pixels defines the operation as dilation or erosion [11].

Understanding Structuring Elements (SE)

An essential part of the dilation and erosion operations is the structuring element used to probe the input image. A structuring element is a matrix consisting of only 0's and 1's that can have any arbitrary shape and size [15]. The pixels with values of 1 define the neighborhood.

Two-dimensional, or flat, structuring elements are typically much smaller than the image being processed. The center pixel of the structuring element, called the origin, identifies the pixel of interest or the pixel being processed. The pixels in the structuring element containing 1's define the neighborhood of the structuring element. These pixels are also considered in dilation or erosion processing. The two basic morphological operations, dilation and erosion with a structuring element B, are defined for a grey-scale image $f \in L\ \alpha$ (IR2) by [1]

$$\text{Dilation: } (f \oplus B)(x) = \sup\{f(x-y), y \in B\} \quad (1a)$$

$$\text{Erosion: } (f \ominus B)(x) = \inf\{f(x+y), y \in B\} \quad (1b)$$

The names can be easily motivated when considering a shape in a binary image and a disc shaped structuring element. In this case dilation blows up its boundaries, while erosion shrinks them. Dilation and erosion form the basis for constructing other types of morphological processes, for instance opening and closing:

Opening: $(f \circ B)(x) = ((f \ominus B) \oplus B)(x)$, (2)

Closing: $(f \bullet B)(x) = ((f \oplus B) \ominus B)(x)$. (3)

In the preceding shape interpretation opening smoothes the shape by breaking narrow region and eliminating small islands, while closing smoothes by eliminating small holes

Selection of structure elements

Structure elements are classified in to Omni directional and multi scaled elements is one way to plot the square windows [19]. In general consider α is the angle of rotation. Let us consider N is a value then order of the SE is (2N+1) X (2N+1). Then the equation of the structure element is represented as

$$W = \{\frac{s(n1+s1n2+s2)}{\theta s} = s\alpha - N \leq s1, s2 \ll N \quad (4)$$

For all s=0, 1 --- 4N-1 and α is the angle of the rotation expressed as $\alpha = 180^0 / 4N$.Suppose N=2 then dimension of the SE is 5 x5, the angle value is obtained as α=0, 22.5, 45,135,157.5

Consider the structure element sequence have same shape in common and size increased follow the accretion of I. then defining to different features from the various values of image, the size of the structure must be adjusted [24]. In general, select basic structure element shape and the number of structure elements of the order (2i+1) X (2i+1).

Opening is applied to highlight or remove the regional maxima's in the gray scale image. Here the structure element is selected a 'disc' shape have dimensions 3 X 3,5x5, 7x7 etc. The best result is obtain at lower dimensions, however the simulation time is increased. The main disadvantage of the opening operation, it may not remove the regions whose dimensions greater than or equal to structural element dimensions. This problem can be solved by using opening by reconstruction [10]. Maker image is produced by subtracting an input image from low constant gray value. After reconstruction the image is marked with regional and appears with the similar intensity. Opening is erosion followed by dilation, while opening-by-reconstruction is erosion followed by a morphological reconstruction [28]. The opening with a closing can remove the dark spots and stem marks in the gray scale image. Then the reconstruction-based opening and closing are more effective than standard opening and closing at removing small blemishes without affecting the overall shapes of the objects. Calculate the regional maxima of dilated image to obtain good foreground markers.

Adaptive bilateral filtering

Bilateral filtering smoothes images while preserving edges, by means of a nonlinear combination of nearby image values. The method is non-iterative, local, and simple. Its combine gray levels or colors based on both their geometric closeness and their photometric similarity, and prefers near values to distant values in both domain and range. The bilateral filter proposed by Tomasi and Manduchi in 1998 is a nonlinear filter that smoothes the noise while preserving edge structures [11]. Bilateral filter are a spatial domain filter, the response of the filter is given in the equation (5)

$$y(m.n) = \sum_k \sum_l h[m, n; k, l]\, x[k, l] \quad (5)$$

Y(m,n) is the noise removed image.

$h[mo, no; k, l]$ is the response at [m,n] to an impulse I[k, l] and x [m,n] is the degraded image.

Where (mo, no) is the center pixel of the window Ω_{m_0,n_0}.

σ_d and σ_r are the standard deviations of the domain and range Gaussian filters, respectively

$$r(m_0, n_0) = \sum_{m=m0-N}^{mo+N} \sum_{n=no-N}^{no+N} e^{\left(\frac{(m-m_0)^2+(n-n_0)^2}{2\sigma_d^2}\right)} . e^{-\frac{1}{2}\left(\frac{g[m,n]-g[m_0,n_0]-w[m_0,n_0]}{\sigma_r[m_0,n_0]}\right)^2} \quad (6)$$

$$h[m, n; m_0, n_0] = I(\Omega_{m_0,n_0}) r_{m_0,n_0}^{-1} e^{\left(\frac{(m-m_0)^2+(n-n_0)^2}{2\sigma_d^2}\right)} . e^{-\frac{1}{2}\left(\frac{g[m,n]-g[m_0,n_0]-w[m_0,n_0]}{\sigma_r[m_0,n_0]}\right)^2} \quad (7)$$

$r(m_o,n_o)$ is a normalization factor that assures that the filter preserves average gray value in constant areas of the image.

A Gaussian filter is filtering the low frequency noise and restores the edges. Combinations of domain and range Gaussian filters are applied to give maximum weight pixels, which is near to centre value. A combined operations of domain and range filter along with the bilateral filter at nearer to edge pixel gray level values is become stretched out, Gaussian filter is slopping around the edge. It gives a guarantee to take an average of adjacent pixel values and minimizes the gradient direction. Thus, the bilateral filter greatly smooth's the noise and restoring edge formations.

The ABF maintains the actual form of bilateral filter [16], in addition two significant modifications is included. As shown in the equation 6 & 7 is consists a two exponential functions one is the operator of range filters and second the domain filter functions. The range filters is included an offset (w) function and width is introduced in domain filters. Those function turns the bilateral filter is spatially adaptive. If the offset value is zero and width is constant the ABF is acts as an ordinary bilateral filter. The variation of these two values or either one is fixed the filters shows an effective performance to restores the image and edges are sharpen. It is concentrated on edges at maximum level and improves the slope.

In ABF the pixel gray level variation plays an important role during the training of filter [20]. Here we make the difference of the centre pixel value with mean of the local widow to be chosen. Its response is more effects on the strength of edges, separates the regions and reduces the robustness to the noise. So apply a Laplacian of Gaussian to the image before undergone for filtering process

Radon transforms and it's like features:

The geometry of the Radon transform of a function *f(x,y)* can be expressed by the following equation [8]:

$$r(s,\theta) = \iint_{-\infty}^{\infty} f(x,y)\,\delta(x\cos\theta + y\sin\theta - s)\,dx\,dy$$

$- \infty \leq S \leq \infty,\ 0 \leq \theta \leq \pi$ (7)

is defined as line integral along a line inclined at an angle θ and at a distance s from the origin [9]. Fig. 2 shows the geometry of Radon transform.

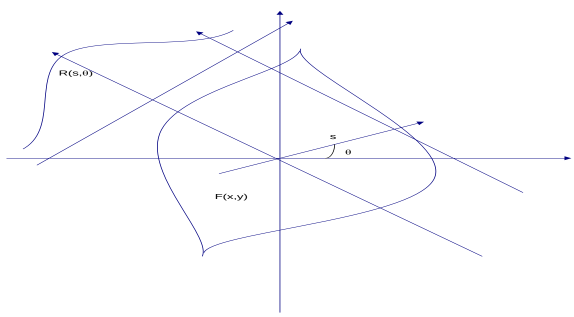
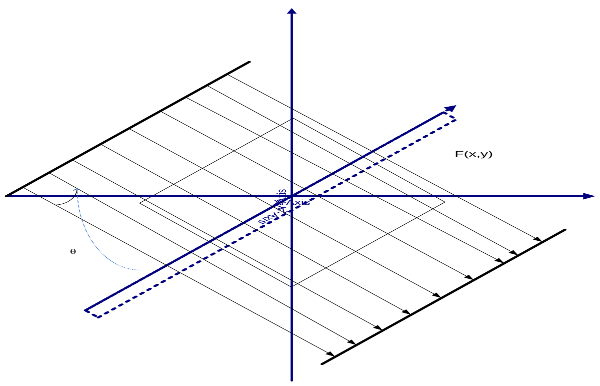


Fig. 2 Geometry of Radon transforms

The radon transform chose the function from different sources along parallel paths spaced equally. Here f(x,y) is the pixel from mammogram image. It generates a multiple projection from the centre of images. These projections are applied to an image by an angle rotating at the centre. The following fig: 3 shows projection at given rotation angle θ



Fig; 3 Projections of scanning at a given angle θ

In practical the projection of the image obtained fan-beams because parallel beam gives a rapid scanning. The source position is characterized by the angle β, and each projection ray is represented by the coordinates (σ,β)

$$-\frac{\pi}{2} \leq \sigma \leq \frac{\pi}{2}, 0 \leq \beta \leq 2\pi \quad (8)$$

The rays are related to the parallel beam coordinates (s, θ) as indicated in equations 2 and 3 [9]. Here D is the distance of the source from the origin of the object.

$$s = D \sin \sigma$$

$$\theta = \sigma + \beta \quad (9)$$

Ritwik Kumaret.al [20] developed a Radon-Like features, which presents an approach combining any preferred information obtain from an image, Example consider an image intensities and shapes of object boundaries. These features can be used to simply as an unsupervised way of enhancing structures in an image. It must be concentrated staining process, which are obtained images are varying significantly in appearance. The radon transform widely used in tomography. These features are in a sampling form of slope and space variations as shown in the equation (5). Its back projection gives an inverse transform. Here it is added some features to the radon transform those are edge mapping, features in the direction of zero, pixel wise feature mean, and pixel wise feature variances. Radon transform process various line segments [22] on image f(x,y) and generate some points called knots on f(x,y).These knots spatially distributed through x,y co-ordinates. From these knots their can perform the extraction process called extraction function. In addition to that more flexibility can be making into results if each knot has an associated in the particular direction. This can be included easily by associating with image f(x,y) angle in the range (0,2π), each angle value gives a tangent provide a slope. It also noted that the tangent slope at θ is different than at θ+π.

Proposed method:

The proposed method shown in the Fig: 4 are experimented on suspected mammograms chosen from mammographic image analysis society (MIAS) data base [25]. Our method has given in fig: 4 are containing the subparts are pre- processing, exactions of micro calcifications, and evaluation of algorithm

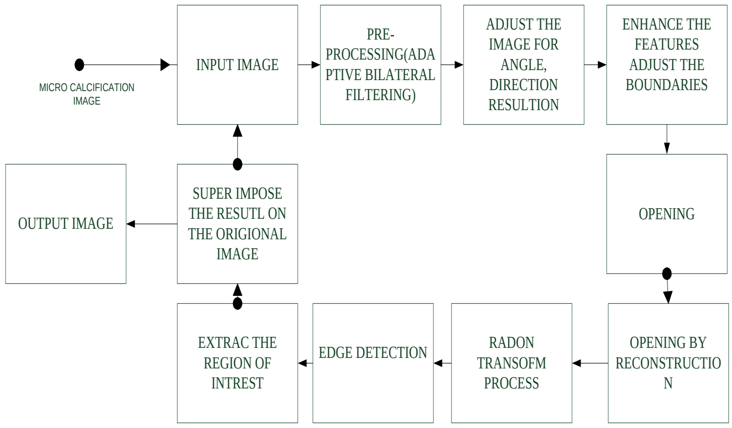


Fig 4: Block diagram of the proposed method

In preprocessing technique an adaptive bilateral filter is applied for removing noise from the image and improve sharpness enhancement of the edges[12, 13]. Noise is the random fluctuation in the response of the detector to the X-ray source [23]. Noise produces mottling of the imaging that minimize diagnostic detail and created more problems to identify tissue abnormalities. The fewer X-ray photons that produce the larger the effect of noise will be affected on the image. Sharpness is the term which gives the ability of the imaging system to define an edge or margin against the surrounding tissue. Unsharpness is also called image blurring may be caused by several factors, including anybody motion caused by a sneeze, motion of the breast, and breathing, or distribution of the signal within the digital image receptor. We chose the ABF best design parameters those are half width, standard deviation to obtain the best output.

To extract the region of interest (ROI) from an image the radon transform is applied to the image. Initially mark the ROI areas on the image. In this regard here we included the morphological operations that is opening followed by opening by reconstruction [11].Opening smoothes the micro calcifications by breaking small regions and eliminated artifacts. Making the micro calcifications in the image is produced by subtracting an input image from low constant gray value. After reconstruction the image is marked with regional and appears with the similar intensity. Then apply the radon transform it scans with respective to (s, θ) coordinates starting at centre over entire image and extracted the only segmented region marked by the morphology operations. It requires (s, θ) coordinates value. θ is given maximum angle value chosen for scanning in the range[0,2π]; ***s*** value gives the number of directions the scanning is to be done. Before applying the radon transform once again adjust the boundaries, also adjust the enhancement features using the filters. Finally we shall apply the canny edge detector at given threshold value to get the boundary of the extracted image. In the proposed method the size of micro calcification is measured using the distance transform. The obtained image is superimposed on the input image to visualize the micro calcifications in a best format of image, here the background marked area are removed. The algorithm must be trained with number of test images to give best results. The performance of the algorithm is evaluated by comparing the results detection of micro calcification by radiologists manually.

Results & discussions

The result of the tested micro calcification is shown in the fig 5. The proposed method is concentrated a suspicious area identified by the radiologist in a mammogram environment area. As we discussed in the earlier section the micro calcifications are usually appear as small sizes, bright spots, sometimes, these are surrounded by the fatty tissue. The ordinary mammogram is unable to detect these lesions and give the proper justification by radiologist [10]. So our method is most useful for them to detects, calcified benign or malignant. In pre-processing, the applied adaptive bilateral filtered to the small field mammogram image. The image must be normalized in the [0 1]. The small field mammograms[23] is taken to extract the accurate separation of micro calcifications and compare with existed results. The best results of ABF is obtained by taking the half width window value is '4' and the standard deviation is 0.4 shown in the fig 5 (A). Radon transform will highlighted the isoclines connect pixels of an image having similar brightness. To improve the quality of the isoclines the opening and opening reconstruction operations are applied with structure element 'disc' and dimensions 3 x3. All the bright smallest areas are marked by the morphological operations. Then application of the radon transform is with features are extracted, the brightness spots which shown in the fig: 5 (B). To obtain the shapes of these spots, a canny edge detector is used with threshold value 0.4 and the generated image as shown in the fig.5 (C). Using distance transform is used to calculate the size and also shape of the each lesion. A micro calcifications are distributed with shapes, they may be centered circles and hard clusters vary the size 0.2mm to 2.5mm are obtained as shown if fig 5 (D). The proposed method also experimented to highlight suspicious estimated a robust clustered cancer mammogram image as in fig 6. The extracted micro calcifications are contains a benign and malignant have the size 0.2 mm to 2.7mm range..

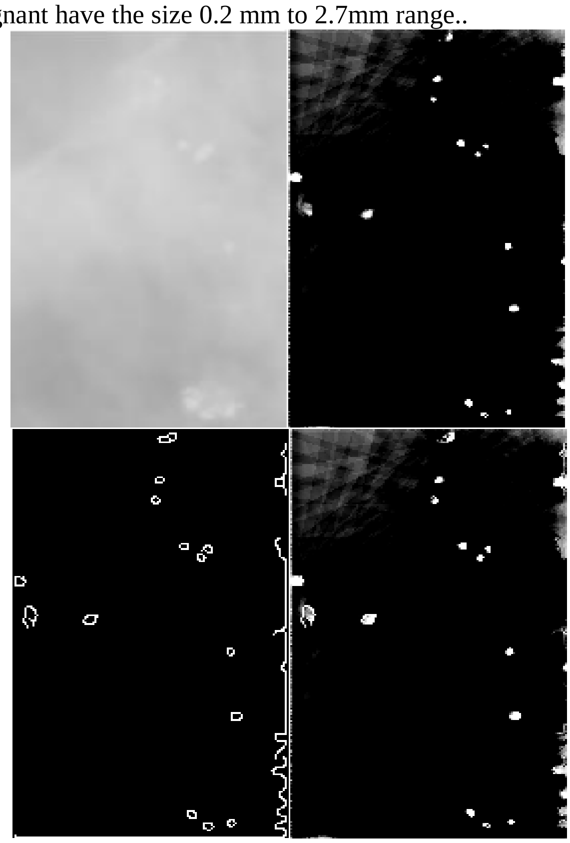


Fig. 5 – Results of applying proposed method A)preprocessed input of micro calcification mammogram B)Extracted lesions using radon like features C)edged detection using canny edge detectors to a mammogram ROI. D) Highlighted micro calcifications with edges

To evaluate the proposed method and estimate the efficiency of the detection process a LeGal and Wolfe breast parenchyma patterns are used.[6]. Those comparisons are represented in the table1 for a small field mammogram shown in fig: 5 and table 2 for a mammogram shown in fig 6. The table shows the average number of clusters of micro calcifications that were detected for a given region of interest. Simultaneously the average estimation of the radiologist is also provided

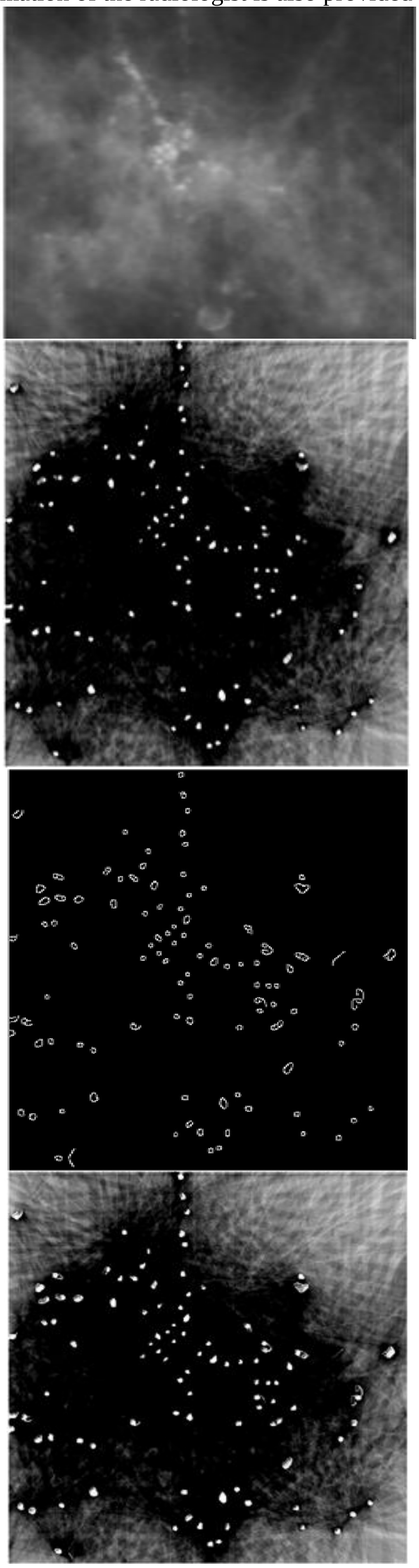


Fig. 6. Results of applying proposed method A)preprocessed input image of micro calcification mammogram B)Extracted lesions using radon like features C)edged detection using canny edge detectors to a mammogram ROI D) Highlighted micro calcifications with edges

The table:1 shows the a comparison of Legal, Wolfe methods with A_{dm} is the average number of cluster of micro calcifications are detected on obtained by the proposed method, but these micro calcifications were not identified by using original mammogram image. The same is to be compared with radiologists and the rating is given by the them with respective type of the lesion according to the Legal, Wolfe.

Table: 1 Performance comparison of the fig

S.No	Type of cluster	A_{dm}	A_{dr}
Legal classifications			
1	Type1	0.2	3.01
2	Type 2	0.5	3
3	Type 3	0.82	3.7
4	Type 4	0.5	3.3
5	Type 5	0.2	3.5
Wolfe classification			
1	N1	0.2	4
2	P1	0.5	2.4
3	P2	1	4.7
4	DY	0.8	5

When the performance of the proposed algorithm is evaluated, it can efficiently detected medium as above possibility malignancy. Radiologists have facility that using this method they can get the very good results without adjustment of contrast. Pre processing of this method is improve the quality of the image and performed well particular ROI areas [9].

According to the Legal evaluation method [6], Micro calcifications are classified Type1 to type 5. The type 1 considers as begin or it cannot be cancer. Type 2 may form as benign is turn into malignancy within a few months age of women, remaining type 3, type 4, and types 5 are malignancy and show the severity in an order. Our proposed method is extracted type 3 micro calcifications very well. Also work well for a moderate level of detection for type 2 and type 4. In general to make the cancer conformation by the radiologists, the type2 and type3 are very important

Table: 2 performance comparison of the fig 2

S.No	Type of cluster	A_{dm}	A_{dr}
Legal classifications			
1	Type1	0.3	3.2
2	Type 2	0.6	4
3	Type 3	0.82	3.7
4	Type 4	0.4	3.3
5	Type 5	0.3	3.9
Wolfe classification			
1	N1	0.4	4
2	P1	0.5	2.8
3	P2	0.9	4.7
4	DY	0.7	4.6

The proposed method also considers the Wolfe evaluation system to check the performance. This proposed method shows a highest improvement to P2, DY type malignancy. These lesion are cannot visualize using original mammogram even though enhance the contrast. N1 type is benign or it is granular tissue. The detection of P1 type is moderate by using this algorithm. In a few test images, the proposed method has given a high false positives and unable to detect the all clusters. According to the radiologists noticed that this was happening only to process the poor quality of the mammogram taken by the low level image acquisition process. Sometime this may leads to overestimate of the detection of micro calcifications.

Conclusions

Proposed method is a reliable and efficient approach for an automatic detection of clustered micro calcifications of small field mammograms. Adaptive bilateral filter is used for pre-processing of the small field digital mammograms. It removes the noises, improves the contrast enhancement and sharpens the edges. Morphological operators are efficiently marking accurately a small regions have with variation of intensities. Radon like features are extracted marked regions also separated those regions from other uniform region by continuous scanning in all directions specified angle and centered at point on the image. The extracted regions are effectively segmented by the canny edge operator. The experimental results showed the calcification accuracy of radon like features with morphological operators. The systems been evaluated by the radiologists through Legal, Wolfe [6] micro calcifications. They have shown improvements in mammogram image analysis using proposed system [9, 10]. Hence, this method can be preferable for diagnosis of early detection malignancy as second reader in mammogram image analysis. This method some time gives more number of false positives, if low quality digital mammogram is chosen. In Future work the micro calcifications accuracy will be improved by representing segmented image in three dimensional, and evaluation process also to be improved by using artificial neural network methods.

Acknowledgements

This research work is fully funded and support by our institutions. The authors show the gratitude to the institutions, Head of the institutions, Co Faculty, Scholars. The authors are thankful to the Local government Hospital near to our institutions to support their clinical suggestions to progress of this work.

References

1. N. Riyahi Alam, F. Younesi, M. S. Riyahi Alam 'Computer-Aided Mass Detection on Digitized Mammograms using a Novel Hybrid Segmentation System' *International Journal Of Biology And Biomedical Engineering* Issue 4, Volume 3, 51(2009)
2. E. Regentova, L. Zhang, J. Zheng, and G. Veni, "Micro calcification detection based on wavelet domain hiddenMarkov tree model: Study for inclusion to computer aided diagnostic prompting system," *Med. Phys.*, vol. 34, no. 6, pp. 2206–2219, (2007)
3. Jelena Bozek, Kresimir Delac, Mislav Grgic ,Computer-Aided Detection and Diagnosis of Breast Abnormalities in Digital Mammography,*50th International Symposium ELMAR-2008*, 10-12 September, Zadar, Croatia(2008)
4. T. Matsubaraa,, T. Ichikawab, T. Harab, H. Fujitab, S. Kasaic, T. Endod, T. Iwasee' Automated detection methods for architectural distortions around skin line and within mammary gland on mammograms, *International Congress Series* 1256, 950–955(2003)
5. Jinsan Tang, Ragaraj M.Rangayan computer aided detection and diagnosis of breast cancer with mammographt: recent advances *IEEE Trans, on information technology in biomedicine* vol 13 no.2 march (2009)
6. Tomasz Arod´za, Detection of clustered micro calcifications in small field digital mammography, *Journal of Computer methods and programs in biomedicine* 81 56–65(2006)
7. Meenalosine S, Kannan E, and Malignancy Detection in Mammogram using Gray Level Gradient Buffering Method, *International Journal of Cancer Research*, Vol.47, Issue1.(2013)
8. Michael radermacher Radon transform techniques for alignment and three dimensional reconstruction from random projections, *scanning microscopy* vol. 11, 171-177, (1997)

9. V. Alarcon-Aquino1, O. Starostenko1, J. M. Ramirez-Cortes2, R. Rosas-Romero1, J. Rodriguez-Asomoza1, O. J. Paz-Luna1 and K. Vazquez-Muñoz1vol 17 Engineering Detection of micro calcifications in digital mammograms using the dual-tree complex wavelet transform *Intelligent Systems* vol 17 no 1 49, (2009)

10. Halkiotis S, Botsis T, Rangoussi M. Automatic detection of clustered micro calcifications in digital mammograms using mathematical morphology and neural networks. *Signal Processing*; 87(7):1559–68(2007)

11. Buyue Zhang, *Jan* P. Allebach Adaptive Bilateral Filter for Sharpness Enhancement and Noise Removal *IEEE transactions on image processing*, VOL. 17, NO. 5, MAY (2008)

12. Alexander Wong, Adaptive bilateral filtering of image signals using local phase characteristics Elsevier Signal Processing 88, 1615–1619, (2008)

13. Jinshan Tang, Shengwen Guo, Qingling Sun, Youping Deng, Dongfeng Zhou 'A bilateral filter for shapness enhancement', *Int. conference on BioComp 2009* Las Vegas, NV, USA. 13-16 July (2009)

14. Hyung W. Kang Charles K. Chui Uday K. Chakraborty A unified scheme for adaptive stroke-based Rendering, *Visual Computer* 22: 814–824 (2006)

15. Xiaoping Lin Research and Application of Mathematical Morphology Algorithms on OSSC, *IEEE- OSSC* 173(2009)

16. Joseph M. Reinhardt and William E. Higgins Efficient Morphological Shape Representation *IEEE transactions on image processing*, VOL. ***5,*** NO. 1, 89(1996)

17. Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins. *Digital Image Processing using MATLAB. Pearson Education*. ISBN 978-81-7758-898-9, (2004)

18. Patrick Guidotti · Kate Longo Two Enhanced Fourth Order Diffusion Models for Image Demising, *J Math Imaging and Visuals* 40: 188–198 (2011)

19. Zijuan Yu, Yuqian Zhao Research Advances and Prospects of Mathematical Morphology in Image Processing, *Int. conf ofCIS 2008* 1242 (2008)

20. S. Greenberg, D. Kogan, Improved structure-adaptive anisotropic filter, *Pattern reconization Lett*. 27 (1) 59–65(2006)

21. Ritwik Kumar, Amelio V´azquez-Reina, Hanspeter Pfister Radon-Like Features and their Application to Connectomics, *IEEE conferencence* 1-6 (2010)

22. Randa Boukhris Trabelsi,,Alima Damak Masmoudi,,and Dorra Sellami MasmoudiHand Vein Image Enhancement With Radon Like Features Descriptor,*World Academy of Science, Engineering and Technolog*y 78 2013 1675

23. R. M. Rangayyan, F. J. Ayres, and J. E. L. Desautels, "A review of computer-aided diagnosis of breast cancer: Toward the detection of early signs," *J. Franklin Inst.*, vol. 344, no. 3/4, pp. 312–348, (2007)

24. Dawei Qi,Lei Yu 'Application of Omni directional structure element of mathematical morphology to wood computer tomography testing' *IEEE conference CCDC 2008* 3703

25. MIAS Data base :http://www.mammoimage.org/databases/

26. M. G. Linguraru, K. Marias, R. English, and M. Brady, "A biologically inspired algorithm for micro calcification cluster detection," *Med. Image Anal.*, vol. 10, no. 6, pp. 850–862, 2006.

27. M. N. Gurcan, Y. Yardimci, A. E. Cetin, and R. Ansari, "Detection of micro calcifications in mammograms is using higher order statistics," *IEEE Signal Process. Lett.*, vol. 4, no. 8, pp. 213–216, Aug. 1997

28. L. Vincent, Morphological grayscale reconstruction in image analysis: applications and efficient algorithms, IEEE Trans. Image Processing. 2 176–201(1993).

29. Rozenn Dahyot and Jonathan Ruttle 'Generalised Relaxed Radon Transform (GR2T) for Robust Inference' *Pattern recognition* 46 pp.788-794 (2013)