

# Auto-Identification of Pectoral Muscle Region in Digital Mammogram Images

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**Abstract**—For the time being Mammography is the most effective imaging modality used by radiologists for screening of breast tumor. Resulting precise, robust and efficient breast segmentation technique still remains a challenging problem in digital mammography. Extraction of the pectoral muscle and breast region is an essential pre-processing step in the process of computer-aided detection. Primarily it allows the search for irregularities to be eliminated from the region of the breast tissue without undue influence from the background of the mammogram.

This paper represents a new automated technique for segmenting a digital mammogram image and identifies the region of pectoral muscle by using a bit depth and edge processes techniques.

**Index Terms**—Digital Mammography, pectoral Muscle detection, breast border, breast cancer.

## I. INTRODUCTION

Breast cancer is a type of cancer originating from breast tissue [1]. Both men and women are threatening to be infecting of this type of cancer. In 2008, breast cancer caused 458,503 deaths worldwide (13.7% of cancer deaths in women) [2]. Early diagnosis of breast cancer can prevent a patient from either removing the whole breast or leading to death.

Mammography is a commonly used method for displaying asymptomatic women for early detection of breast cancer. Mammographic screening uses X-rays to examine the breast for any uncharacteristic masses or lumps. Mammogram takes images of the whole breast, while a diagnostic mammogram should be focus on a specific mass or lump which is the suspected area. Huge number of mammograms produced by screening of population must be construed and diagnosed by relatively limited number of radiologists [3]. However, for improving the accuracy of interpretation Computer-Aided Diagnosis (CAD) systems will be needed [4].

CAD systems require an initial processing step that splits

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the image into stimulating region, such as the breast region, pectoral muscle region, image background and patient markings. Moreover, the segmentation method should be effective to handle an extensive range of mammographic images obtained from various image acquisition systems.

Most of the Medio-Lateral Oblique (MLO) views the pectoral muscle as a predominant density region in mammograms and can affect the results of image processing methods [4]. The pectoral muscle depicted as a bright triangular region in the image upper side towards the chest wall as shown in Fig. 1. However, that region looks like the same density as the dense tissues of concern (mass or lump) in the image. Consequently, mathematical processes are significant in order to finding the pectoral muscle region.

Identification of pectoral muscle region in mammogram image is an easy mission but it required a sequence of mathematical analysis method to be recognized. In addition to, breast border identification and finding the starting slop of the breast by pointing some points in breast borders boundary in mammogram image [5], [6].

In the proposed method mammography image databases, particularly Mammographic Image Analysis Society (MIAS) [7] as well as Digital Database for Screening Mammography (DDSM) [8] are utilized. Both included of scanned and digitized Structure From Motion (SFM) images. This technique has been examined on set of thirty digital mammography images.

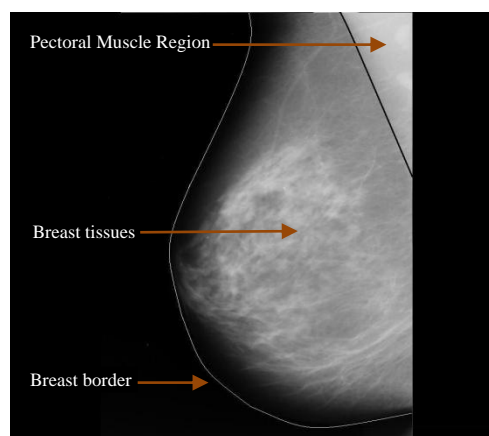


Fig. 1. Anatomy of woman breast.

## II. PECTORAL MUSCLE DETECTION

Detecting pectoral muscle is crucial task has to be preregistered for breast segmentation process. However, the reason behind detecting pectoral muscle is either to eliminate it from considerations or to find some key-points in mammography image so it can be registered subsequently.

Preregistration can benefit in some auto detect procedures for example finding bilateral asymmetry. The reliability of irregularities (tumor) detection may be increases by extracting the pectoral muscle from the breast area.

A mathematical forming method for purpose of pectoral muscle is obtained, bearing in mind the actual anatomy of breast and pectoral muscle. In the propose method assumes that they have an interface point at the top of the breast – muscle – chest. Mammograms are limiting into breast tissues and pectoral muscle region. The results for the mammograms are shown in Fig. 2 [9].

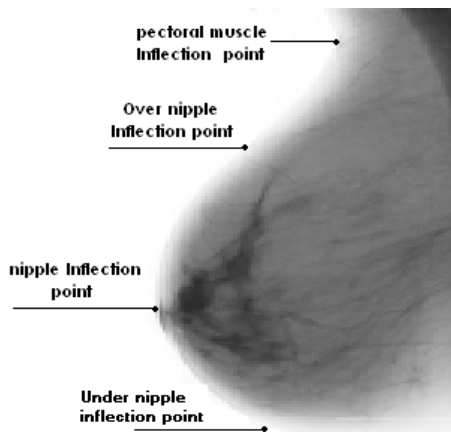


Fig. 2. Original mammogram image shows the inflection points in the breast border.

Based on what Alhsnony stated on his previous publication [10], A **New Technique for Pectoral Muscle Detection**, general equations represent pectoral muscle besides breast border boundaries. The flow chart as shown in Fig. 3 displays the arrangement techniques procedures for the performance of the technique consequentially as.

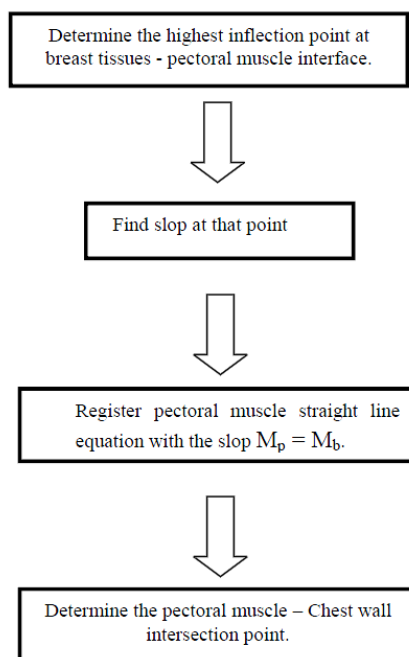


Fig. 3. Flow chart of technique procedures.

### III. MATLAB COMPUTING AND CALCULATIONS

Equation (1) represents breast curvature polynomial

equation in MATLAB software by using simple steps and analysis aiming to extract the pectoral muscles from mammography image.

$$U = aV^3 + bV^2 + cV + d \quad (1)$$

The techniques simply involve computing matrix and derive it in order to determine the highest inflection point at breast tissues - pectoral muscle interface. By referring to (2) slop of breast equation is obtained at a specific calculated point.

$$M_b = 3aVi^2 + 2bVi + c \quad (2)$$

where  $Vi$ : Is the highest inflection point.

On the other hand, the slop of the pectoral muscle inflection point equal or same slop with the breast slop. Via equalizing of  $M_p$  with  $M_b$  ( $M_p = M_b$ ).

where:

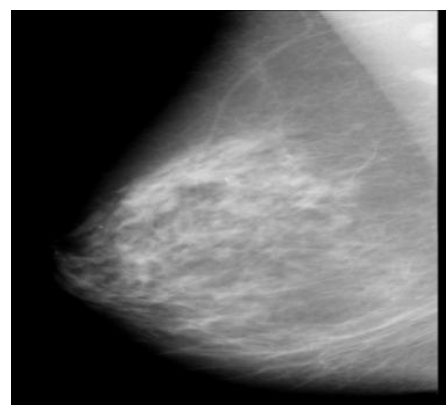
- $M_b$ : Slop of the breast.
- $M_p$ : Slop of pectoral muscles at inflection point.

Equation (3) is a straight line equation obtained from Pectoral muscle line gives the idea to evaluate pectoral muscle – chest wall between  $Y$  axis and  $X$  axis in the image.

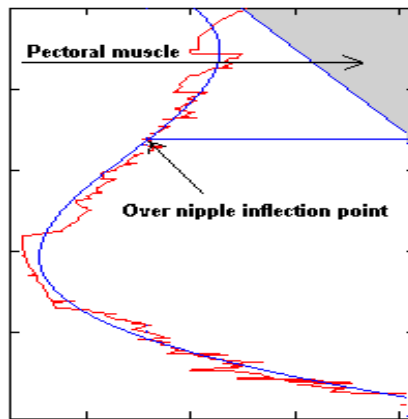
$$Y = M_b X + k \quad (3)$$

### IV. APPLYING THE SCHEME ON DIFFERENT REAL CASES

From the thirty case that has been examined. Randomly select case (5) and case (8) where chosen to be represented in this paper. In Fig. 4(a) and Fig. 5(a) show real breast mammogram image however, by taking a glance to the both pictures it is obvious to notice the pectoral muscle appears as triangle in the top - right of each image. Consequently, Fig. 4(b) depicts the MATLAB software plot display the breast borders as well as to a triangle null gray region which was originally the pictorial muscle region. In the plot, a bit over the nipple a blue straight horizontal line appears starts from the inflection point over nipple towards to the image wall which ended at the lower point of Pectoral muscle. The Read color line tracking represents the real points of breast borders while the blue represented after modification to give the curve shape of the breast to be shown as a breast borders to display the steady slop.

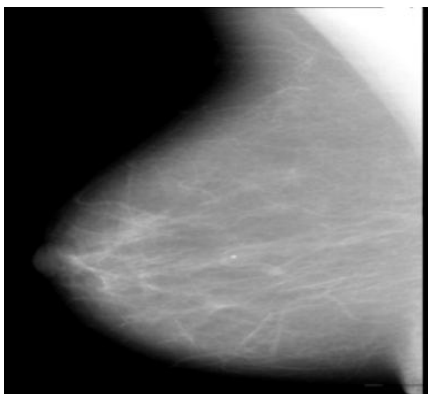


(a) Original breast mammogram image (case 5).

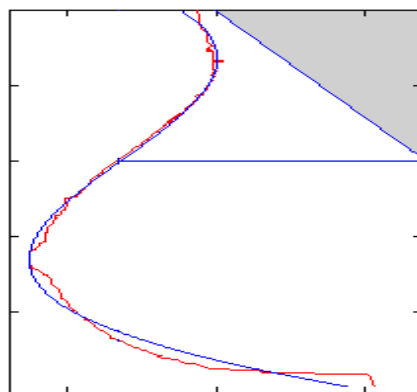


(b) MATLAB pectoral muscle detector.  
Fig. 4. Case (5) pectoral muscle detection.

Similar to the previous scenario Fig. 5(b) depicts the MATLAB software plot of Fig. 5(a) which represents the breast borders along with a triangle null gray region which was originally the pectoral muscle region. In this case the blue straight horizontal line over the nipple starts from slope upper the nipple ended to the image wall illustration the location of lower point of pectoral muscle which is a bit lower than the previous case. The red color line tracking represent the real points of breast borders tracks seeing to be more smooth in compare to Case (5) because of the pixel edges contrast of the real image. While the blue line represents the breast shape after modification to obtain the curve shape of the breast to be shown as a breast borders to display the steady slope which later on can determine the start point of pectoral muscle.



(a) Original breast mammogram image (case 8).



(b) MATLAB pectoral muscle detector.  
Fig. 5. Case (8) to pectoral muscle detection.

It is worthy to mention here that the crossing point

between the pectoral muscle straight line and the chest wall is the same location of crossing point between the tangent line and over nipple inflection point. As depicted in both cases of Fig. 4(b) and Fig. 5(b).

## V. CONCLUSION

Considering the mentioned above study and analyses it was found that the 3rd order fitting curve can be used to determine the breast border. Furthermore, it has been found that the interface among breast- pectoral muscle - chest wall helps to detect the pectoral muscle upper location and to determine its modeling equation. Besides, it can help for finding it is lower limiting point against the nipple location.

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