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Adaptive Multi Thresholding for Breast Cancer Stem Cell Detection- A Review

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Abstract: Image analysis of cancer cells is important for breast cancer diagnosis and therapy, because it is recognized as most effective and efficient way to observe its generation. In this paper we are going to present a noble method to detect breast cancer stem cell for an image, as the growth in automatic detection of breast cancer using image processing grows it attract many researchers to research and optimized the detection for breast cancer using various algorithms. I am going to use multi thresholding concept to detect breast cancer stem in biomedical images and to implement the concept of over segmentation so that no cell left behind.

Keywords: Breast Cancer Detection, Microwave Imaging, Modeling, Thermo-acoustic Imaging.

I. INTRODUCTION

Breast cancer is a type of cancer originating from breast tissue. The size, stage, rate of growth, and other characteristics of breast cancer determine the treatment. The treatment of breast cancer may include surgery, drugs (hormonal therapy and chemotherapy), radiation, and/or immunotherapy. Worldwide, breast cancer accounts for 22.9% in women. In 2012, approximately 39,520 women were expected to die from breast cancer.

In breast cancer diagnosis, pathologist inspects biopsy images captured from stained tissue specimens via a microscope. Such biopsy images comprise number of pixels, and inspection imposing heavy burden on pathologists, possibly resulting in false diagnosis. Therefore, there is a great demand for improving the accuracy and efficiency in development of a supporting system based on image recognition.

Various methods have been proposed for automating breast cancer detection. Many morphological feature based methods are extracted based on the segmentation of biopsy images such as by counting the components after binarzation and by measuring dimensions of segmented region after Hough transform. Such morphological results are doubtful and solely depend upon quality of segmentation, which is mostly degraded by image noise.

Thus, I propose a method based on pixel-wise posterior probabilities of co-occurrence of cell components to improve the accuracy of breast cancer detection from stained tissues of biopsy images. Although the previous approaches have shown some advantages, but there are still some shortcomings. Firstly, Level set and Active contour takes more processing time and thus time-consuming. In both approaches, synchronously segmentation inaccuracy cannot be avoided and overcame. Secondly, double threshold provides simple and easy way to handle segmentation problem instead of lengthy equations and complicated mathematic theory. But still we can see some drawbacks in this approach too in aspect of segmentation.

So, I here propose a new approach Adaptive Multi-Thresholding detection of breast cancer stem cell which not only aim to the introduction and analysis of adaptive multi-thresholding method but also for the purpose of comparison of different ways.

II. RELATED WORKS

A. MICROWAVE INDUCED THERMO –ACOUSTIC IMAGING MODEL FOR POTENTIAL BREAST CANCER DETECTION

In this microwave induced thermo acoustic imaging model is developed. Finite – difference time domain simulations of entire TAI model including feeding antenna, fluid environment, acoustic transducer, 3-D breast model and matching mechanism is investigated on acoustic pressures generated by different breast tissue targets [1]. Results of simulation achieve quantative relationships between input microwave peak and power and absorption rate as resulted and output acoustic pressure. This also helps in design, evaluation and optimization of spectroscopy and microwave induced TAI [2].

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Other techniques like X-ray mammography, MRI and ultrasound imaging is done for detecting breast tissues. But all these have several drawbacks such as false-negative rates, poor accuracy, and is time consuming [3]. The new complementary technique TAI applies short pulse microwave signal to irradiate a breast.

A Thermo acoustic phenomenon consists of two processes generally: acoustic wave generation and microwave energy absorption. To satisfy the condition of stress confinement these acoustic wave radiation and generation is taken into account to guarantee accuracy during microwave pulse. In EM model, microwave signal as shown in Fig.1 is used as a source,

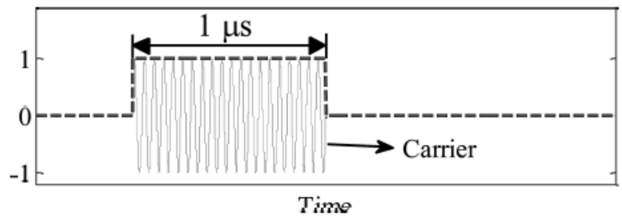

Fig.1 Square pulse modulated sinusoidal signal (the carrier frequency is decreased to enhance visibility).

whose microwave energy is partially absorbed by breast model [4]. The EM simulation starts when the pulse starts and is ceased when pulse ends [5]. Dimensions, locations and morphologies of tumors can be determined from the image. This TAI modeling can also be applied to brain imaging [6], foreign body detection [7], tumor detection [8] and renal calculi imaging [9].

B. BILATERAL ASYMMETRY IDENTIFICATION FOR THE EARLY DETECTION OF BREAST CANCER

Bilateral asymmetry detection is composed of following steps:

1) Fibro-glandular disc detection [10] and mammography density analysis through adaptive clustering techniques,
2) Implementation and analysis of bilateral asymmetries detection algorithms based on Gabor filters analysis [11-12],
3) Use of a linear Bayes classifier with the leave-one-out method to assess the asymmetry degree of the two breasts [13].

Asymmetry between the left and right mammograms is an important sign to diagnose breast cancer by radiologists of a given subject. Asymmetry analysis provides clues of early signs of tumors like parenchyma distortion, small asymmetric bright spots and contrast which are not evaluated by other methods [14].

The results in determination of the alignment angle corresponding in difference between the left and right pectoral muscle line orientations are analyzed. Also a pattern procedure is implemented to provide results in form of sensitivity.

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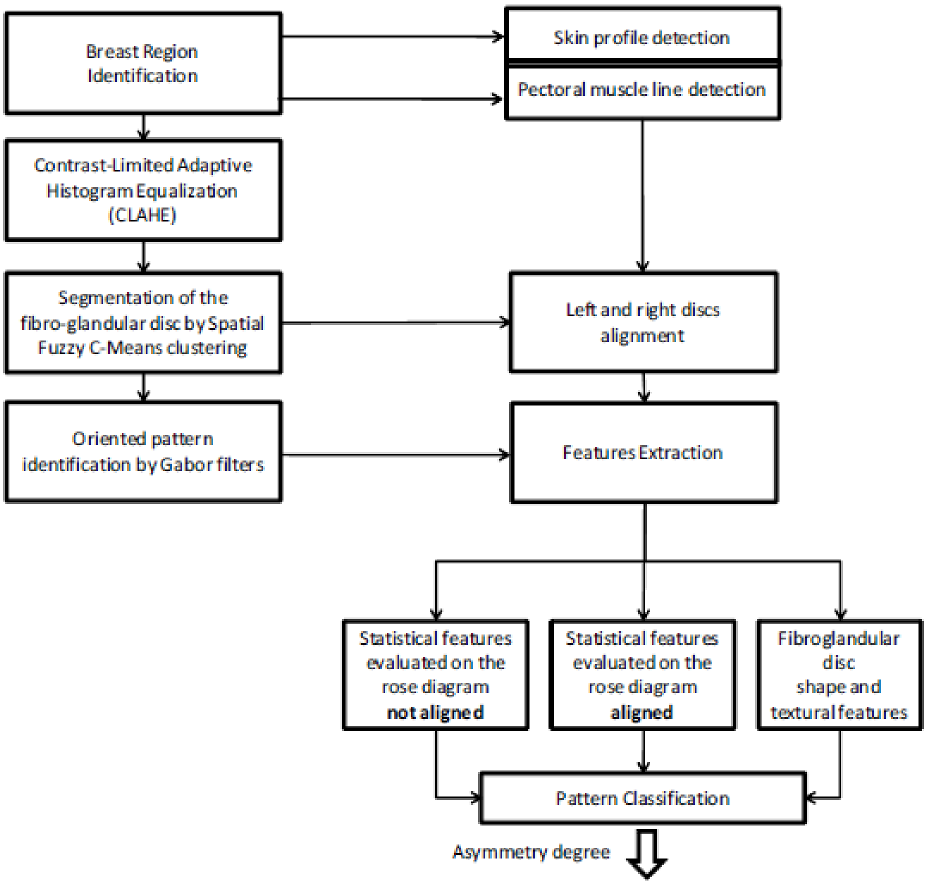

Fig.2 A schematic flowchart of whole algorithm.

C. UNSUPERVISED TIME REVERSAL BASED MICROWAVE IMAGING FOR BREAST CANCER DETECTION

THE DAF/EDF ALGORITHM [15-16]

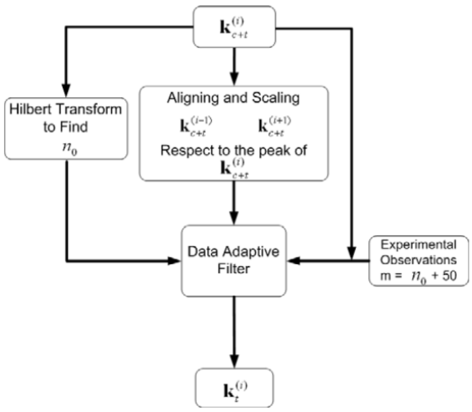

Fig.3 The DAF/EDF Algorithm

Here, DAF/EDF algorithm along with TR array imaging algorithm offers a practical approach for breast cancer detection because of two important reasons:

1) It does not need a training stage,

2) It can overcome multipath distortions which can be observed in microwave breast imaging. It also localizes the breast tumors with high accuracy which can be seen by FDTD simulation by combining TR imaging algorithm with DAF/EDF.

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D. A DOUBLE THRESHOLDING METHOD FOR CANCER STEM CELL DETECTION

In this paper comparison of double thresholding with other two approaches level set and active contour have been shown.

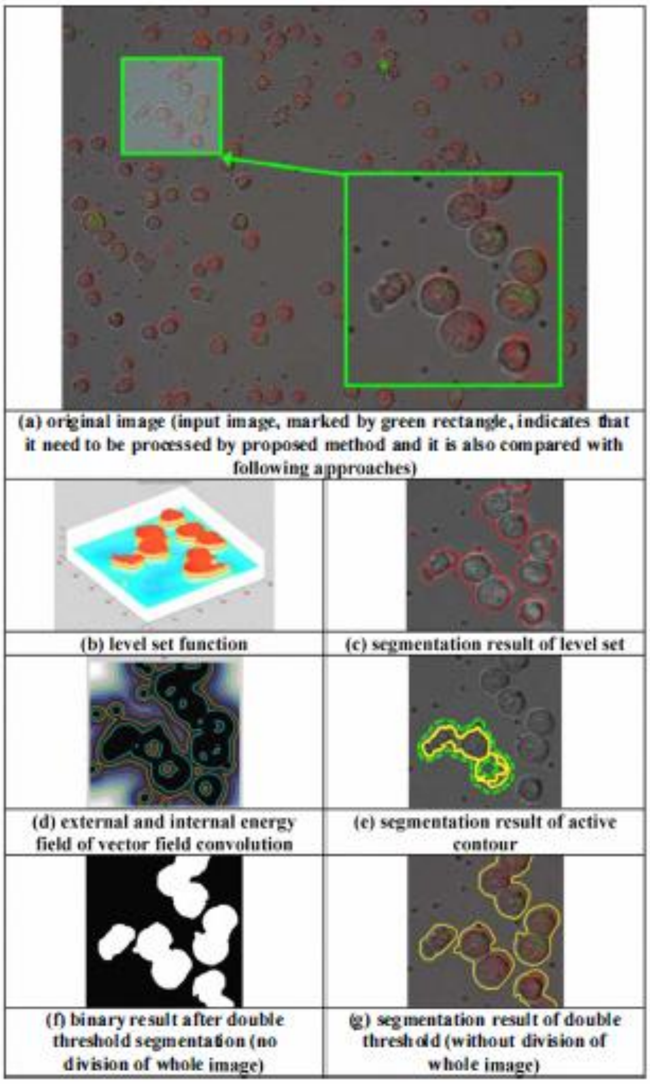

Fig.4 Comparison with level set and active contour

With comparison with other approaches Double thresholding has been found as the simplest strategy with highest accuracy and short processing time. The proposed work can be used in recognition and detection of breast cancer stem cells in images effectively.

Double thresholding present an approach which can be easily assessed for the automatic detection of breast cancer stem cells on microscopic images. Being different from other segmentation approaches, it deals with segmentation problems under real-time condition [17-21]. According to its name, it represents both low and high gray levels suited in gray histogram. Binary results can be achieved after confirming the two values.

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	Processing time	Number of iteration	Segmentation Accuracy
Level set	*4.65s*	*610*	*Good. Almost all ROI have been surrounded except the area in the top and bottom right corner of image.*
Active contour	*1.94s*	*75*	*Good. Contour of external as well as internal field is most likely to draw the outline of real edge of ROI even though its some parts lose shape.*
Double threshold (without division of whole image)	*1.32s*	*unnecessary*	*Better. All the ROI have been detected from background but some pixels lost in the top of image.*

Fig.5 Estimation of three segmentation approaches.

Level set and active contour is time consuming, segmentation inaccuracy cannot be easily avoided and properly overcame. Their application is also limited ad restricted in the face of a great number of objects, images and targets. Whereas double threshold method provides easy and simple way to handle segmentation instead of complicated lengthy mathematical equations.

E. MICROWAVE INDUCED THERMAL –ACOUSTIC IMAGING MODEL FOR POTENTIAL BREAST CANCER DETECTION

Here, a finite-difference time-domain (FDTD) simulations of acoustic models and electromagnetic (EM) are targeted to investigate acoustic pressure generated by spherical breast tumor. Simulation results show quantative relationship between input power and output acoustic pressure. In this paper, accurate EM model of the TAI system including fluidic environment [22], feeding antenna, and 3D sample are studied and developed in a broadband frequency range.

In recent years, many TAI demonstrations have been reported [23-24]. 2D imaging of breast tissue phantoms has been achieved. Acoustic wave propagation established in previous works has not been much reported to work on the electromagnetic (EM) modeling of TAI instrument and its quantative correlation with acoustic output. Thus, microwave-induced thermal acoustic imaging (TAI), combining the high contrast of microwave imaging and high resolution of ultrasound imaging, is a promising candidate of breast cancer detection [23].

This model also promises hybrid modality for breast cancer detection [23]. Matching mechanism has many applications in EM systems. Matching layer is beneficial for the efficiency of high power pulsed signal generator in real experiments.

A real feeding RW antenna is used as a microwave radiation source. Optimization of power transmission is done by matching layer. Interesting microwave frequency dependence is signified and demonstrated. Parametric studies (pulse width and waveform, microwave frequency, antenna matching) can be performed to optimize overall TAI system.

III. PROPOSED DESIGN

From the previous methodologies mentioned above, in this paper new method is proposed having following features with adaptive multi-thresholding for the detection of breast cancer stem cells with highest accuracy and preventing over segmentation:

A. Taking image into MATLAB workspace and separating its RGB (red green blue) colors.

B. Calculating histograms for individuals R G and B areas

C. Implementing adaptive multi thresholding considering over segmentation.

D. Thinning of cell boundaries.

E. Finding clusters using morphological operations.

F. Detection of cancer area and marked automatically red.

IV. CONCLUSION AND FUTURE WORK

Considering all the approaches and models above adaptive multi thresholding for breast cancer stem cell detection can give good results over segmentation. Its high speed is a main advantage in simulation process. The further work will be done by optimizing multiple random threshold values and taking image into MATLAB workspace for an efficient image recognition and highest accuracy.

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