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Ultrasound Image Processing Techniques: A Review

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Abstract:

The ultrasound images are the medical images which are used for the medical purpose. The Ultrasound images had various techniques which are used for the breast cancer calcification. The ultrasound images are used for the breast cancer calcification. The breast cancer calcification approach has certain steps like pre-processing, segmentation, feature extraction and masking. The calcification method will mask the cancer portion from the input image. The results will be analyzed in terms of accuracy, precision and recall.

Keywords

Ultrasound Images, Calcification, Feature extraction

1. Introduction

Breast cancer is one third of all types of cancers diagnosed among females. This is the main reason of 18% of cancer deaths worldwide. Up to now, breast cancer was the major cause of death among females however, since 1985 it has been ranked second after lung cancer (Ma Y, Tay PC, Adams RD, Zhang JZ, 2010). It is not possible to prevent this cancer due to the lack of adequate knowledge regarding its cause. Nevertheless, modern treatment technologies are extremely efficient against breast cancer. Using these technologies, it is possible to detect this cancer in its early stage. Thus, removing cancer in its early stages is the most efficient way to get a change in the existing breast cancer situation (Shen L, Rangayyan RM, Desautels JL, 1994). A technique named mammography is used to detect breast cancer in most reliable manner. On the other hand, about 10 to 30% of female breast cancer patients who experience mammography have negative mammograms. The radiologist could not detect the cancer that was evident on second thoughts in about two thirds of these false negative mammograms. Maintaining interest in understanding huge amount of images that shows merely a small number of abnormalities is a complex task for human radiologist (Ren J, 2012). Therefore, it is required to develop computer aided systems for diagnosing breast cancer in mammograms.Several ultrasound techniques have been proposed for designing automated breast detection methods. Among such techniques, few ultrasound techniques have been discussed in the following section.

The first ever designed technique for breast cancer screening in women is the automated breast ultrasound technique. For women with dense breast tissue and for those who had no breast biopsies or surgical procedures previously, this technique was designed. The detail resolution is sharpened by high center-frequency and the distinct contrast differentiation is delivered simultaneously by the ultra-broadband performance (Stojadinovic A, Nissan A, Gallimidi Z, 2005). For detecting the tissues of breast which accumulate higher levels of radioactive tracer through which gamma radiation is emitted, a non-invasive diagnostic technology is designed known as Breast Specific Gamma Imaging (BSGI). It is also commonly known as molecular breast imaging (MBI). Once the radioactive tracers are administrated intravenously, a gamma camera is used to perform tests.

For patients who have suspicious mammograms, the selection for biopsy can be improved by Scintimammography which is helpful for mammography and physical examination. An imaging method that uses sound waves instead of ionizing radiation to particular body part is known as breast ultrasound, also commonly called sonography (Tasoulis MK, Zacharioudakis KE, Dimopoulos NG, Hadjiminas DJ., 2014). A small instrument similar to microphone is placed on the skin to perform this test. Sound waves are emitted by this device and the echoes bouncing off the body tissues are gathered. A monochrome representation is generated on a PC screen by converting the received echoes. To evaluate certain breast masses and to know if certain region is a cyst or not, ultrasound is the best method known. By performing only physical exams, one cannot diagnose cysts accurately (Wang T, Wang K, Yao Q, 2010). To assist doctors in guiding a biopsy needle into few breast lesions, the breast ultrasound might also be used. For helping radiologists in analyzing images and automating the reporting process, pattern recognition methods are used by Computer-Aided Detection (CAD) systems for ultrasound. The standardized breast ultrasound reporting is promoted by these systems (Hellgren R, Dickman P, Leifland K, 2017). For helping the interpretations of radiologists of contrast-enhanced breast MRI, the Computer-Aided detection was used. Due to its high sensitivity in detecting breast lesions, this CAD-with-MRI can be utilize as an option in contrast to mammography and Diagnostic tests. Place a sensor with a touch array in contact breast is known as tactile breast imaging. The data signals are processed into multi-dimensional color images when the clinician moves the hand-held sensor across the breast and underarm region. The clinician can clearly view the dimensions, shape, strength and position of suspicious masses through these multi-dimensional color representation which become visible on the screen of the pc (Hussain R, Buscombe JR., 2006). In conjunction to mammography, a confirmatory test was designed for Electrical Impedence Scanning. Small electrical currents are used by this device to detect the abnormal breast tissue. A conductivity map of the breast is created by the produced electrical current from malignant tissues which conduct more electricity as compared to normal tissue. The suspicious sites are identified automatically through this process. An electrical patch on the handheld device's arm which goes to the breast is used to transmit the electricity into the body (Kim Y, Kang BJ, Kim SH, 2016). A probe on the surface of skin is used to measure it. AMRI method that is phase contrast based dependent on quantitative variations of mechanical properties of typical and malignant tissues is known as Magnetic Resonance Elastography (MRE) of the Breast. In comparison to normal tissues, the breast cancers are harder (Liberman M, Sampalis F, Mulder DS, 2003). A known stressor can be applied to measure this difference and then the resulting deformation is measured. A non-intrusive imaging modality in which the magnetic and radio frequency areas are used is known as Magnetic Resonance Imaging (MRI). Very detailed, cross-sectional images of bogy are generated by MRI to image the body tissues. No ionizing radiation is used by MRI inconsistent with CT and this process is known to be safe.

2. Literature Review

RongrongGuo, et.al(2017) summarized the different ultrasound imaging techniques as well as theirclinical applications in which the breast cancer patients were managed. Several newly designed and previously proposed techniques were discussed in order to review their performance outcomes. The final sections of this review also compare certain techniques in terms of their outputs achieved for diagnosis of Breast Cancer. The review showed that for managing breast cancer patients, the newly designed ultrasound imaging techniques provided certain important tools which proved to be highly beneficial.

AmirEhsanLashkari, et.al (2016) proposed a completely automated mechanism to classify the suspicious regions of thermogram images such that the physicians to detect the breast cancer in patients at early stages. Since every individual person has different temperature, data normalization was used. The elements of image matrix were categorized into norm in this step. Experiments conducted showed few of the best combinations that provided the best accurate outcomes of feature selection. To evaluate the breast images, the classifier and feature extraction values provided best were achieved here.

Susanne Wienbeck, et.al (2017) proposed a new imaging approach through which isotropic 3D representation of breast were generated that included high spatial and contrast resolution. The proposed technique was named as the dedicated Cone-Beam breast Computed Tomography (CBBCT) approach. To visualize the breast masses, Non-contrast and contrast-enhanced Cone Beam Breast Computed Tomography(CE-CBBCT) was known to provide better outcomes particularly for patients with dense breast tissues, as compared to mammography. With the availability of CE-CBBCT, the conspicuity of malignant calcifications

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improved. An option to quantify lesion improved was provided additionally by CE-CBBCT due to which the biopsy related decisions could be made correctly.

Yan-na Zhang, et.al (2015) proposed a research for detecting the axillary lymph node metastases of breast cancer by evaluating the diagnostic value of ultrasound for Chinese patients. For these patients, the clinicopathologic aspects in relevance with the false-negative ultrasound outcomes were also examined here. For detecting the positive axillary lymph nodels of Chinese women, the proposed method provided diagnostic value. Therefore, this approach warranted the improvement of ultrasound sensitivity, specificity and accuracy.

CaiFeng Wan, et.al(2012) presented a research in which the prognostic factors of breast cancers were used to analyse the correlation among enhancement patterns and contrast material–enhanced ultrasonography (US) parameters. The institutional ethics committee aimed to approve this study and obtain a written consent. To provide non-intrusive prediction of prognostic aspects of breast cancers, it was important to use the enhancement patterns and contrast-improvement Ultrasonograhy parameters.

O. Sarica, et.al(2014) studied the diagnostic breast MRI value in this research. With solid breast lesions,the unnecessary medical biopsies in patients were reduced in breast MRI. This research included 277 breast lesions that had a documents histological diagnosis which was confirmed by ultrasonic biopsy. To rule out the need for biopsy to assess the sonographic lesions of BI-RADS 4, dynamic MRI though, did not seem to be effective enough despite its efficient outcomes in this research. So, to assist in enhancing possible advantages of MRI, advanced MRI techniques might be used in future research.

Elena Pastor Pons, et.al (2014) proposed a research that evaluated the precision of real-time Ultrasound integrated with supine-MRI using volume navigation method(RtMR-US). The biopsy of incidental Breast Lesions (ILSM) and Axillary Lymph Nodes (LNSM) suspected of malignancy was used on the contrast enhanced magnetic resonance imaging(CE-MRI). The detection of ILSM was improved by applying RtMR-US as per the achieved results. For detecting theoccult carcinomas of the breast and assessing the propagation of cancer the RtMR-US might be used which provided highly effective outcomes.

Table 2.1: Table of Comparison

Authors Names	Year	Description	Outcomes
RongrongGuo, et al	2017	The different ultrasound imaging techniques as well as their clinical applications in which the breast cancer patients were managed were summarized.	The review showed that for managing breast cancer patients, the newly designed ultrasound imaging techniques provided certain important tools which proved to be highly beneficial.
AmirEhsanLashkari, et al	2016	A completely automated mechanism was proposed to classify the suspicious regions of thermogram images such that the physicians to detect the breast cancer in patients at early stages.	To evaluate the breast images, the classifier and feature extraction values provided best were achieved here.
Susanne Wienbeck, et al	2017	A new imaging modality was proposed through which isotropic 3D images of breast were generated that included high spatial and contrast resolution.	An option to quantify lesion improved was provided additionally by CE-CBBCT due to which the biopsy related decisions could be made correctly.
Ying Xu et al	2015	A research was proposed for detecting the Axillary lymph Node metastases of Breast Cancer	Therefore, this approach warranted the improvement in the sensitivity, specificity

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		by evaluating the diagnostic value of the ultrasound for Chinese patients.	and accuracy of ultrasound.
CaiFeng Wan et al	2012	A research was proposed in which the prognostic factors of breast cancers were used to examine the relationship among enhancement patterns and parameters of contrast material–enhanced ultrasonography (US) patterns.	To provide nonintrusiveprediction of prognostic features of breast cancers, it was important to use the enhancement patterns and parameters of contrast-improvement US.
O. Sarica, et al	2014	The unnecessary medical biopsies in patients were reduced with solid lesions of breast in breast MRI.	For ruling out the necessity of biopsy to assess the sonographiclesions of BI-RADS 4, dynamic MRI yet, did not seem to be effective enough despite its efficient outcomes in this research.
Elena Pastor Pons et al	2014	A research was proposed that evaluated the precision of real-time Ultrasound integrated with supine-MRI using volume navigation method(RtMR-US).	For detecting the occult breast carcinomas and assessing the cancer extension the RtMR-US might be used which provided highly effective outcomes.

3. Conclusion

In this work, it is concluded that ultra sound images are proposed for the breast cancer calcification. The ultra sound images have various noises which can be removed for the further processing. The techniques for the processing of ultra sound images have discussed in this paper. The ultra sound images are proposed for the breast cancer calcification which have various steps like pre-processing, segmentation and calcification.

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