DETECTION OF BREAST TUMORS BASED ON TISSUE ELASTICITY MEASUREMENT FROM B MODE ULTRASOUND IMAGES.

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Introduction

Currently breast cancer has become a major killer among Malaysian women population. Currently, there isn’t any standard mass screening procedures adopted by the Health Ministry of Malaysia for early breast cancer detection in this country. Mammography and biopsy are costly procedures done on patients on a case to case basis which also exhibits health hazards. The proposed ultrasound elastography based detection method can be used to adjunct current imaging techniques. This cost effective method has the potential to be used as a mass screening method for early breast tumor detection in Malaysia.

Elasticity of soft tissue can be qualitatively or in some cases quantitatively measured and imaged to bear useful information regarding tissue pathology. Pathological changes are generally correlated with changes in tissue stiffness and this in turn can be related to abnormality in soft tissue. Tumors in breast, liver and prostate are normally suspected by palpation through the underlying tissue.

Currently, no clinical imaging modality can elucidate the elastic properties of soft tissues. However in 1991 a first study led by Ophir et al proved that the mechanical properties information can be obtained from radio frequency ultrasound images, leading to a new imaging technique termed elastography. Elastography, which is based on principal of physical elasticity, consists of applying a pressure on the examined medium and in estimating the induced strain distribution by tracking the tissue motion. This is done by acquiring ultrasound images from a tissue in both rest and stressed states. By evaluating the variations within the signals induced by the stress, localized strain maps are generated.
Most of the previous investigations on elastography can be broadly divided into the followings:

- The study of tissue elastic constants where the biomechanical studies carried out provided a foundation for modelling and interpretation of elastograms
- The study of tissue motion using imaging system where various signal processing methods were suggested to quantify motion
- The study of vibration targets using coherent radiation where external laser and ultrasound have been used to extract the motion parameters of a vibrating target

Various elastography techniques are being developed and investigated in order to better understand biological properties of tissues. Many parameters such as strain, stress, velocity, phase and quasistatic information are derived which to provide additional diagnostic information for clinicians to detect pathological soft tissue lesions.

**Objective**

The main objective of this study is to develop an automated instrument and algorithm for detection of breast tumor using the elastography principle from B mode ultrasound images. In order to substantiate the proposed system, a finite element model will be developed to analyze the force distribution in soft and hard tissue during static and dynamic pressure loading. This data will be used to build phantoms to demonstrate the significance of the developed models and to test the automated instrument for pressure loading and image acquisition system. Optical flow software algorithms will be developed to calculate displacement parameters from the acquired images. These values shall be analyzed and further used to detect breast tumors.

**Approach**

This study shall include development of the automated instrumentation to acquire B mode ultrasound images when breast tissue is subjected to different amount of pressure. The overall methodology can be summarized as follows:

- Develop a finite element model of soft tissue which includes hard material to simulate tumor inclusion. Algor software will be used to carry out the finite element analysis.
- Study the deformation of the soft tissue using finite element analysis under various loading conditions. Varying conditions shall include varying pressure, shape of the actuator and the dynamics while the pressure is being applied.
- Build phantoms to be made from tissue mimicking materials with soft and hard inclusions for experimental tests and finite element model verifications
- Design instrumentation for pressure loading and image acquisition
- Conduct experimental tests using the developed phantoms
- Develop optical flow algorithm to evaluate displacement of tissue in B mode ultrasound images. Sets of B mode images will be post processed to obtain the tissue strain information by using the optical flow technique. Different algorithms of optical flow calculation will be analyzed and tested. The constraints arising from these algorithms will be reported.
• Use the data as extracted features and further develop pattern classification of tumors based on neural network. Strain parameters of the tissue under stressed will be generated and these information will be used as the feature extraction for the artificial intelligence system. Existing data set from ongoing research will be initially used to enhance the classifier performance.
• If clinical data is available, then acquire images from patients at the HUKM facility and analyze the results. Clinical data from normal and mammography undergoing patients will be obtained if available and further classified to evaluate the efficacy of the developed system. Initial test results on patients undergoing mammography will be studied and reported.

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