Chapter 65
Classification of Breast Thermograms Using Statistical Moments and Entropy Features with Probabilistic Neural Networks

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ABSTRACT

Breast cancer is considered as one of the life-threatening disease among woman population in developing as well as developed countries. This specific study reports on classification of breast thermograms using probabilistic neural network (PNN) with four statistical moments features mean, standard deviation, skewness and kurtosis and two entropy features, Shannon entropy and Wavelet packet entropy. The CLAHE histogram equalization algorithm with uniform and Rayleigh distributions were considered for contrast enhancement of breast thermal images. The asymmetry detection was performed by applying bilateral ratio. A total of 95 test images (normal = 53, abnormal = 42) was considered. Simulation

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study shows that CLAHE -RD with wavelet entropy features confirms the existence of symmetry on the right and left breast thermal images. An overall classification accuracy of 92.5% was achieved using the proposed multifeatures with PNN classifier. The proposed technique thus confirms the suitability as a screening tool for asymmetry detection as well as classification of breast thermograms.

INTRODUCTION

Medical thermography is found to be a promising tool for early breast cancer detection and provides a scope of developing computer aided diagnostics tool for the biomedical engineering community. The high metabolic changes are reflected in the form of high temperature in the localized region through infrared thermal images and this property is well exploited for the clinical breast cancer interpretation (Kontos et al., 2011; Amri et al., 2016). The inherent relation between the radiation from the human skin and surface temperature has a huge influence in the level of skin's blood perfusion. This property is being exploited for infrared thermal imaging and the effect of angiogenesis, inflammatory, etc. is well captured by this imaging procedure. It has the ability to showcase the changes in the vascular process referred as neoangiogenesis (Nishida et al., 2006). The increase in surface temperature in the cancerous regions can be well exploited using this imaging procedure. The active and inactive blood vessels in and around the breast region can be well mapped through this thermographic imaging. It further detects the newly formed or activated blood vessels with distinct appearance. Due to its ability to detect changes at the cellular level, study reveals that the thermographic imaging test can detect activity 8 to 10 years before any other test. This makes the IR imaging based thermography as the potential candidate to detect the metabolic changes before the actual formation of the tumor (Moghbel et al., 2011; Bhowmik et al., 2015; Amri et al., 2016; Garduño-Ramón et al., 2017).

Several attempts have been made towards the detection of breast cancer using thermography imaging technique. Kuruganti & Qi (2002) performed asymmetric analysis in breast cancer detection. The hotspot cancerous tissue due to temperature variation was recognized by this approach. Initial segmentation was performed using Hough transform. The test images were obtained from Bioyear Inc. with a sensitivity of 0.05 degrees Celsius.

Mahmoud Zadeh et al. (2015) have applied the extended hidden Markov model for optimal segmentation of breast thermal patterns. The proposed method was able to recognize semi hot regions into distinct areas. The computational burden was less compared to other segmentation procedures reported in the literature. A specific study on breast cancer detection using rotational thermography was reported (Francis et al., 2014). The proposed work showed a significant improvement on detection of breast cancer compared to the traditional thermography procedure. Textural features were extracted to distinguish cancer and non-cancerous tissues from breast thermo grams. Acharya et al. (2010) have showed the effect of textural features with support vector machine classifier for breast cancer detection using infrared thermal images. An overall classification accuracy of 88.10% was attained based on the database obtained from General hospital, Singapore. Bhowmik et al. (2015) have shown a specific study on analysis of hybrid intelligent techniques using breast thermography the detection of breast cancer. A specific study by making use of higher order statistics for breast thermograms was reported (Acharya et al., 2014). Ramakrishnan & Suganthi have investigated the effect of Gabor wavelet transform for breast thermogram images (Ramakrishnan & Suganthi, 2014).