Full Intelligent Cancer Classification of Thermal Breast Images to Assist Physician in Clinical Diagnostic Applications

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Abstract

Breast cancer is the most common type of cancer among women. The important key to treat the breast cancer is early detection of it because according to many pathological studies more than 75% – 80% of all abnormalities are still benign at primary stages; so in recent years, many studies and extensive research done to early detection of breast cancer with higher precision and accuracy. Infra-red breast thermography is an imaging technique based on recording temperature distribution patterns of breast tissue. Compared with breast mammography technique, thermography is more suitable technique because it is noninvasive, non-contact, passive and free ionizing radiation. In this paper, a full automatic high accuracy technique for classification of suspicious areas in thermogram images with the aim of assisting physicians in early detection of breast cancer has been presented. Proposed algorithm consists of four main steps: pre-processing & segmentation, feature extraction, feature selection and classification. At the first step, using full automatic operation, region of interest (ROI) determined and the quality of image improved. Using thresholding and edge detection techniques, both right and left breasts separated from each other. Then relative suspected areas become segmented and image matrix normalized due to the uniqueness of each person's body temperature. At feature extraction stage, 23 features, including statistical, morphological, frequency domain, histogram and Gray Level Co-occurrence Matrix (GLCM) based features are extracted from segmented right and left breast obtained from step 1. To achieve the best features, feature selection methods such as minimum Redundancy and Maximum Relevance (mRMR), Sequential Forward Selection (SFS), Sequential Backward Selection (SBS), Sequential Floating Forward Selection (SFFS), Sequential Floating Backward Selection (SFBS) and Genetic Algorithm (GA) have been used at step 3. Finally to classify and TH labeling procedures, different classifiers such as AdaBoost, Support Vector Machine (SVM), k-Nearest Neighbors (kNN), Naïve Bayes (NB) and probability Neural Network (PNN) are assessed to find the best suitable one. These steps are applied on different thermogram images degrees. The results obtained on native database showed the best and significant performance of the proposed algorithm in comprise to the similar studies. According to experimental results, GA combined with AdaBoost with the mean accuracy of 85.33% and 87.42% on the left and right breast images with 0 degree, GA combined with AdaBoost with mean accuracy of 85.17% on the left breast images with 45 degree and mRMR combined with AdaBoost with mean accuracy of 85.15% on the right breast images with 45 degree, and also GA combined with AdaBoost with a mean accuracy of 84.67% and 86.21%, on the left and right breast images with 90 degree, are the best combinations of feature selection and classifier for evaluation of breast images.

Keywords: *Breast cancer*, *breast thermography*, *classification*, *feature selection*, *TH*, *thermogram*
Web link: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4786959/