Microcalcification Detection in Mammography using Wavelet Transform and Statistical Parameters

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RESUMO

Breast cancer is the most frequently diagnosed type, ranking at first place as death cause due to cancer in women worldwide. The early diagnosis of malignant tumors can contribute, according to statistics collected in USA [2], for the survival of patients up to 98 percent, and since 1990 the rates for breast cancer death have been decreasing about 3 percent per year exactly due to earlier detection of the disease. A mammography is a specific type of imaging that uses a low-dose x-ray (photone-beam) therapy to examine breasts and a mammography exam is called a mammogram [5]. One of the indicators of breast cancer searched in mammograms are clusters formed by microcalcifications, tiny calcium deposits in breast tissues, that appear as small bright spots in the imaging [5].

In the last 15 years several mammography processing methods have been developed in order to help radiologists with the task of detecting microcalcifications. Among them wavelet based methods have been designed also in association with different statistical measurements [3, 4]. According to [4], microcalcifications in mammograms correspond to high frequency coefficients of the image spectrum and a possible procedure to detect and extract these calcifications is simply to decompose the mammography by wavelet transforms [1], supress the low frequency subband (scalling coefficients block), and reconstruct a new image considering only the high frequency wavelet coefficients. Unfortunatelly this procedure can lead to a high number of false positive results. When a region contains microcalcifications then the symmetry of the Gaussian distribution of wavelet coefficients is destroyed and the tails of their distribution are heavier [3]. The statistical parameters responsible for measuring these deformation effects in distributions are the third and fourth order correlation parameters, called skewness and kurtosis, respectivelly. Therefore their computitation for the wavelet coefficients can be used to localize regions where microcalcifications clusters are more alike, considered as regions of interest.

In the present work the methodology to be proposed for analyzing mammographies differes from the one presented in [3], since now the discrete Daubechies wavelet transform with 2 null moments, Db2, is considered. Another difference is that here no overalping subregions are analyzed, instead the three subbands with the corresponding wavelet coefficients are considered, where on each row and column of these subbands, skewness and kurtosis are computed. The vectors containing these values are then thresholded, keeping only significant values, those higher than the threshold parameter (here 80% of the maximum of the details of each band). The

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crossing of rows and columns associated to the significant values determine candidate regions of microcalcifications clusters. The mammographies presented here, scanned as raw format with 8-bit grayscale and 512 by 512 pixels size, were obtained from the University of South Florida Digital Mammography Home Page [6]. Fig. 1a is a mammography with normal tissues. Fig. 1b, 1c and 1d are breast imagings containing microcalcifications clusters. The red curves, provided by the data bank [6], are annotations done by specialists. Fig. 1c shows two candidates as being the regions around the crossings obtained by the proposed methodology. The second detected region in Fig. 1c is also associated to a microcalcification cluster, but in this case it is not a malignant one, according to [6]. And in Fig. 1d the crossings determine the same cluster.

For validation, 12 mammographies from [6] were analyzed, six of them each containing one microcalcification cluster and the other six images from normal exames. For the test group considered normal, the algorithm did not detect any region of interest, obtaining therefore 100% of correct detection. For the abnormal case, results are shown on Table 1. When only skewness was analyzed, the results match with the same regions determined when only kurtosis was taken into account. The two cases where more than one region were identified were all related to the same microcalcification cluster, and do not characterize false positive results. As a continuation for this research, the delimitation of regions is going to be improved.

<table>
<thead>
<tr>
<th>Image number</th>
<th>Detection Skewness and Kurtosis detections Identified Malignant regions [6]</th>
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</thead>
<tbody>
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<td>7</td>
<td>1</td>
</tr>
<tr>
<td>8 Fig. (d)</td>
<td>4</td>
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Referências


