

Image enhancement techniques for mammography classification

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1 Introduction

Breast cancer is a disease characterized for abnormal cell sprawl which can develop to malignant tumors. Mammography is the most used exam to earlier detection of malignant and benign tumors. To reduce exam limitations, algorithms have been developed to propose an automated image analysis. In this paper we present a comparative study between three image enhancement methods for mammography classification.

2 Methodology

Standard Grayscale Histogram Equalization (GHE) is an image enhancement technique used to promote a better image histogram variance [4]. Assuming that G is the gray-level value, histogram equalization can be represented by Equation (1):

$$f(x_k) = x_0 + ((G - 1) - x_0)c(x_k) \quad (1)$$

where x_0 represents the first gray-level value of image and $c(x_k)$ represents cumulative distribution function (CDF).

Preserving Bi-Histogram Equalization (BBHE) algorithm is a histogram equalization extension where the image is decomposed into vectors X_L and X_U defined as $X_L = \{f(i, j); f(i, j) \leq f_m\}$ and $X_U = \{f(i, j); f(i, j) > f_m\}$. Here $\{f_0, \dots, f_{G-1}\}$ is the set of gray-levels of the image f , $f(i, j)$ is a gray-level in the pixel (i, j) , and f_m is the mean gray value of f . Transform function of BBHE be given similar to the Equation (1).

The last method developed was Adaptive Histogram Equalization. AHE presents a local histogram equalization providing great results on medical images [3].

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3 Experiments and Results

Three tests were developed based on concepts presented on Section 2. Histogram images examples are available on [6]. After preprocessing step, Tsallis entropy [5] features were extracted from gray-level co-occurrence matrix (GLCM) [2]. A Support Vector Machine (SVM) library [1] was used to perform classification step. Table 1 shows the best accuracy rate between HE, BBHE and AHE algorithms.

Table 1: Histogram Equalization

Tech.	q	d	Statistics (%)				
			ACC	SENS	SPEC	VPP	VPN
HE	1.32	0°	89.88	80.57	99.19	99.00	83.62
BBHE	1.32	135°	86.84	80.57	93.12	92.13	82.73
AHE	1.32	135°	80.16	74.90	85.43	83.71	77.29
BBHE	1.40	0°	89.27	82.19	96.36	95.75	84.40
HE	1.40	0°	87.85	81.78	93.93	93.09	83.75
AHE	1.40	0°	80.57	81.38	79.76	80.08	81.07
AHE	1.36	0°	82.59	79.76	85.43	84.55	80.84
HE	1.40	135°	85.22	83.00	87.45	86.86	83.72
BBHE	1.40	0°	84.62	80.16	89.10	88.00	81.78

4 Conclusions

From results presented on Section 3, it is possible to conclude that the best equalization method for mammography classification was HE providing an accuracy rate of 89.88% while BBHE presented 89.27% and AHE presented 82.59%.

References

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