POSTERS

Mass Detection in Single-View Mammograms

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MASS DETECTION is essential for the early detection of breast cancer in screening mammograms. Our method for detecting circumscribed masses in single-view mammograms was developed as part of a larger effort in computer-aided diagnosis for mammography. Our goal was a simple method having as few controlling parameters as possible.

METHOD

The method starts by segmenting potential masses from their surroundings using multilevel thresholding. The range of intensities for the multilevel thresholding is determined from a histogram of the breast region. The breast region is identified by locating the boundary between the skin and the film background, as previously described.¹ A typical histogram of the breast region is shown in Figure 1. We restrict the multilevel thresholding to the interval from the highest peak in the histogram to the maximum intensity value.

At each threshold value, the connected components are extracted from the binary image using the morphologic open operator to disconnect potential masses from the surrounding tissues. The connected components are then used to mask the intensity image, and a feature vector is calculated for each connected component.

The following is a brief description of the set of features. A parallel-piped classifier is used to detect suspicious densities.

Area: the number of pixels in the connected component.

Compactness:

$$P^2/A,$$

where P is the perimeter, and A is the area of the connected component.

Eccentricity:

$$r_{\max}/r_{\min},$$

where $r_{\max}$ and $r_{\min}$ are the maximum and minimum distances between the center of the connected component and the perimeter.

Variance:

$$(1/n) \sum_{i=1}^n (g_i - \mu)^2,$$

where g_i is the grey value at location i , μ is the sample mean for the grey values of the pixels in the connected component, and n is their number.

Laws texture features: These features are based on the application of convolution kernels to the image, followed by the measurement of various statistics on the convolution images. We used the four kernels E5L5, R5R5, E5S5, and L5S5; these have been shown to be the most useful ones.

RESULTS

We have evaluated this method on parts of two clinically relevant mammography data sets. On small subsets consisting of only cancer cases, we have achieved better than 90% detection accuracy, with approximately 1.5 false positives per image. On larger data sets, having a better approximation to a screening population, we have achieved a 75% detection rate, with just over 2.0 false positives per

Fig 1. A histogram of pixel values in the breast region

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Fig 2. An original mammogram and the mammogram with results (*white boxes*) and ground truth (*dark outline*).

image. Figure 2 shows an example of the results, with the original mammogram, and, superimposed on the same image, the results of the method (the white rectangles) and the radiologist-drawn outline of the cancer (the black irregular shape near the nipple).

REFERENCES

1. Abdel-Mottaleb M, Carman C, Vafai S: Locating the boundary between breast skin edge and the background in digitized mammograms. Proceedings of the Third International Workshop on Digital Mammography, Chicago, IL, June, 1996