AUTOMATED DETECTION OF BREAST TUMOR

S. Mei Lai, Xiaobo Li, Walter F. Bischof

Department of Computing Science
University of Alberta
Edmonton, Alberta T6G 2H1

ABSTRACT

Mammography is an effective method for detecting breast cancer at the earliest possible stage. Mass screening of mammograms requires the development of automated systems to diagnose breast cancer reliably and efficiently. This paper reports an approach to the detection of one marker, circumscribed masses, using a combination of detection criteria used by experts. The cirteria include the shape, brightness contrast and uniform density of tumor areas. Our techniques employ modified median filtering to enhance mammogram images and template matching to detect breast tumor. The results obtained by applying these techniques to 24 test images are described.

KEYWORDS : breast tumor, mammogram, median filter, template matching, cross-correlation.

1. Introduction

Breast cancer is a leading cause of death among all cancers for women of middle age and older [14]. Although no prevention exists at this time, early detection and subsequent surgery is expected to result in lower death rates. Mammography has been found to be an effective breast screening technique and mass screening of mammogram is being considered as a potential approach to detect breast cancers at the earliest possible stage [17]. A major problem in such a screening program is that it involves the interpretation of the large volume of mammograms by expert radiologists. Due to the shortage of radiologist and the need to improve the cost benefit ratio of such a program, the need to construct computer-aided systems to diagnose breast cancer in mammogram becomes apparent.

In diagnosing breast cancer, radiologists use several indicators or "markers" in mammograms, all being defined by a set of criteria, such as area, brightness contrast and shape. Our long-term goal is to implement an expert system for breast cancer diagnosis based on the same set of markers and criteria the experts use. At a first stage, we are concerned with the reliable detection of likely tumor sites. Our major obstacle in this approach is the fact that experts' verbal descriptions of markers cannot be easily translated into a set of image analysis procedures. This paper is concerned with our approach to the detection of one marker, *circumscribed masses*, using a combination of detection criteria considered relevant by experts.

The evaluation of mammograms by computer can be roughly divided into three sequential processes [5] :

1. location of suspicious areas within the breast image,
2. extraction of local descriptive features from suspicious areas,
3. feature-based classification of these areas (into non-tumors, benign or malignant tumor areas).

In the past, several groups [1,16], have demonstrated the potential use of computers in feature extraction and classification of suspicious areas. Since human assistance is needed to locate these areas before the computer processes the images, these systems are not fully automated. If automatic screening of mammogram is to become a practical reality, it is necessary to develop algorithms that reliably detect suspicious tumor areas in mammograms.

Many computer-aided techniques have been developed for the analysis of medical images, but their effectiveness is very often application dependent. This is analogous to the fact that radiologists adopt different strategies to analyse different types of medical images. In addition, different imaging processes produce images with different characteristics which in turn affect the effectiveness of a given image processing technique. For instance, in the detection of Pneumonconiosis Opacities in chest X-Ray [11], the well defined equal-density contours within opacities provide a firm support for the logic upon which *Li, Savol and Fong*'s region growing algorithm is based. Therefore, it is obvious that the choice of technique used in locating suspicious areas in mammograms is directly related to the criteria used by experts and to the characteristics of mammogram images.

In the case of circumscribed masses, the criterion used by radiologist for distinguishing *"suspicious"* from *"clearly normal"* regions on a film mammogram is that a suspicious area is a bright (comparing with surrounding tissues) and approximately circular area of uniform density, and of varying size [15]. Inspite of these characteristics, locating suspicious areas in mammograms is difficult for a number of reasons. The small differences in density between normal and tumorous tissues in human breast create little contrast between a tumor area and its background in the image. This contrast is also reduced in the filming and digitization process of the mammogram images. In addition, the presence of noise and other anatomical structures, such as ducts and glands increases the background variations of tumor areas. The boundaries of tumor areas are fuzzy and in some instances, boundaries may be only partially visible. Together with the small size of early-stage