

# Chapter 8

## Image Analysis and Understanding Techniques for Breast Cancer Detection from Digital Mammograms

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### ABSTRACT

*In this chapter, an overview of recent developments in image analysis and understanding techniques for automated detection of breast cancer from digital mammograms is presented. The various steps in the design of an automated system (i.e. Computer Aided Detection [CADe] and Computer Aided Diagnostics [CADx]) include preparation of image database for classification, image pre-processing, mammogram image enhancement and restoration, segmentation of Region Of Interest (ROI) for cancer detection, feature extraction of selected ROIs, feature evaluation and selection, and classification of selected mammogram images in to benign, malignant, and normal. In this chapter, a detailed overview of the various methods developed in recent years for each stage required in the design of an automated system for breast cancer detection is discussed. Further, the design, implementation and performance analysis of a CAD tool is also presented. The various types of features extracted for classification purpose in the proposed tool include histogram features, texture features, geometric features, wavelet features, and Gabor features. The proposed CAD tool uses fuzzy c-means segmentation algorithm, the feature selection algorithm based on the concepts of genetic algorithm which uses mutual information as a fitness function, and linear support vector machine as a classifier.*

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## INTRODUCTION

Cancer is a group of diseases that cause cells in the body to change and grow out of control. Most types of cancer cells eventually form a lump or masses called a tumor, and are named after the part of the body where the tumor originates. Breast cancer begins in breast tissue, which is made up of glands for milk production, called lobules, and the ducts that connect lobules to the nipple. The remainder of the breast is made up of fatty, connective, and lymphatic tissue. Breast cancer is a leading cause of cancer deaths among women. For women in US and other developed countries, it is the most frequently diagnosed cancer. About 2,100 new cases of breast cancer and 800 deaths are registered each year in Norway. In India, a death rate of one in eight women has been reported due to breast cancer. Efficient detection is the most effective way to reduce mortality, and currently a screening program based on mammography is considered one the best and most popular methods for detection of breast cancer. Mammography is a low-dose x-ray procedure that allows visualization of the internal structure of the breast. Mammography is highly accurate, but like most medical tests, it is not perfect. On average, mammography will detect about 80%-90% of the breast cancers in women without symptoms). Testing is somewhat more accurate in postmenopausal than in premenopausal women. The small percentage of breast cancers that are not identified by mammography may be missed for just as mammography uses x-ray machines designed especially to image the breasts (Acha, Rangayyan, & Desautels, 2006). An increasing number of countries have started mass screening programmes that have resulted in a large increase in the number of mammograms requiring interpretation. In the interpretation process radiologists carefully search each image for any visual sign of abnormality. However, abnormalities are often embedded in and camouflaged by varying densities of breast tissue structures. Estimates indicate that between 10 and 30 per cent of breast radiologists

miss cancers during routine screening. In order to improve the accuracy of interpretation, a variety of screening techniques have been developed American College of Radiology (ACR, 2003)

Breast image analysis can be performed using mammography, magnetic resonance, nuclear medicine or ultrasound. So far the most effective and economical breast imaging modality has been mammography due to its simplicity, portability and cost effectiveness. Segmentation is the fundamental process which partitions a data space into meaningful salient regions. Image segmentation essentially affects the overall performance of any automated image analysis system thus its quality is of the utmost importance (Rangayyan, Ayres, & Desautels, 2007).

Digital mammography is a technique for recording x-ray images in computer code instead of on x-ray film, as with conventional mammography. The first digital mammography system received U.S. Food and Drug Administration (FDA) approval in 2000. An example of a digital mammography system is the Senographe 2000D. The images are displayed on a computer monitor and can be enhanced (lightened or darkened) before they are printed on film. Images can also be manipulated; the radiologist can magnify or zoom in on an area. From the patient's perspective, the procedure for a mammogram with a digital system is the same as for conventional mammography

Digital mammography may have some advantages over conventional mammography. The images can be stored and retrieved electronically. Despite these benefits, studies have not yet shown that digital mammography is more effective in finding cancer than conventional mammography. Initial mammographic or MRI images themselves are not usually enough to determine the existence of a benign or malignant disease with certainty. If a finding or spot seems suspicious, your radiologist may recommend further diagnostic studies. Interpretations of mammograms can be difficult because a normal breast can appear differently for each woman. Also, the appearance of an image may be compromised if there is powder or salve

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