

## Chapter 4.4

# Computer–Aided Detection and Diagnosis of Breast Cancer Using Machine Learning, Texture and Shape Features

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### **ABSTRACT**

Breast cancer is a malignant (cancer) tumor that starts from cells of the breast, being the major cause of deaths by cancer in the female population. There has been tremendous interest in the use of image processing and analysis techniques for computer aided detection (CAD)/ diagnostics (CADx) in digital mammograms. The goal has been to increase diagnostic accuracy as well as the reproducibility of mammographic interpreta-

tion. CAD/CADx systems can aid radiologists by providing a second opinion and may be used in the first stage of examination in the near future, providing the reduction of the variability among radiologists in the interpretation of mammograms. This chapter provides an overview of techniques used in computer-aided detection and diagnosis of breast cancer. The authors focus on the application of texture and shape tissues signature used with machine learning techniques, like support vector machines (SVM) and growing neural gas (GNG).

DOI: 10.4018/978-1-60960-818-7.ch4.4

## **INTRODUCTION**

Breast cancer is a malignant (cancer) tumor that starts from cells of the breast. It is found mostly in women, but men can get breast cancer, too. Breast cancer continues to be a significant public health problem in the world, being the major cause of deaths by cancer in the female population. Even more disturbing is the fact that approximately one out of 11 women in the western world will develop breast cancer at some point during her lifetime (Dominguez, 2008). The chance of dying from breast cancer is about 1 in 35. According to the American National Cancer Institute (NCI,2008), it is estimated that every three minutes a woman is diagnosed with breast cancer and every 13 minutes, a woman dies from the disease.

Primary prevention seems impossible since the causes of this disease still remain unknown. Early detection is the key to improving breast cancer prognosis. The earlier the cancer is detected, the better a proper treatment can be provided. For women whose tumors were discovered early, the five-year survival rate was about 82%, against 60% of those which had not been found early (Cheng,2003).

Thus, it is very important to find cancers before they start to cause symptoms. For early breast cancer detection the American Cancer Association (ACS, 2008) recommends that women age 40 and older should have a screening mammogram every year and should continue to do so for as long as they are in good health. The term screening refers to tests and exams used to find a disease like cancer in people who do not have any symptoms. Besides this, also it is recommended that women in their 20s and 30s should have a clinical breast exam as part of a regular exam by a health expert, at least every 3 years together with a breast self exam.

A mammogram is an X-ray of the breast, using very low levels of radiation. The image acquired from this exam is used to look for breast disease in women. During a mammogram, the breast is

pressed between 2 plates to flatten and spread the tissue. This is needed to get a good picture.

Mammography is currently the best technique for reliable detection of early, non-palpable, potentially curable breast cancer (ACS, 2008). In 1995, the mortality rate from this disease decreased for the first time, due in part to the increasing utilization of screening mammography (ACS, 2008).

However, the interpretation of the image is a repetitive task that requires much attention to minute details, and radiologists vary in their interpretation of mammograms.

Digital mammography represents an enormous advance in detection and diagnosis of breast abnormalities. Through image processing techniques, it is possible to enhance the contrast, color, and sharpness of a digital mammogram. Thus, several possible breast abnormalities can become detectable for human beings.

Therefore, in the past decade there has been tremendous interest in the use of image processing and analysis techniques for Computer Aided Detection (CAD)/Diagnostics (CADx) in digital mammograms. The goal has been to increase diagnostic accuracy as well as the reproducibility of mammographic interpretation. CAD/CADx systems can aid radiologists by providing a second opinion and may be used in the first stage of examination in the near future, providing the reduction of the variability among radiologists in the interpretation of mammograms.

This chapter provides an overview of techniques used in Computer-Aided Detection and Diagnosis of Breast Cancer. We focus on the application of texture and shape tissues signature used with machine learning techniques.

The background section provides some information about breast cancer issues highlighting the importance of the early detection and diagnosis and providing a description of the techniques that are used to develop the CAD/CADx systems for Breast Cancer. The following section presents the general architecture of CAD/CADx systems, describing some related works, and presenting

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