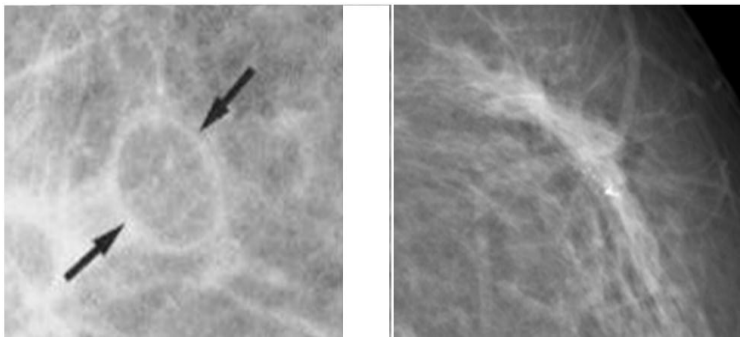
Chapter 1
Introduction

This chapter presents the motivation concepts for this thesis; moreover, it introduces the concept of breast cancer mass detection. Finally this chapter presents the main contributions of the research work and the thesis outline.

1.1 Research Motivation

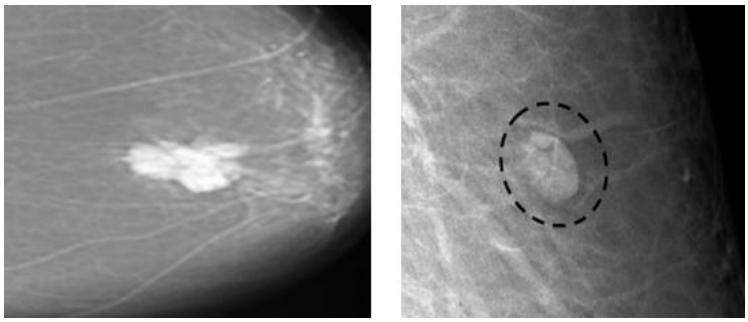
Breast cancer is the second most cancer diagnosed among women and the second most cancer deaths in the world. It can be treated by early discovery which can significantly reduce breast cancer mortality. Mammography is at present the most efficient and cost-effective available technique for early detection of breast cancer. It is a procedure that uses low-dose X-rays to examine the human breast and it is primarily used to detect and diagnose breast cancer (J. Bozek, 2009).

Radiologists visually search mammograms for specific abnormalities. The most common breast abnormalities that may indicate breast cancer are masses and calcifications. Masses appear in the mammogram as bright regions of different sizes, margins (circumscribed, micro lobular, obscured, indistinct, and spiculated), shapes (round, oval, lobular, and irregular) and gray-level intensities and contrasts that depend on their surrounding tissues (Reston, 2003; J. Bozek, 2009). Examples of masses with circumscribed and spiculated margins and lobular and round shapes are shown in figure 1. 1 & figure 1. 2 respectively.



(a) (b)

Figure 1. 1 (a) Circumscribed margin, (b) spiculated margin



(a) (b)

Figure 1. 2 (a) Lobular shape, (b) round shape

These masses are called tumors and can be either cancerous "malignant" or non-cancerous "benign". They can't be recognized from the surrounding parenchyma because their features can be similar to the normal inhomogeneous breast tissues (Islam, 2009).

Breast lesions have a wide range of features that can indicate malignant changes, but can also be part of benign changes. For example round and oval shaped masses with smooth and circumscribed margins usually indicate benign changes; also tend to have very low density, such as that of fat, (N. Dongola, 2011). On the other hand, a malignant mass usually has a spiculated, rough and blurry boundary also tends to have density greater than that of the normal breast tissue (Reston, 2003; J. Bozek, 2009).

Examples of round and oval shaped masses with smooth and circumscribed margins benign masses and examples of spiculated malignant mass are shown in figure 1. 3 & figure 1. 4 respectively. While calcifications are tiny deposits of calcium, which appear as small bright spots on the mammogram. They are characterized by their type and distribution properties (Jirari, 2008).

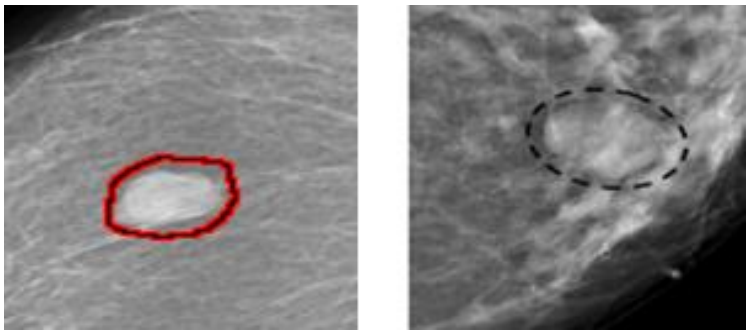


Figure 1. 3 Round and oval shaped masses with smooth and circumscribed margins benign masses

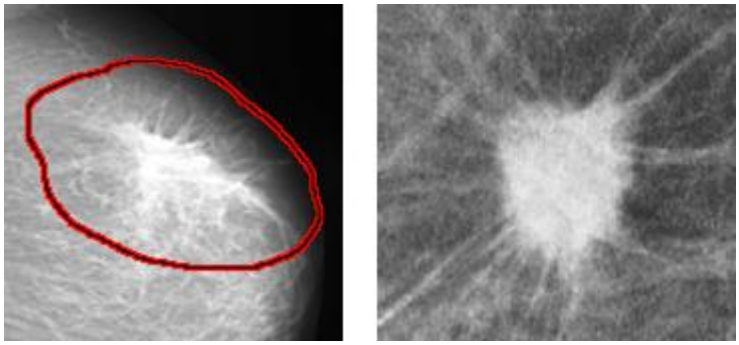


Figure 1. 4 Spiculated malignant mass

Breast lesions are described and reported according to the Breast Imaging Reporting and Data System (BI-RADS) (Reston, 2003). BI-RADS is a mammography lexicon developed by the American College of Radiology (ACR), for the description of mammographic lesions. The BI-RADS lexicon includes descriptors such as the margin of a mass and the distribution of calcifications and it defines final assessment categories to describe the radiologist's level of suspicion about the mammographic abnormality (Jirari, 2008; N. Dongola, 2011).

BI-RADS categories or levels are used to standardize interpretation of mammograms among radiologists. They are useful for statistical analysis of mammography practice, and BI-RADS results are compiled on a nationwide basis in the US to help refine mammographic procedures everywhere (Jirari, 2008; N. Dongola, 2011).

Early detection via mammography increases breast cancer treatment options and the survival rate. Although mammography remains the best way to screen for breast cancer, it is not perfect as the detection of suspicious abnormalities is a repetitive and fatiguing task, as it misses nearly one in five breast cancers that have grown large enough to feel. There exist from 15 to 20 percent of cancers missed cases. This is because reading a mammogram requires 90 percent science, but it's also 10 percent art. Distinguishing a tumor mass from other distortions takes the expert skill of a highly trained radiologist. Spotting tiny cancers against the background of dense glandular tissue challenges the best radiologists (Engel, 2009; Davis, 2011).

It is important to realize that mammographic image analysis is an extremely challenging task for a number of reasons. Because of the large variability in the appearance of abnormalities makes this a very difficult image analysis task, also abnormalities are often occluded or hidden in dense breast tissue, which makes detection difficult.

Radiologist's misinterpretation of the lesion can lead to a greater number of False Positive (FP) cases. Humans are susceptible to committing errors and their analysis is usually subjective and qualitative. Objective and quantitative analysis facilitated by the application of computers to biomedical image analysis leads to a more accurate diagnostic decision by the physician (J. Bozek, 2009).