# Chapter 20
# Machine Learning Applications in Breast Cancer Diagnosis

**Syed Jamal Safdar Gardezi**
*Universiti Teknologi Petronas, Malaysia*

**Mohamed Meselhy Eltoukhy**
*Suez Canal University, Egypt*

**Ibrahima Faye**
*Universiti Teknologi Petronas, Malaysia*

## ABSTRACT

*Breast cancer is one of the leading causes of death in women worldwide. Early detection is the key to reduce the mortality rates. Mammography screening has proven to be one of the effective tools for diagnosis of breast cancer. Computer aided diagnosis (CAD) system is a fast, reliable, and cost-effective tool in assisting the radiologists/physicians for diagnosis of breast cancer. CAD systems play an increasingly important role in the clinics by providing a second opinion. Clinical trials have shown that CAD systems have improved the accuracy of breast cancer detection. A typical CAD system involves three major steps i.e. segmentation of suspected lesions, feature extraction and classification of these regions into normal or abnormal class and further into benign or malignant stages. The diagnostics ability of any CAD system is dependent on accurate segmentation, feature extraction techniques and most importantly classification tools that have ability to discriminate the normal tissues from the abnormal tissues. In this chapter we discuss the application of machine learning algorithms e.g. ANN, binary tree, SVM, etc. together with segmentation and feature extraction techniques in a CAD system development. Various methods used in the detection and diagnosis of breast lesions in mammography are reviewed. A brief introduction of machine learning tools, used in diagnosis and their classification performance on various segmentation and feature extraction techniques is presented.*

DOI: 10.4018/978-1-5225-2229-4.ch020

## INTRODUCTION

Breast cancer accounts for the largest number of cancer cases all around the world. These numbers are particularly high in developing countries. The World Health Organization (WHO) estimates that over 522,000 women are fell victim to breast cancer only in 2012. The incidence rates have risen by 20% since 2008, with mortality rates reaching up to 14% (Xiaoyong et al., 2013, Gaber et al., 2015). In United States (US), breast cancer disease is the most common diagnosed cancer in women. It is ranked as second cause of cancer death in women. The breast cancer only estimated new cases are 249,260 (29% of cancer in women), and mortality of 40,890 (American Cancer Society, 2016). Early detection is the key to reduce the mortality rates. Mammography screening has proven to be one of the effective tools for diagnosis of breast cancer (Gaber et al., 2003, Penhoet, Petitti, & Joy, 2005). Studies have shown that mammogram screening programs have helped to reduce the mortality rates by 20% as compared to non-screening programs (P.E. Shile, 2002). Mammographic abnormalities that can indicate breast cancer can be characterized into four classes: micro-calcifications, masses, architectural distortion and bilateral asymmetry. If the traces of abnormal tissues are found during the screening, further investigations are carried out by performing additional breast imaging such as ultrasound imagery. In some cases after confirmation, breast biopsy may be performed. Biopsy involves microscopic study of the cancerous cells to determine the true nature of the cells whether the cell under study belongs to a normal or cancerous class. However, a surgical biopsy is not a straight forward job, it involves a lot of risk; it can results in anxiety and stress in the patients (Brodersen & Siersma, 2013) and may also distort the breast tissues which make it difficult for the radiologist to interpret the reading of the subsequent mammogram. Therefore, it is important to detect the disease carefully to minimize the number of biopsies. Mammography helps radiologists and surgeons by identifying the correct area to be operated. Mammography can be divided into two categories i.e. screening mammography and diagnostic mammography. Screening mammogram involves the X-ray examination of the breast. X-ray examination is the first step of examination and all women have to undergo a thorough scan, even they do not have any symptoms or signs in the physical examination. The screening mammography aims to find all the acute signs that are too small to be felt by physician or by the patient. Early detection of these small abnormal regions in screening programs has considerably improved the success rates in the breast cancer treatment. The screening checkup is recommended every 1 to 2 years for women amongst 40 years age group while incase of 50 years and above once a year screening tests are recommended. Diagnostic mammography is an x-ray examination of the breast in a woman with symptoms of breast cancer found during the screening mammography. For example, a breast lump or nipple discharge was discovered in the self-exam or any abnormality found during screening mammography. Unlike the screening mammography the diagnostic checkup is more complex process. In the diagnostic program, the examination requires more time because exact size and location of the abnormal regions and their surrounding tissue and lymph nodes are to be determined. Several images per breast are taken with varying orientations of the breast parenchyma, thus, making it more expensive as well as time consuming as compared to screening mammography. In addition, double reading has been advocated as a method to improve detection of overlooked findings by a single reader. It is used to reduce the false positive rates in single reading mammograms.