Chapter 5
Computer Techniques for Detection of Breast Cancer and Follow Up Neoadjuvant Treatment: Using Infrared Examinations

Adriel dos Santos Araujo
Fluminense Federal University, Brazil

Roger Resmini
Federal University of Rondonópolis, Brazil

Maira Beatriz Hernandez Moran
Fluminense Federal University, Brazil

Milena Henriques de Sousa Issa
Federal Hospital of Servants of Rio de Janeiro, Brazil

Aura Conci
Fluminense Federal University, Brazil

ABSTRACT

This chapter explores several steps of the thermal breast exams analysis process in detecting breast abnormality and evaluating the response of pre-surgical treatment. Topics concerning the process of acquiring, storing, and preprocessing these exams, including a novel segmentation proposal that uses collective intelligence techniques, will be discussed. In addition, various approaches to calculating statistical and geometric descriptors from thermal breast examinations are also considered of this chapter. These descriptors can be used at different stages of the analysis process of these exams. In this sense, two experiments will be presented. The first one explores the use of genetic algorithms in the feature selec-

DOI: 10.4018/978-1-7998-3456-4.ch005

tion process. The second conducts a preliminary study that intends to analyze some descriptors, already used in other works, in the process of evaluating preoperative treatment response. This evaluation is of fundamental importance since the response is directly associated with the prognosis of the disease.

INTRODUCTION

Cancer is characterized by uncontrolled growth of cells genetically altered that can be treated when correctly diagnostic is done. This situation expands to various types of cancer, including breast cancer. After the malignancy of breast cancer is indicated (by some method of tissue analysis, such as a core biopsy or mammotomy, for example), the patient in the nowadays neoadjuvant follow-up is treated in order to promote a process to encapsulate it reducing its size and especially its activity before the removal of cancerous tissues by surgery. This process is done to prevent the blood and lymphatic stream on carrying and distributing malignant cells to other parts of the body (causing metastasis or cancer in other organs).

In this sense, the use of imaging to follow this process of treatment of patients whose breast cancer has already been diagnosed can be a vital ally. The use of thermography certainly causes less discomfort in patients, who often have hypersensitivity in the breast region, and organ pain caused by the disease or forms of treatments. Digital Infrared Thermal Examination (DITE) appears as a possibility for follow up that has been recently studied and applied in research for detection and clinical monitoring of different diseases. The camera used for DITE allows capturing infrared radiation emitted by objects and converts this radiation to temperature values when environmental conditions are well known. This is a noninvasive and inexpensive technique that has recently been applied to the study of various diseases (Polidori et al., 2017; Staffa et al., 2017; Etehadtavakol and Ng, 2017; Moran et al., 2018).

The temperature acquired at each point can be analyzed in its original form, that is, a set of temperatures arranged in a bidimensional matrix represented by M(x,y), where x e y represents the indexes in that matrix. Another approach converts the range of temperature into a generic image I, represented by the function I (x, y) = i, being I a color that represents a temperature value and x e y the indexes in that image.

DITEs are characterized as functional exams and could be able to detect changes by the thermal pattern earlier than other exams since most of those exams are structural rather than physiological. There are reports in the literature mentioning that this type of test can help detect cancer up to ten years before being observed in other approaches. Besides, unlike other tests, DITE does not use ionizing radiation, are not harmful to the patient and are completely noninvasive (Gautherie, 1983; Keyserlingk et al., 1998).

MAIN FOCUS OF THE CHAPTER

The process of DITE analysis can be divided into several stages. Some of the most common could include activities inherent in exam acquisition, preprocessing, segmentation, the definition of the Region of Interest (ROI), feature computation, feature selection, and classification. In this chapter, several important points that go through all these steps will be discussed.

Some protocols used in the process of acquiring thermographic exams, will be discussed, pointing out the main differences and similarities between them. Moreover, a public dataset with over 7000 DITE and over 2500 users will be presented. The exams in this repository have helped thousands of institutions