Chapter 11
Developing and Using Computational Frameworks to Conduct Numerical Analysis and Calculate Temperature Profiles and to Classify Breast Abnormalities

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ABSTRACT

In this chapter, computational tools that have been designed to analyze and classify infrared (IR) images will be presented. The function of such tools is to interconnect in a user-friendly way the algorithms that are used to map temperatures and to classify some breast pathologies. One of these performs texture mapping using IR breast images to relate temperatures measured to the points over the substitute tridimensional geometry mesh. Another computer-aided diagnosis (CAD) tool was adapted so that it could be used to evaluate individual patients. This methodology will be used when the computational framework approach for classification is described. Finally, graphical interfaces and their functionalities will be presented and explained. Some case studies will be presented in order to verify whether or not the computational classification framework is effective.

DOI: 10.4018/978-1-7998-3456-4.ch011

INTRODUCTION

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COMPUTATIONAL FRAMEWORK TO AID THE DETECTION OF BREAST CANCER

Medical breast images obtained by different types of exam provide a high degree of relevant information to the specialist performing the analysis (Borchartt, 2013). Technological advances in areas such as computer science, computer graphics and engineering have enabled Computer-Aided Diagnosis (CAD) systems to be developed. Their function is to process images by using predefined algorithms in order to provide medical specialists with information that will speed up and/ or improve diagnosis (Cotrim, Silva, & Bezerra, 2007).

CAD systems are considered important tools which assist the medical diagnosis of breast cancer. The intention behind using them is to improve the consistency of the interpretation of the images by considering how the CAD responds to them. This answer, which may be useful when diagnosing a disease is partly based on the subjectivity of a visual analysis. Thus, double reading - by an expert physician and a computer - can significantly improve the efficiency of diagnosis (Furuie, Gutierrez, Bertozzo, & Yamagutti, 1999 as cited in Cotrim et al., 2007).

Due to the limitations of the human visual system and of physicians' experience of interpreting thermographic images, some CAD systems are being developed to improve the detection of breast abnormalities. These systems can also be used to investigate the viability of using the thermography technique as a screening exam. In other words, temperature values can be used both to analyze normal patients (without any breast abnormality) and patients who have a malignant tumor, a benign tumor or a cyst.

Typically, CAD systems are associated with graphical interfaces to facilitate how users interpret the results. One of the main advantages of creating a graphical user interface (GUI) is to make the program developed accessible to medical practitioners who do not understand programming language (Kapoor, Prasad, & Patni, 2012). By incorporating CAD systems, these human-computer interfaces may have great potential for diagnosing breast abnormalities that thermograms have identified.

Motivated by the need for a screening tool that can aid the diagnosis of breast cancer, a graphical interface was developed that lets the researcher or the mastologist evaluate a breast abnormality easily and quickly when thermographic images are used.