Chapter 4
Feature Selection Based on Dialectical Optimization Algorithm for Breast Lesion Classification in Thermographic Images

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ABSTRACT

Breast cancer is the leading cause of death among women worldwide. Early detection and early treatment are critical to minimize the effects of this disease. In this sense, breast thermography has been explored in the process of diagnosing this type of cancer. Furthermore, in an attempt to optimize the

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diagnosis, intelligent pattern recognition techniques are being used. Features selection performs an essential task in this process to optimize these intelligent techniques. This chapter proposes a features selection method using Dialectical Optimization Method (ODM) associated to a KNN classifier. The authors found that this combination proved to be a good approach showing a low impact on breast lesion classification performance. They obtained around 5% decrease in accuracy, with a reduction of about 46.80% of the features vector. The specificity and sensitivity values they found were competitive to other widely used methods.

INTRODUCTION

Cancer is one of the leading causes of death and has become one of the biggest public health problems in the world. For decades, breast cancer has been the most common type of cancer among women and is currently ranked among the top five causes of cancer death worldwide (American Cancer Society, 2019). Several studies have shown that in the case of breast cancer, the early detection raises the possibility of cure to 85%. When detected at an advanced stage this percentage reduces to 10% (Ng & Sudharsan, 2001).

Nowadays, some imaging techniques are used to detect breast cancer. The most common techniques are mammography, ultrasonography, magnetic resonance imaging, x-ray tomography and thermography. The combination of these techniques is also assessed to provide a robust and more accurate diagnosis. Among these screening tools, mammography is the most widely used. It is a low-dose x-ray procedure and is considered the gold standard for breast cancer diagnosis. Yet, mammography has some limitations. Among its main limitations are the cost of the exam and the exposure to cumulative ionizing radiation, which is a risk factor for cancer. Another important concern is the high false negative rates among young women, since their breasts tend to have mostly dense tissue, which appear on the same color of a lesion in mammographic image (American Cancer Society, 2019).

These limitations of mammography, in parallel with the increasing number of cases of breast lesions in younger patients (dense breasts), lead to the search and development of new techniques for the early detection of breast lesions. Among which, the thermography is evident.

Thermography began to be used in mastology in 1959. But, the existing technology at the time made the method discredited and not recommended for the diagnosis of breast lesions. With the technological advancement of the new thermographic cameras, new methodologies using image processing and analysis techniques can be developed. These techniques can help the detection of breast alterations by thermographic images. Thus, these new methodologies aim to verify the possibilities of using thermography as a screening exam in mastology.

Thermography is being used as an auxiliary screening tool for breast cancer. In this technique, the image is acquired by an infrared camera. The camera captures infrared radiation emitted by the surface of interest. The resulting image shows the surface temperature distribution. Therefore, there is no need for invasive procedures or exposure to ionizing radiation. In addition, this technique provides physiological information, since damaged areas show increased metabolic activity. More cellular activity increases the temperature around the area, so breast lesions can be seen as warmer spots. Considering that physiological alterations precede anatomical alterations, the use of this technique is a great step for early diagnosis (Ng & Sudharsan, 2001).

Despite being a promising technique, the interpretation of thermographic images is often difficult. It becomes more difficult when the lesions are far from the surface of the skin. In these cases, changes in