Chapter 5
Melanoma Image Classification Based on Multivariate Parametric Statistical Tests of Hypothesis

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ABSTRACT

This chapter proposes a novel method, based on the multivariate parametric statistical tests of hypotheses, which classifies the normal skin lesion images and the various stages of the melanoma images. The melanoma images are categorized into two classes, such as initial stage and advanced stage, based on the degree of aggressiveness of the cancer. The region of interest is identified and segmented from the input skin melanoma image. The features, such as HSV color, shape, and texture, are extracted from the region of interest. The features are treated as a feature space, which is assumed to be a multivariate normal random field. The proposed statistical tests are employed to identify and classify the melanoma images. The proposed method yields an average correct classification up to 91.55% for the normal skin lesion versus the initial and the advanced stages of the melanoma images, up to 91.39% for initial stage melanoma versus the normal skin lesion and the advanced stages melanoma, and up to 92.27% for the advanced stage melanoma versus the normal skin lesion and the initial stage melanoma. The proposed method yields better results.

INTRODUCTION

The advances in computer vision system have exponentially increased the applications of image processing methods in many fields. Particularly, the medical imaging system, such as ultrasonography, computed tomography (CT), magnetic resonance (MR) imaging system, cancer analysis and classification, and nuclear medicine, those are used to assist doctors in diagnosis, treatment, and research. Nowadays, many corporate-based healthcare organizations use Robotics for complicated surgery with the assist of

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a specialized surgeon in the respective domain. In order to make the computerized analysis of medical image processing systems as an effective and efficient tool, a proper image classification method is required. The classification refers to assigning a physical object or incident into one of a set of predefined categories. The classification plays a noteworthy role in disease classification, like cancer identification, segmentation and classification, brain disease classification, CT liver image classification, X-ray image segmentation, gene classification, etc. The medical image classification is more sensitive, because they could vary with a minute feature or signature. This chapter concentrates on melanoma image classification, based on a multivariate parametric statistical methods. It is observed from the literature that the existing methods identify or classify whether a skin image is melanoma or not. Though, clinically the melanoma has been categorized into four groups, based on the degree of aggressiveness of the cancerous, the existing methods classify only two groups, that is, whether the skin image is melanoma or not. This motivated to develop this chapter to classify a three different category of melanoma images, namely (i) normal dermoscopic images; (ii) initial stage melanoma; (iii) advanced stage melanoma. The proposed classification method is developed based on the statistical tests of hypothesis, such as the test for equality of covariance and the test for equality of mean vector. The test for equality of covariance compares the covariance of two groups, whereas the test for equality of mean vector compares the mean vectors of the two groups.

BACKGROUND

Despite there are a number of methods available for medical image classification, some methods require high computational complexity for feature extraction and classification (Li & Shen, 2018; Lee et al., 2018; Ma et al., 2017), for instance the method which comprises of deep learning, deep convolutional learning while some other methods follow a lot of procedures for feature extraction (Lee et al., 2018; Ma et al., 2017; Silveria et al., 2009). The medical image classification comprises of image acquisition, preprocessing, feature extraction, classification, and performance evaluation. The pre-processing is a course of actions that is executed on raw image data, in order to achieve a best recital of a data set. It has a significant impact on the performance of the classification algorithm. Data pre-processing phase, in medical image processing, comprises of image cropping, filtering, segmentation, gradient operations and scaling. Feature extraction engages feature estimation and feature selection methods. A considerable number of texture feature extraction methods available in the literature, such as Gabor, Haralick's, and wavelet histogram, and so on; each of them describes some aspects of image contents. Therefore, feature extraction is a process of analyzing objects and images, which extracts the most prominent features that corresponds to various classes of objects. Therefore, it is worth to state that improving the feature extraction process will improve the performance of a described classification algorithm.

The X-ray medical images play a noteworthy role in clinical diagnosis of the diseases. It has turned the attention of the computer vision community to the medical image analysis such as classification, segmentation, compression, and retrieval. Pourghassem and Ghassemian (2008) have proposed a hierarchical medical image classification, based on a perfect set of various shape and texture features; and a tessellation-based spectral feature as well as a directional histogram has been proposed. They have adopted a merging scheme, which applies three measures -- *accuracy*, *miss-classified ratio*, and *dissimilarity* – to detect the overlapping classes. The accuracy and miss-classified ratio realizes a supervised