Artificial Intelligence in Computer-Aided Diagnosis

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INTRODUCTION

Professionals of the medical radiology area depend directly on the process of decision making in their daily activities. This process is mainly based on the analysis of a great amount of information obtained for the evaluation of radiographic images.

Some studies demonstrate the great capacity of Artificial Neural Networks (ANN) in support systems for diagnosis, mainly in applications as pattern classification.

The objective of this article is to present the development of an ANN-based system, verifying its behavior as a feature extraction and dimensionality reduction tool, for recognition and characterization of patterns, for posterior classification in normal and abnormal patterns.

BACKGROUND

The computer-aided diagnosis (CAD) is considered one of the main areas of research of the medical images and radiological diagnosis (Doi, 2005).

According to Giger (2002) “In the future, is probable that all the medical images have some form of executed CAD to benefit to the results and the patient cares”.

The diagnosis of the radiologist is normally based on qualitative interpretation of the analyzed data, that can be influenced and be harmed by many factors, as low quality of the image, visual fatigue, distraction, overlapping of structures, amongst others (Azevedo-Marques, 2001). Moreover, the human beings possess limitations in its visual ability, which can harm the analysis of a medical image, mainly in the detection of determined presented patterns (Giger, 2002).

Research demonstrates that when the analysis is carried out by two radiologists, the diagnosis sensitivity is significantly increases (Thurffjell et al., 1994). In this direction, the CAD can be used as a second specialist, when providing the computer reply as a second opinion (Doi, 2005).

Many works analyze the radiologist performance front the use of a CAD systems, of which we detach the research of Jiang et al. (2001) and Fenton et al. (2007).

In the development of CAD systems, techniques from two computational areas are normally used: Computer Vision and Artificial Intelligence. From the area of Computer Vision, techniques of image processing for enhancement, segmentation and feature extraction are used (Azevedo-Marques, 2001).

The enhancement objectives to improve an image to make it more appropriate for a specific application (Gonzalez & Woods, 2001). In applications with digital medical images, the enhancement is important to facilitate the visual analysis on the part of the specialist.

The segmentation is the stage where the image is subdivided in parts or constituent objects (Gonzalez & Woods, 2001). The result of the segmentation is a set of objects that can be analyzed and quantified individually, representing determined characteristic of the original image.

The final stage involved in image processing is the feature extraction, that it basically involves the quantification of elements that compose segmented objects of the original image, such as size, contrast and form.

After concluded this first part, the quantified attributes are used for the classification of the structures identified in the image, normally using methods of Artificial Intelligence. According to Kononenko (2001), the use of Artificial Intelligence in the support to the diagnosis is efficient, for allowing a complex data analysis of simple and direct form.

Many methods and techniques of Artificial Intelligence can be applied in this stage, normally with the objective to identify and to separate the patterns in distinct groups (Theodorides & Koutroumbas, 2003), for example, normal and abnormal patterns. According to Kahn Jr (1994), among the main techniques, can be
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