

Computerized Detection of Interstitial Disease in Chest Radiographs

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Abstract

In this article the elements that constitute a computer-aided diagnosis system for the detection of interstitial disease in chest radiographs are described. First, because of the diffuse nature of interstitial abnormalities, a method for texture analysis is usually involved. A second element is the classifier: In the classification stage, one has to choose between multiclass or one-class classification. A third aspect is the selection of regions of interest for analysis, which is linked to the segmentation problem. Finally, there are several ways to combine the results of analyses of ROIs into a final diagnosis of the complete image in several ways. Results from the approach I have adopted will be presented and some directions for future research are given.

Key words: Computer-aided diagnosis, Digital chest radiograph, Interstitial disease

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1. Introduction

Interstitial disease (ID) affects the interstitium of the lung, which consists of the connective tissue between the blood vessels and the alveoli, the tiny air sacs. The detection and differential diagnosis of interstitial disease belongs to the most difficult tasks in chest radiology. Usually, interstitial disease reveals itself as a diffuse process, in which the 'textural appearance' of the lung has changed. These changes can be very subtle; some examples are shown in **Fig. 1**. Because of this diffuse appearance, most attempts at computerized detection of interstitial disease use texture analysis methods. The overall architecture of computer-aided diagnosis (CAD) systems for ID is as follows. Regions of interest (ROIs) are selected in the lung fields. Texture features are extracted from these ROIs. Based on these features a classification is made, usually an estimate of the probability that the ROI contains abnormal signs. Finally, the estimates can be combined into a diagnosis for the complete image.

In the 1970s, much research focussed on the detection of pneumoconiosis, or coal miners' disease, for example [1 ~ 4]. Later work was aimed at interstitial disease in general, to which I will refer below. Work of myself and my co-workers, also discussed below, was specifically aimed at the detection of tuberculosis. For a review of research on computer-aided diagnosis in chest radiography, see [5, 6].

In this article I will critically review the various choices one has to make when designing a computer-aided diagnosis system to detect interstitial disease.

2. Feature extraction from texture analysis

Given a region of interest (ROI) of a chest radiograph containing lung tissue, texture features can be computed. Texture analysis has produced a vast amount of literature. Overviews can be found in standard handbooks on image processing or review articles, e.g. [7]. Based on these features, the probability that the ROI contains abnormalities can be estimated. Various types of texture features have been used for this purpose. In a large number of studies Katsuragawa and co-workers have focused on moments of the Fourier spectrum and geometrical features [8 ~ 16].

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