Available online at www.sciencedirect.com
SCIENCE DIRECT®
ELSEVIER
Pattern Recognition Letters 26 (2005) 909–919
Pattern Recognition Letters
www.elsevier.com/locate/patrec

Neural vs. statistical classifier in conjunction with genetic algorithm based feature selection

Ping Zhang [a,*], Brijesh Verma [b], Kuldeep Kumar [a]

[a] School of Information Technology, Bond University, Gold Coast 4229, Australia
[b] School of Information Technology, Central Queensland University, Rockhampton 4702, Australia

Received 10 September 2004

Abstract

Digital mammography is one of the most suitable methods for early detection of breast cancer. It uses digital mammograms to find suspicious areas containing benign and malignant microcalcifications. However, it is very difficult to distinguish benign and malignant microcalcifications. This is reflected in the high percentage of unnecessary biopsies that are performed and many deaths caused by late detection or misdiagnosis. A computer based feature selection and classification system can provide a second opinion to the radiologists in assessment of microcalcifications. The research in this paper proposes and investigates a neural-genetic algorithm for feature selection in conjunction with neural and statistical classifiers to classify microcalcification patterns in digital mammograms. The obtained results show that the proposed approach is able to find an appropriate feature subset and neural classifier achieves better results than two statistical models.
© 2004 Elsevier B.V. All rights reserved.

Keywords: Microcalcifications pattern classification; Neural networks; Statistical methods; Feature selection; Genetic algorithm

1. Introduction

Breast cancer is a leading cause of cancer death in women between the ages of 40 and 55 [1]. Currently, there is no certain way to prevent breast cancer (Breast Cancer Facts, 2002). This is one reason of why early detection represents a very important factor in its treatment and consequently the survival rate.

Digital mammography is considered to be the most reliable method of early detection, however, in the early stage, the visual clues are subtle and varied in appearance, making diagnosis difficult, challenging even for specialists. In mammography breast abnormalities are divided into exhibiting

* Corresponding author. Tel.: +61755953378; fax: +61755953320.

E-mail addresses: pzhang@staff.bond.edu.au (P. Zhang), b.verma@cqu.edu.au (B. Verma), kkumar@staff.bond.edu.au (K. Kumar).

[1] Y-me Nation breast http://www.y-mechicagoland.org/breast_info.htm

0167-8655/$ - see front matter © 2004 Elsevier B.V. All rights reserved.
doi:10.1016/j.patrec.2004.09.053

microcalcification, circumscribed lesions and spiculated lesions. Microcalcification appears as a small bright spot on the mammogram. Most of the minimal breast cancers are detected by the presence of microcalcifications (Chitre et al., 1993). It is however difficult to distinguish between benign and malignant microcalcifications. To decide whether a suspicious area on a digital mammogram contains benign/malignant microcalcifications, traditionally the tissue has to be removed for examination using breast biopsy techniques. The computer classification system of the microcalcifications can provide a second opinion to the radiologists and reduce the number of unnecessary biopsies. A digital mammogram brought the possibility of using computer-aided diagnosis system.

Current image processing techniques make microcalcification detection easier, however classification of malignant and benign microcalcifications is still very challenging and a difficult problem for researchers. One important factor directly affects the classification result is feature extraction. Researchers spend a lot of time in attempt to find a group of features that will aid them in improving the classification for malignant microcalcifications from benign. In the literature, region-based features (Chitre et al., 1993; Zheng et al., 1994), shape-based features (Shen et al., 1994; Jiang et al., 1996; Shen et al., 1994), image structure features (Chitre et al., 1993; Zokos, 1998; Verma, 1998, 1999; Kevin et al., 1993; Chris and Tina, 1997), texture based features (Maria-luiza et al., 2001; Marcoz and Torres-Torriti, 2001), and position related features (Maria-luiza et al., 2001) are described and used for experiments.

One feature taken alone might not be significant for the classification but might be very significant if combined with other features. The whole set of the features may include the redundant or irrelevant information. Ho (1998), combined and constructed multiple classifiers using randomly selected features which can achieve better performance in classification than using the complete set of features. The only way to guarantee the selection of an optimal feature vector is an exhaustive search of all possible subset of features. However, search spaces to be explored could be very large. For N features, the number of possible subsets is 2^N. Feature subset selection is defined as a process of selecting a subset of features out of the larger set of features, which maximize the classification performance of a given procedure over all possible subsets. The objective of this paper is to propose and investigate a neural-genetic algorithm in conjunction with neural and statistical classifiers to find the most significant features or the sets of features suitable for classifying abnormalities of microcalcifications.

The remainder of this paper is organized as follows: Section 2 reviews the work has been done in this area. Section 3 describes the proposed research methodology. The experimental results are presented in Section 4. Section 5 discusses the obtained results by the proposed technique. The conclusion and future directions are stated in the final section.

2. Literature review

Researchers put lots of effort to find best feature or best combination of features (i.e. feature vector) that gives highest classification rate using appropriate classifier. Search strategies such as *Hill-climbing* and *Best-first search* have been used by Kohavi and Somerfield (1995) to find subsets of features with high predictive accuracy. Cost and Salzberg (1996) used *feature weighting* technique assigning a real-valued weight to catch feature. The weight associated with a feature, measures its relevance or significance in the classification task. John et al. (1994) examined the use of *heuristic* search for feature subset selection. Most of these techniques assume monotonicity of some measure of classification performance and then use branch and bound search. This monotonicity assumption in some form appears to work reasonably well with linear classifiers. However, they can exhibit poor performance with nonlinear classifiers such as neural networks (Liu and Setiono, 1966).

Racz and Nieniewski (2000), employed most discriminative components analysis and a forward/backward selection strategy to reduce the input size from 189 to 46 for his computer aided diagnosis system based on analysis of microcalcifi-

Download English Version:

https://daneshyari.com/en/article/10362228

Download Persian Version:

https://daneshyari.com/article/10362228

Daneshyari.com