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Performance Analysis of Different Classification Algorithms Using Different Feature Selection Methods on Parkinson's Disease Detection

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Abstract

Background

In diagnosis of neurodegenerative diseases, the three-dimensional magnetic resonance imaging (3D-MRI) has been heavily researched. Parkinson's disease(PD) is one of the most common neurodegenerative disorders.

New Method

The performances of five different classification approaches using five different attribute rankings each followed with an adaptive Fisher stopping criteria feature selection (FS) method are evaluated. To improve the performance of PD detection, a source fusion technique which combines the gray matter (GM) and white (WM) tissue maps and a decision fusion technique which combines the outputs of all classifiers using the correlation-based feature selection (CFS) method by majority voting are used.

Results

Among the five FS methods, the CFS provides the highest results for all five classification algorithms and the SVM provides the best classification performances for all five different FS methods. The classification accuracy of 77.50% and 81.25% are obtained for the GM and WM tissues, respectively. However, the fusion of GM and WM datasets improves the classification accuracy of the proposed methodology up to 95.00%.

Comparison with Existing Methods

An f-contrast is used to generate 3D masks for GM and WM datasets and a fusion technique, combining the GM and WM datasets is used. Several classification algorithms using several FS methods are performed and a decision fusion technique is used.

Conclusions

Using the combination of the 3D masked GM and WM tissue maps and the fusion of the outputs of multiple classifiers with CFS method gives the classification accuracy of 95.00%.

Keywords: Parkinson's disease, structural MRI, DARTEL, feature selection, source fusion, decision fusion.

1. Introduction

The neurodegenerative disorders are characterized by the progressive deterioration of the brain neurons [1, 2]. Parkinson's disease (PD) and Alzheimer's disease (AD) are the two most common neurodegenerative diseases. In neurodisease classification, in order to detect the disorder by using only one MRI scan, there is a need to have a model generated from a large collection of diseased and healthy controls (HCs) datasets [3, 4]. Even though in the AD the atrophies in the brain are clearly visible from the structural MRI (sMRI) and might be sufficient to decide the level of the disease, in PD, the atrophies might not be sufficient. Hence, in addition to sMRI data, the clinical examinations and the medical histories of the patients are required [5, 6]. To improve the accuracy of clinical tests on PD identification and make it robust, a computer-aided detection (CAD) has been progressively used in neurodegenerative disease detection [7, 8, 9]. There have been various neuroimaging methods used in the literature such as sMRI [10], functional MRI (fMRI) [11], positron emission tomography (PET) [12], and single photon emission computed tomography (SPECT) [13]. Among these neu-

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