Automatic classification and prediction models for early Parkinson's disease diagnosis from SPECT imaging

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1. Introduction

Parkinson's diseas is a neurodegenerative disease, because the cells which are used for the transit of the signals in the brain tend to disapear. The diagnosis of parkinson is complicated but a new medical imaging device ((SPECT) with ^{123}I-Ioflupane (DaTSCAN)) prone to have good good results for the early diagnosis [1]. And the earlier we detect the disease, the easier it will be to treat it.

2. Method

The paper of Prashanth *et al.* [2] is interesting because it combines probability and statistics. Indeed, there are two main steps in their method :

1. Extraction and statistical analysis of the features (Striatal Binding Ratio of right, left caudate, right putame and left putamen)
2. Binary classification of the patent (early parkinson or not) with a linear classifier and a probabilitic classifier

I plan to implement all the paper withouth the extraction of the features. For the classification they are using two types of classifier, a linear classifier (SVM) and a probabilist one (logistic regression). These two classifiers are complementary because the SVM will give the boolean decision (parkinson or not) where the logistic will predict a probability of the disease.

3. Experimentation

I plan to code and run the program using MATLAB. After reading and understading all the paper, I will download the database of patent results with the four features (already extracted from SPECT imaging) and the label (early parkinson or not). I will use these features to first statistically analyse them : I will compute the box plots. After, I will implement the SVM using SVM-lite and try different parameters and kernel to extract the more suitable, the model will be trained using a 10-fold cross-validation. A multinomial logistic regression will be coded using the MATLAB built-in function, and I will extract the statistical signficance of the regression coefficient. Finally I will compare the two classifiers using a confusion matrix (with true and false detection) and conclude to the viability of the method.

To extend their work, it can be possible to have a more accurate statistical analysis (khi-2, overlap and divergence of the four groups). Moreover, the implementation of a new classifier is probable using a bayes rule and GMM/EM to model the early- parkinson /not early- parkinson for each feature.

References

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[2] R. Prashanth, S. D. Roy, P. K. Mandal, and S. Ghosh. Automatic classification and prediction models for early parkinson's disease diagnosis from spect imaging. *Expert Systems with Applications*, 41(7):3333–3342, 2014.