交点を有する新しい階層的クラスタリングアルゴリズムを用いた機能的MRIデータ解析に関する研究

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Summary

Title: Functional MRI Data Analysis Using New Hierarchical Clustering Algorithm with Intersection Points

In this dissertation, first we briefly reviewed the functional MRI data analysis and its applications and purpose of this work. In second chapter we introduced and explained about resting state functional MRI data, psychometric parameters and functional networks which are used in this dissertation. Subsequently we explained our strategy to analyze the fMRI data with classification algorithm and then we presented the result of our experiments. Although classification results are above the chance level (12.5%), the accuracy is not sufficient for practical applications. There are many causes for low classification accuracy and outlier is one of the prevalent causes. Therefore we attempted to check whether outlier detection can increase classification accuracy or not.

In third chapter, three widely used multivariate outlier detection methods namely statistical based, clustering based and distance based methods are explained and applied for outlier detection on six benchmark medical datasets with different number of features and instances. To evaluate the efficiency of outlier detection methods we used well-known classifiers to classify mentioned datasets before and after outlier detection. The accuracies of classifiers are increased and variance values of datasets are decreased after applying outlier detection, but the increment in accuracy is not very significant. According to experiment results, clustering based outlier detection is the method that provided better result than others, but with high computational time.

In chapter 4, we attempted to introduce a new bottom-up hierarchical clustering algorithm with intersection points to provide valid and accurate clustering result with lower computational time. This algorithm can be used for outlier detection purposes too. Again we used benchmark datasets in our experiments. First we applied our proposed clustering algorithm as well as other well-known clustering algorithms to cluster these datasets. Purity, computational time and variance values are calculated to compare clustering results. In this experiment our proposed algorithm outperforms other clustering algorithms. Next, we used the new clustering algorithm for the purpose of outlier detection in benchmark datasets that were used in previous section. The

improvement in accuracies of classifiers after applying this algorithm is not very remarkable. However, the considerable point of this algorithm is that number of detected outliers is less than outliers detected by other methods, but provided results are same and in some cases better than others algorithms.

Chapter 5 began with applying two outlier detection methods (old hierarchical clustering and new algorithm with intersection points) on fMRI data to increase the classification accuracy. Again the increment in classification accuracy was not significant. Subsequently, we described a new strategy for fMRI data analysis which starts by clustering fMRI data. In this part we used clustering results as target values for training classifiers. By this strategy we can separate the uncertainties originated from MRI measurement and the one originated from behavioral measurement. In this way we could increase classification accuracies from around 30% to around 80% which is very significant. In chapter 2 behaviorally measured data were used as the target values in the design of SVM classifiers and the uncertainty was originated from both behavioral measurement and fMRI measurement. But in this chapter we separated mentioned uncertainties, since we did not use behavioral data in the SVM training. This method can be applied to evaluate human traits and also brain dysfunction on the basis of rs-fMRI.

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