Multiple Sclerosis Lesion Segmentation in MRI Images

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Abstract

The abstract paragraph should be indented 1/2 inch (3 picas) on both left and right-hand margins. Use 10 point type, with a vertical spacing of 11 points. The word **Abstract** must be centered, bold, and in point size 12. Two line spaces precede the abstract. The abstract must be limited to one paragraph.

1 Introduction

What is MS? Why it is an interesting problem? Problem definition and motivation. What are the challenges?

1.1 Related Work

Segmentation of Lesions in MRI images is an active area of research. The 3 main objectives are: 1) Extracting features that can differentiate healthy tissues from scar tissues, 2) Selecting the most relevant features that help achieve the task, and 3) Improving the performance of the classification.

1.1.1 Review of Segmentation Methods

In MS lesion segmentation, classical features are the intensity of each voxel in different modality images. Additionaly, some methods like [1], combined K-NN based on intensities with a template-driven segmentation method to reduce false positive. Others like the method presented in [6] used the probability of a voxel belonging to tissue class with help of an atlas. Moreover, as another feature, intensity of the six neighbor voxels can be added to feature vector of a point which has been used with an ANN in [5]. In [3], they used up to 255 features derived from applying different filters

on images, and then with the help of principal component analysis (PCA), data is transformed to a new orthogonal coordinates so the first column covers the greatest variance between data; hence, a simple thresholding on the first component of PCA can classify lesions. In [2], random decision forest (RDF) is used with local (like intensity) and context-rich (will be discussed later) features. RDF has the advantage of automatically using best features over other methods.

1.1.2 Exploring Combinations [PLEASE GIVE YOUR COMMENTS ON THIS PART]

Lots of methods has been employed for lesion segmentation as mentioned before; but, no valid comparision is done to measure performance of different classifiers using different features. In this project we try to compare various algorithms' efficiencies on the same dataset and same set of features to explore their properties in the task of lesion segmentation. We use Support Vector Machine (SVM), Neural Networks, K-Neares Neighbors, Random Forest, Markov Random Field, and Logistic Regression as classifier; and Haar-Like, image filters, LM filters, entropy, gaussian based, and atlas as our features. In a broad sense, we tried to extract all possible features to see how the well-known classifiers operate based on them.

2 Feature Detection

Image analysis aims at reducing information to a subset that is relevant to the task in hand. Information reduction often happens gradually with information being reduced until the desired result is extracted from the data. [4] The first level of reduction computes local features that are assumed to pertain to objects of interest.

2.1 Context (Haar-Like Features)

2.2 Image Filters

2.2.1 Leung-Malik(LM) Filter Bank

2.3 Entropy & Gaussian based Features)

2.4 Atlas Features

All the features need to explained briefly with good images.

3 Classifiers

Reasons for using each classification method. Brief description about them. No need for images here I guess.

3.1 Support Vector Machines

3.2 Neural Networks

3.3 k-Nearest Neighbours

3.4 Random Forests

3.5 Markov Random Fields

The basic principal of markov random field is treating the input image as a graph in which each voxel is a node and neighboring voxels are connected. In the case of foreground segmentation, two spacial nodes of foreground and background are added to the graph and edges between voxels and each of these two nodes have a weight equal to the probability of that voxel belongs to eighther foreground or background. Aim of the algorithm is using a graph-cut to divide graph into two classes subject to the combination of cutted edges is minimum.The advantage of this method is considering neighbors probabilities as a feature. In this project, we trained a random forest (which claimed to be the best

algorithm for lesion segmentation) and used it to obtain initial probabilities of each voxel belonging to lesion. Then, MRF is applied based on the constructed graph.

3.6 Logistic Regression

4 Experiment Design

Pipeline Diagram is required here

4.1 Validation Measures

False Positive, false negative, etc. Why Dice is preferred?

4.1.1 Dice Score

4.1.2 Accuracy

4.1.3 Sensitivity

4.1.4 Detections

4.2 Training and Test Data

BrainWeb and Miccai Challenge Data. Explain how sampling is done on data to train the classifier.

5 Results

Lots of Images! Table with comparative results. Explanation for why we get these results.

5.1 State of the art results

Brief description of the benchmark

5.2 Discussion

Detailed analysis of the results we get from different results

6 Conclusion

7 Acknowledgements

8 References

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