Chapter 33
Lesions Detection of Multiple Sclerosis in 3D Brian MR Images by Using Artificial Immune Systems and Support Vector Machines

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ABSTRACT

This paper presents a segmentation method to detect multiple sclerosis (MS) lesions in brain MRI based on the artificial immune systems (AIS) and a support vector machines (SVM). In the first step, AIS is used to segment the three main brain tissues white matter, gray matter, and cerebrospinal fluid. Then the features were extracted and SVM is applied to detect the multiple sclerosis lesions based on SMO training algorithm. The experiments conducted on 3D brain MR images produce satisfying results.

INTRODUCTION

Multiple sclerosis is an autoimmune chronic disease of the central nervous system especially the brain, the optic nerves and the spinal cord. The symptoms are very variable, numbness of a limb, blurred vision, loss of equilibrium…etc (Xavier et al, 2012).

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Magnetic resonance (MR) imaging can accurately visualize and locate plaques in both the brain and spinal cord. Depending on the sequences used, they appear white (in technical terms, we speak of "hypersignals") or black ("hyposignals").

In 2019, more than 2.4 million people suffer from multiple sclerosis .The research is focused on finding innovative treatments to relieve people with MS. The goal of this study is to detect abnormalities of gray matter and white matter in MS from 3D RM Image

Many methods have been proposed to automatically segment lesions since manual segmentation requires expert knowledge, is time consuming and is subject to intra- and interexpert variability (Vera-Olmos et al, 2016).

Veronese et al (Veronese et al, 2013) proposed a fuzzy classification algorithm that uses spatial information for MS lesion segmentation. In addition to spatial information, standard deviation dependent filtering is incorporated into the algorithm to provide better noise immunity. Also, fuzzy logic is adjusted to be more selective on vertical elliptical objects instead of circular objects since most plates are in this form.

Saba et al (Saba et al, 2018) presented a method of segmentation of MS lesions beginning with contour detection using the canny algorithm, and then a modified blurred mean c algorithm is applied to increase the accuracy of the diagnosis. Pre-treatment techniques are applied to get the best result were used, such as the brain extraction tool and binarisation

Bassem (Bassem, 2012) proposed a technique for segmentation of Sclerosis lesions by using texture textural features and support vector machines. They used two generic configurable components: a central processing module that locates areas of the brain that may form MS lesions, and a post-processing module that adds or removes these areas for more accurate data. Based on these configurable modules, single-view segmentation and multiple-section view pipelines are provided to address the limitations found in segmentation results.

Khotanlou et al (Khotanlou et al, 2011) proposed a SCPFCM algorithm named based on t membership, typicity and spatial information. Firstly, initial segmentation is applied to T1-w and T2-w images to detect MS lesions. then the non-cerebral tissues are removed by using morphological functions and finally for extraction of MS lesions, the result of the image T1 is used as a mask and compared to the image T2.

Ayelet et al (Ayelet et al, 2009) presented a multiscale method to detect lesions in multiple sclerosis based on two phases: segmentation and classification. The first one obtains a hierarchical decomposition of a multichannel anisotropic MRI scans and produces a set of features. These features are used in the second phase via a decision tree to detect lesions at all scales.

The authors find that the problem of MS lesions segmentation is still widely open especially for supervised automatic approaches. This motivates to propose an automatic approach for MS lesion detection that uses a supervised learning without an explicit expert intervention. The approach is based on AIS for brain tissue segmentation and SVM with SMO for lesions detection. A number of features to define vector types of specific lesions were calculated and these vector types were used as inputs for SVM.

This paper is organized as follows. In section 2, the researchers resent their proposed approach. Section 3 shows the obtained experimental results. Section 4 describes the comparison with a previous work and another proposed method. The final section provides the conclusion of this work.