

Automatic Diagnosis of Brain Magnetic Resonance Images based on Riemannian Geometry

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ABSTRACT

Automated brain tumor detection and segmentation, from medical images, is one of the most challenging. The authors present, in this paper, an automatic diagnosis of brain magnetic resonance image. The goal is to prepare the image of the human brain to locate the existence of abnormal tissues in multi-modal brain magnetic resonance images. The authors start from the image acquisition, reduce information, brain extraction, and then brain region diagnosis. Brain extraction is the most important preprocessing step for automatic brain image analysis. The authors consider the image as residing in a Riemannian space and they based on Riemannian manifold to develop an algorithm to extract brain regions, these regions used in other algorithm to brain tumor detection, segmentation and classification. Riemannian Manifolds show the efficient results to brain extraction and brain analysis for multi-modal resonance magnetic images.

Keywords: Automatic Brain Diagnosis, Brain Extraction, Medical Imaging, Multi-Modal RMI, Riemannian Manifolds

1. INTRODUCTION

In recent years, the evolution of medical imaging techniques allow us to use them in several areas of medicine, for example, the diagnosis of pathologies, computer-assisted monitoring of these pathologies, surgical planning, orientation surgical, statistical analysis, etc. Among all medical imaging modalities, magnetic resonance imaging (MRI) is the most frequently used imaging

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technique in neuroscience and neurosurgery. IRM creates a 3D image that perfectly visualizes the brain anatomical structures such as deep structures and tissues of the brain, as well as pathologies.

The segmentation of anatomical structures and pathologies from MRI images is a fundamental task, given that the results often become the basis for other applications. Methods for effecting segmentation vary widely depending upon the specific application and the modality of the image. Moreover, the segmentation of medical images is a challenge because they usually involve a large amount of data, they sometimes have motion artifacts or limited acquisition time and soft tissue limits patients are generally not well defined.

To analyze certain diseases of internal brain injuries, the doctor must analyze medical images. To follow the evolution of a tumor, it is necessary to know the changes in these structures. The visual interpretation of brain MRI is not always safe. In addition, the amount of images increases, making the late diagnosis. In therapy, to ensure that the irradiation treatment encompasses the entire tumor, including cancer cells not revealed by MRI, doctors treat brain volume that extends 2 cm from the tumor margin visible. This approach ignores the dynamics of tumor growth varies in different tissues of the brain, so it can result in killing some healthy cells while leaving cancer cells alive in other areas. These cells can cause recurrence of the tumor later in time, which limits the effectiveness of therapy. However, the automatic interpretation allows to assist physicians in their decision-making was felt. Thus, the automatic interpretation of brain tumors remains a difficult problem because of the complexity of the structures of the normal and pathological variability of brain structures image hence the need to develop methods of fusion of multi-sequence information for using the automatic diagnosis of cancerous cells. Several techniques have been developed by researchers to identify anatomical brain abnormalities.

There are many methods proposed for brain image segmentation in the past several decades. These approaches can be classified in terms of different criteria. For brain extraction (Kristi Boesen, & al. 2004), the major criteria are divided into two strategies, algorithms of a single strategy (Shattuck, & all, 2001. Smith, 2002) and algorithms of hybrid strategy (Eloy Roura, & all, 2014, Somasundaram K., Kalaiselvi, T., 2010). There are several techniques for brain tumor segmentation, which can be classified into four major classes (Gordillo & all, 2013): Threshold-based techniques (Shanthi & all, 2007), region-based techniques (Li & all, 2008), pixel classification techniques (Kong & all, 2006) and model-based techniques (Yao J., 2006). Unfortunately, intensity inhomogeneity, which can change the absolute intensity for a given tissue class in different locations, is a major obstacle to any automatic method for MR image segmentation and make it difficult to obtain accurate segmentation results.

In this paper, we propose to set up an automatic system to aid in the diagnosis of brain tumors. The accurate detection of tumor areas is an essential preliminary step to match the specific segmentation of the tumor, and possibly swelling. We use the histogram method based on the covariance to locate the position of the tumor in the MRI images of brain multi-modal weighted. The ultimate goal is to achieve a precise segmentation automatically localized healthy tissue to extract their attributes based on Riemannian varieties. We propose the use of a geodesic distance on Riemannian varieties to replace the Euclidean distance used in clinical practice, and correctly identify the margin of tumor invasion. For better identification of the abnormal area in the brain MRI images, eliminating non-brain areas that disrupts the right location is a crucial pre-treatment phase. Because 1. false positives are likely to occur as the tissue can look like extra-cerebral brain in structure, and 2. the computational complexity is high, which becomes a major problem for large structures. However, the automatic extraction stage of the brain region and very important given the complexity of human brain structures on the one hand, and inhomogeneities of the second intensity.

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