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IMPROVED PROJECT GRADIENT METHOD FOR TISSUE DIFFERENTIATION

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Abstract

Medical Image Processing is one of the most challenging and emerging topics in today's research field. Processing of Magnetic Resonance Spectroscopic Imaging (MRSI) is one of the parts in this field. In recent years, multispectral MRI has emerged as an alternative to Ultrasound (US) image modality for clear identification of tumors. In order to analyze a disease, Physicians consider MR imaging modality is the most efficient one for identification of tumors present in Brain. Therefore, analysis on MR imaging is required for efficient disease diagnosis. The nosologic images of the brain using magnetic resonance spectroscopic imaging (MRSI) data in an unsupervised way is created to differentiate various tissue patterns of glioma(Brain Tumor). Different tissue patterns are identified from the MRSI data using Improved project gradient method for nonnegative matrix factorization and are then coded as different primary colors (i.e. red, green, and blue) in an RGB image, so that mixed tissue regions are automatically visualized as mixtures of primary colors. Nosological images is useful in assisting glioma diagnosis, where several tissue patterns such as normal, tumor, and necrotic tissue can be present in the same voxel/spectrum. Error-maps based on linear least squares estimation are computed for each nosologic image to provide additional reliability information, which may help clinicians in decision making. Thus detection and extraction of brain tissue from MRI image is effectively done for glioma diagnosis.

***Keywords**: hierarchical nonnegative matrix factorization(hNMF),magnetic spectroscopic imaging(MRSI),nosologic imaging, non negative matrix factorization(NMF);*

1. Introduction

Exact analysis of brain tumors is of one of the utmost significant work in planning, therapy, and conducting surgery. Magnetic resonance spectroscopy imaging (MRSI) is an innovative non invasive imaging technique that supplements conventional magnetic resonance imaging (MRI) by delivering multivoxel spectra of specific biochemical information associated to the tumor nature and grade. Magnetic Resonance Imaging (MRI) is an advanced medical imaging technique used to produce high quality images of the parts contained in the human

body. MRI uses magnetic field and pulses of radio waves.Magnetic Resonance Spectroscopic Imaging (MRSI) provide information about the spatial metabolic heterogeneity of an organ in the body and to detect regions with abnormal tissue metabolism. The main drawback of MRI and MRSI in clinical practice is that the analysis of data requires lot of expertise from radiologist[4]. Contemporary studies have utilized MRSI or shared MRI with an MRSI to build nosologic images.[1]-[5]. The nosologic image aim at providing tumor type and grade in a single image, where different tissue forms are encoded with diverse colors. The earlier work on nosologic imaging has been based on supervised grouping procedures. The main drawback of the supervised grouping was obtaining enormous datasets for training classifiers was not always practicable. Glioma, is a type of tumor that starts in the brain or spine(glial cells).Glial cells are the tissue that supports and surrounds neurons in the brain. This are the most popular primary tumors in adults, and can be heterogeneous and infiltrative, especially for the higher grade cases. Which makes the surgical removal very impossible and complicate. MRSI may contain voxels indicating influence from various tissues, blended in random percentages. Nosologic images where "mixed tissue "is considered as separate class[4] disregard the fact that the percentages of each tissue patterns in each "mixed "voxel may differ significantly. In general, envisioning clear contours(e.g., tumor, normal tissue, and, possibly, mixed tissue) is not practical for assorted brain tumors such as glioma. Thus, the tumoral region of glioma can consist of several tissue patterns, namely normal tissue (called 'normal'), actively growing tumor tissue (referred to as 'tumor') and necrotic tissue consisting of dead cells (referred to as 'necrosis'). Moreover, glioma are highly infiltrative and present patterns very similar to those of other brain tumors (i.e. metastasis, lower grade). These characteristics have posed serious difficulties in the diagnosis and prognosis of glioma. The identification and localization of normal, tumor and necrosis patterns can provide added value to the clinical investigation of glioma for the guidance of therapy and determination of prognosis (i.e. the presence and amount of tumor and necrosis indicate the aggressiveness).Here the demonstration of fully Unsupervised method based on blind source separation (specifically, on nonnegative matrix factorization (NMF)[6]) to automatically create nosologic images of glioma is done and issues of image reliability is addressed by displaying "error -maps". NMF was used to differentiate brain tumor tissue from normal tissue without the need of model spectra[7]-[9].Recent studies showed that the hierarchical tissue pattern differentiation method utilising NMF(hNMF) is able to separate three tissue patterns present in glioblastoma multiforme[10].As an disapproval to current nosologic imaging methods[1]-[5],where one colour represents one tumor class, The unsupervised nosologic imaging summarizes the presence of different tissue and lessions in a single image by color coding each voxel or pixel according to histopathological class it's assigned to. Nosologic images provides an image guided surgery of brain tumour. Unsupervised nosologic imaging method provides mixtures of primary colors (i.e., red, green, and blue) between different tissue patterns; hence, the information of mixed tissue, i.e., the information about tumor heterogeneity, is maintained.

The rest of this paper is organized as follows. In Section 2, we discuss about the existing system of the project. In Section 3, the proposed system , In Section 4, the expected results of the project are discussed. In Section 5, provides the conclusion and future work of the project.1

1.1 Objective

With regard to provide a image guided surgery , the main aim of improved project gradient method for tissue differentiation is to create nosological images of the brain and to provide better tissue differentiation by minimizing the loss of healthy, functionally significant tissues.

2. EXISTING SYSTEM:

The hierarchical nonnegative matrix factorization method is used to create nosologic images of the brain using magnetic resonance spectroscopic imaging(MRSI) data in an unsupervised way. Different tissue patterns are classified and identified from the MRSI data using hierarchical nonnegative matrix factorization(HNMF) and are then coded as different primary colors(i.e. red, green, and blue) in an RGB image, so that mixed tissue regions are automatically visualized as mixtures of primary colors. The hierarchical nonnegative matrix factorization is useful in assisting glioma diagnosis, where several tissue patterns such as normal, tumor, and necrotic tissue can be present in the same voxel/spectrum. Error-maps based on linear least squares estimation are computed for each nosologic image to provide additional reliability information, which may help clinicians in decision making. An hNMF first separates the brain tissue into normal and abnormal, then by applying an optimized threshold, the abnormal tissue is further separated into actively proliferating tumor and necrosis. In this way, the three most meaningful spectral sources for GBMs are

recovered, as well as their spatial distribution information. The decision whether two or three spectral sources are more appropriate for each MRSI dataset can be based on the absence or presence of necrosis.

3. PROPOSED SYSTEM

Clinical outcome of patients diagnosed with primary brain tumour has been correlated with the extent of surgical resection. In treating this disease, the neurosurgeon must balance between an aggressive, radical resection and minimizing the loss of healthy, functionally significant brain tissue.

Improved project gradient method for tissue differentiation is a novel approach to create nosologic images of the brain using magnetic resonance spectroscopic imaging (MRSI) data in an unsupervised way. Different tissue patterns are classified and identified from the MRSI data using Improved project gradient method for non negative matrix factorization and are then coded as different primary colors (i.e. red, green, and blue) in an RGB image, so that mixed tissue regions are automatically visualized as mixtures of primary colors. The Improved project gradient method for tissue differentiation is useful in assisting glioma diagnosis, where several tissue patterns such as normal, tumor, and necrotic tissue can be present in the same voxel/spectrum. Error-maps based on linear least squares estimation are computed for each nosologic image to provide additional reliability information, which may help clinicians in decision making. And provides an image guided surgery of brain tumour

The steps involved in this are as follows:

Data preprocessing

The aim of the preprocessing step is to remove the irrelevant information, while enhancing the key features in order to extract them. MRS signals are affected by the presence of artifacts, instrumental errors, noise and other unwanted components. The spectral quality can be considerably improved by appropriate manipulation of the data. The sequence of preprocessing methods should be chosen carefully since one step may influence the other. The residual water removal can be performed by a subspace-based modelling approach such as HLSVD-PRO. The user can apply a HLSVDPRO filtering [LMV+02] on the following region [-499,-280] and [-32,499] Hz. SPID is the matlab tool used for the preprocessing purpose. The goal of SPID is to provide the user with tools capable to simulate, preprocess,process(quantification and feature extraction) and classify in vivo and ex vivo MRS signals. These tools are embedded in a matlab graphical user interface (GUI)

Tissue Differentiation Process

In this step, For any MRSI dataset, matrix X to contain spectra as column vectors, one voxel per column. Each column of this matrix can be approximated as a linear combination of r constituent spectra (i.e., "spectral sources") of specific tissue patterns, leading to the factorization.Each column of W represents a spectral source. Each row of H contains the linear combination weights. Spatial distribution information of each tissue pattern can be provided by re shaping each row of H back to the original spatial dimensions.

Nosologic Imaging Process

In this step, The new spatial distributions for all the r tissue patterns are obtained, each dimension representing one tissue pattern. The new spatial distribution of each tissue pattern (normalized between 0 and 1) as a color channel in an RGB image by encoding the spatial distribution for necrosis as red channel (if not present, this channel is set to zero), the one for tumor as green channel and the one for normal tissue as blue channel. The regions where the red or green color gets darker are the most aggressive regions for the respective dataset.

4. EXPECTED RESULTS

The nosologic images clearly displays the similar tissue pattern and their locations: blue for normal tissue, green for fast growing tumor, and red for necrosis. Regions of non informative spectra that are present at the outer line of PRESS excitation are displayed with black color. Mixed tissue regions are also represented using mixture of primary colors. The error maps are plotted for each nosologic image. Where red region shows the lower reliability and blue shows the higher probability.

5. CONCLUSION

Unsupervised nosologic imaging provides a novel way for MRSI data interpretation without the need of large training datasets. The created nosologic image is obtained on the whole PRESS excitation volume and mixed tissues in heterogeneous tumors can be shown as mixtures of primary colors. Furthermore, standard error maps provide extra information about the reliability of the nosologic images. The proposed method can also be enhanced for homogeneous tumors. Moreover, homogeneous tumors, which do not contain mixed tissues, should be easier to analyze with this approach than glioma, Since the proposed method provides a direct and effective first glance at the information contained in MRSI signals. MRSI data can be summarized in nosologic images ,easily interpretable by radiologists and provide significant added value for brain tumor type diagnosis. Furthermore nosologic imaging takes into account tumor heterogeneity and can help in stereotactic biopsy guidance and therapy follow-up.

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A Brief Author Biography

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