بسم الله الرحمن الرحيم

شبكة المعلومـــــات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قَسَــم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد اعدت دون آية تغيرات

يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of 15 – 25c and relative humidity 20-40 %

بعض الوثائق الأصلية تالفة

بالرسالة صفحات

لم ترد بالأصـــــل

NEW METHODOLOGIES FOR DATA ANALYSIS OF DIFFUSION WEIGHTED MAGNETIC RESONANCE IMAGING

By

Eng. Inas Ahmed Mohamed Yassine Mahmoud

Systems and Biomedical Engineering Department
Faculty of Engineering, Cairo University

A Thesis Submitted to the
Faculty of Engineering, Cairo University
in Partial Fulfillment of the
Requirement for the degree of
(MASTER OF SCIENCE)
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Approved, chairman

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Yaser M. Kadah

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Abstract

Diffusion tensor imaging (DTI) is a non-invasive quantitative method of characterizing tissue micro-structure. Diffusion imaging attempts to characterize the manner by which the water molecules within a particular location move within a given amount of time. The advantage of this modality lies in the fact that the changes in water diffusion at each direction, produced by alterations in brain biochemistry, can be measured as the Apparent Diffusion coefficient (ADC). Measurement of the diffusion tensor (D) within a voxel enables the mobility of water to be characterized along orthotropic axes, allows a macroscopic voxel-averaged description of fiber structure, orientation and fully quantitative evaluation of the microstructural features of healthy and diseased tissue.

The single tensor model is incapable of resolving multiple fiber orientations within an individual voxel. This shortcoming of the tensor model stems from the fact that the tensor possesses only a single orientational maximum. At the millimeter-scale resolution typical of DTI, the volume of cerebral white matter containing such intravoxel orientational heterogeneity (IVOH) may be considerable given the widespread divergence and convergence of fascicles. Several authors reported this non-mono-exponential behavior for the diffusion-induced attenuation in brain tissue in water and NAA signals.

In this work, we started by comparing between some of the published methods to solve muti-tensor models. Then, deriving the methodology and apparatus for multi-axon fiber tracking based on high angular resolution diffusion-weighted acquisitions. A multi-compartmental model was used to represent the physical make-up of imaging pixels. Based on an analytical expression of apparent diffusion tensor, the mixture model parameters are calculated using global nonlinear least squares methods. The presence of many fibers in the same direction results in an effective tensor that has the same shape as one of them. This simplified case is usually in fiber tracking. Here, the intravoxel heterogeneity was allowed to be included in the analysis by proposing a pixel model with multiple tensors instead of one. Given the nonlinearity of the parameter estimation problem here, global nonlinear least-squares methods are utilized to compute the solution.

Finally, Monte Carlo simulation was used on true tissue data to confirm that below a certain signal to noise ratio (SNR), the estimation must be pronounced. The results of this thesis can be considered to be profound step in the path of addressing the problem of fiber tracking more accurately in the future taking into account the practical limitations outlined in this work.

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