A Restriction Spectrum Imaging Method and Device for Probing Tissue Microstructure

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OTHER INFORMATION

KEYWORDS

imaging, neuroimaging, MRI, diagnosis, diagnose, in vivo, non-invasive, neurologic, neurodegenerative, neurodegeneration, diffusion MRI, DTI, HARDI, DSI, tractography, histology, cerebellum, cerebral cortex, striatum, basal ganglia, restriction spectrum

CATEGORIZED AS

- **Medical**
  - Devices
  - Diagnostics
  - Disease: Cancer

RELATED CASES

2011-311-0, 2012-844-1

BACKGROUND

The ability to study the microstructural and physiological properties of biological tissue *in vivo* has benefited greatly from the exquisite sensitivity of water diffusion magnetic resonance imaging (MRI). However, the ability to effectively and non-invasively probe biological tissue microstructures requires that one resolve both scale and orientation information. While current approaches (such as diffusion spectrum imaging (DSI) and high angular resolution diffusion imaging (HARDI)) are designed to capture either parameter separately, these methods do not allow simultaneous estimation of both scale and orientation.

TECHNOLOGY DESCRIPTION

UC San Diego researchers have developed an advanced diffusion MRI method, which can be used to probe tissue orientation structures over a range (or "spectrum") of hindered and restricted diffusion length scales with minimal assumptions on the underlying microarchitecture. The invention uses a linear mixture model to relate biological tissue parameters to diffusion MRI signals, which may be collected with various combinations of diffusion gradient strengths, diffusion times, diffusion weighting factors ("b-values"), and diffusion directions. An efficient estimation procedure is used to remove unwanted contributions to the measured signal, while preserving the desired signals related to the tissue parameters of interest.

APPLICATIONS

The technology may be used to develop non-invasive biomarkers of healthy and diseased tissue and may be customize to enable the measurement of such biomarkers.

ADVANTAGES

The device and method:

- Are able to non-invasively measure both the dimension (scale) and orientation (geometry) of separable hindered and restricted water compartments.
- Capture important microstructural information that is not afforded by traditional DSI or HARDI.
- Can be implemented on most current clinical MRI systems using modest scan times (5 to 10 minutes).

STATE OF DEVELOPMENT

Histological examination of tissue samples has been used to validate a method that can probe tissue orientation structures over a range of length scales with minimal assumptions about the underlying microarchitecture. In addition, the method has been shown to capture important, structural information that is not afforded by traditional DSI or HARDI.Software implemented in related Case 2012-844 (copyright).

INTELLECTUAL PROPERTY INFO

Pending US rights available for exclusive licensure.

RELATED MATERIALS

White, N.S., et al., Probing Tissue Microstructure With Restriction Spectrum Imaging: Histological and Theoretical Validation, Hum Brain Mapp, 34(2):327-46.
White, N.S., et al, Restriction Spectrum Imaging of Glioblastoma Multiform: Comparison vs. ADC, International Society for Magnetic Resonance in Medicine (ISMRM) Meeting abstract, May 7-13, 2011.
See laboratory Web site.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,404,986	08/02/2016	2011-311

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Fast Correction of Inhomogeneous Magnetic Field Distortion in MRI

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