Fast Correction of Inhomogeneous Magnetic Field Distortion in MRI

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BACKGROUND

Magnetic Resonance imaging ("MRI") used to map white matter tractography, as well as perfusion/diffusion-related techniques for tumor assessment (DTI/DWI) and functional brain studies (fMRI) all rely on Echo Planar Imaging (EPI). However, EPI is subject to severe geometric and intensity distortion. Quantitative anatomical precision in such measurements requires that the images are accurately corrected.

TECHNOLOGY DESCRIPTION

The subject invention gives a method by which to process MRI data in Echo Planar Imaging (EPI) systems to compensate for the high level of distortion that is typical in EPI, both from gradient variations in the MRI system, as well as induced MRI fields within the patient. The corrective method given here can be applied in under one minute to the typical scan, improving the use of EPI in the clinical setting.

EPI is a common acquisition modality where high temporal resolution is required, such as in fMRI which is used to track hemodynamic response to neuronal activity in the brain, or in Diffusion Weighted Imaging (DWI) where EPI is used for early detection of stroke. EPI is a data acquisition strategy used in MR imaging, permitting very rapid data acquisition. The method was originally described by Mansfield in 1977 and employs the following imaging strategy. Rather than acquiring a single image line (in k space) after the preparation phase of the pulse sequence, the entire MR image is acquired. Multiple variations of this image acquisition strategy have been devised since its inception, but the basic concept is that multiple rather than single image lines are acquired after spin preparation.

APPLICATIONS

- Brain tumor assessment
- White matter tractography
- Functional response of the brain (fMRI)

ADVANTAGES

- Highly anatomically accurate
- Fast
- Portable

STATE OF DEVELOPMENT

Working C++ code is developed for performing image correction and software may be particularly useful to MRI manufacturers. The work is described in the first reference under "Related Materials."

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,160,319	04/17/2012	2007-217

CONTACT

University of California, San Diego
Office of Innovation and Commercialization
innovation@ucsd.edu
tel: 858.534.5815.

INVENTORS

- Dale, Anders M.
- Holland, Dominic

OTHER INFORMATION

KEYWORDS

Diffusion Tensor Imaging, DTI, Diffusion Weighted Imaging, functional MRI, fMRI, Echo Planar Imaging, perfusion, diffusion, white matter tracts

CATEGORIZED AS

- **Computer**
  - Software
- **Imaging**
  - Medical
- **Medical**
  - Diagnostics

RELATED CASES

2007-217-0

OTHER INFORMATION

Issued US Patent No. 8,160,319 available for non-exclusive licensure

RELATED MATERIAL

Holland D, et al., Efficient correction of inhomogeneous static magnetic field-induced distortion in Echo Planar Imaging. Neuroimage. 2010 50(1):175-83.

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McDonald CR, et al., Changes in fiber tract integrity and visual fields after anterior temporal lobectomy. Neurology. 2010 75(18) 1631-8.

Vardal J, et al., Correction of B0-distortions in echo-planar-imaging-based perfusion-weighted MRI. J Magn Reson Imaging. 2014 39(3) 722-8.
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- A Restriction Spectrum Imaging Method and Device for Probing Tissue Microstructure

University of California, San Diego

Office of Innovation and Commercialization

9500 Gilman Drive, MC 0910, ,

La Jolla,CA 92093-0910

Tel: 858.534.5815

innovation@ucsd.edu

https://innovation.ucsd.edu

Fax: 858.534.7345