Eliminating Encoding Distortion in MRI for Clarity in the Presence of Metal

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method for improving the reliability of 3-D magnetic resonance imaging (MRI) near metal with a spectrally resolved system free of distortions induced by frequency encoding gradients.

Overview

Visualizing a body's internal structures by MRI is an essential clinical practice. Yet acquiring images in the presence of metal, like the steel screws of an implant, remains challenging because of the off-resonance, signal loss and signal pile-up artifacts that occur in the magnetic field surrounding the object.

Recent methods have confronted the problem of distortion by imaging the distinct ranges of frequencies found near metal. Errors continue to arise, however, as data are acquired during frequency encoding, when a magnetic field gradient is applied to proportion an atom's resonance frequency to the position of its spin.

An innovative MRI method, free of frequency encoding-related distortion and delivering higher spatial resolution than current technology, is desirable.

The Invention

UW–Madison researchers have developed a new pulse sequence approach for performing spectrally-resolved, 3-D MRI without using a frequency encoding gradient during the scan process. This allows for spectral encoding of signals such that local magnetic field differences—like those around metal substances—can be measured. Moreover, signal separation can be performed to distinguish tissue types and the relaxation rate of transverse magnetization, R_2*, can be measured.

The technology comprises a magnet configured to generate a polarizing field around a subject, gradient coils and a radio frequency (RF) system applying and receiving signals. A computer first directs the RF system to produce a pulse that rotates net magnetization about an axis, and the coils establish three phase-encoding gradients along respective perpendicular directions.

Data are acquired as defined by the three gradients by sampling magnetic resonance signals during multiple time points in which no field gradients are established by the MRI system. This process eliminates any artifacts due to frequency encoding and enables accurate, spectroscopic imaging with higher spatial resolution.

Applications

- Clinical imaging in the presence of metal
- New R_2* mapping, quantification and related
- Tracking Super Paramagnetic Iron Oxide (SPIO)-labeled stem cells

Key Benefits

- Distortion-free imaging near metal
- Spectral sampling at each spin-echo
- High spectral bandwidth for estimation of B_0, R_2*and water-fat separation
- Potential parallel imaging in all three encoding directions

Stage of Development

The researchers have implemented the method to acquire images with high resolution.

Additional Information

For More Information About the Inventors

- Scott Reeder

Publications

- Sirlin C.B. and Reeder S.B. 2010. Magnetic Resonance Imaging Quantification of Liver Iron. Magn. Reson. Imaging Clin. N. Am. 18, 359-381.

Tech Fields

- Medical Imaging : MRI

For current licensing status, please contact Jeanine Burmania at jeanine@warf.org or 608-960-9846