Post-Processing MRI Fat Suppression Method to Enhance Image Quality and Improve Medical Diagnostics

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing an improved MRI data processing method to enhance image reconstruction and substantially suppress fat or water signals, facilitating MRI medical diagnostics.

OVERVIEW

Magnetic resonance imaging (MRI) is a diagnostic imaging technique that is especially effective for soft tissues such as the brain and other organs. To produce an MR image, the patient is subjected to a polarizing magnetic field, B_0, causing the magnetic moment, or spin, of water molecule protons in tissues to align with the field. An excitation field, B_1, then is applied perpendicular to B_0 via radio frequency (RF) antenna or coils, which induce a slight excitation in the protons spin. When B_1 is terminated, the excited spins return to their equilibrium energy state at a rate characteristic of the specific tissue while emitting very weak nuclear magnetic resonance (NMR) signals. A series of B_1 pulses are used to generate NMR signals that are received by the RF coils, digitized and processed to reconstruct a diagnostic image.

Conventional MRI scans require several minutes to acquire data for processing because transverse magnetization is allowed to fully relax between B_1 pulses. A newer class of MRI techniques called steady-state free precession (SSFP) employs fast pulse sequences with repetition times much shorter than the relaxation time, which drives the transverse magnetization into a steady-state of equilibrium. Through SSFP methods have much shorter scan times, fat produces bright signals that obscure nearby tissues and banding artifacts appear in regions of B_0 inhomogeneity.

UW-Madison researchers previously developed a method to combine NMR signals acquired at the beginning and end of the repetition time in vastly under-sampled isotropic projection reconstruction (VIPR) MRI techniques (see WARF reference number P04252US). This approach utilizes radial acquisition techniques to provide high resolution images at speeds up to 30 times greater than conventional Cartesian sampling and suppress either fat or water in a single acquisition. This method also greatly reduces scan times to increase patient throughput and comfort while minimizing motion artifacts, suppressing fat signals and reducing banding artifacts present in SSFP images.

THE WARF ADVANTAGE

Since its founding in 1925 as the patenting and licensing organization for the University of Wisconsin-Madison, WARF has been working with business and industry to transform university research into products that benefit society. WARF intellectual property managers and licensing staff members are leaders in the field of university-based technology transfer. They are familiar with the intricacies of patenting, have worked with researchers in relevant disciplines, understand industries and markets, and have negotiated innovative licensing strategies to meet the individual needs of business clients.

THE INVENTION

UW–Madison researchers have developed a post-processing technique to improve fat and water suppression in images reconstructed from VIPR-SSFP data acquired by the previous method. The improved processing method, termed Dual Acquisition Phase Difference SSFP, acquires two echo signals which are combined in a second cancellation step after initial VIPR-SSFP data reconstruction. First, the phase of one echo is shifted and combined with the second echo in a process that transforms the radial data to Cartesian coordinates as in the previously developed method, which is known as Linear Combination SSFP. The second step involves application of a phase mask, derived from the echoes' phase difference, to the reconstructed image. The additional phase difference mapping provides fat signal cancellation across a wide range of off-resonance frequencies centered about the fat resonance peak.

The improved dual acquisition technique allows for reconstruction of fat or water suppressed images in shorter scan time, at higher resolution or at higher signal-to-noise ratio. Utilizing the SSFP method to reduce scan times will increase patient comfort and throughput as well as minimize motion artifacts. The improved resolution and signal-to-noise ratio also enhance the quality of MR images, which will facilitate the applicability of this technology in standard medical diagnostics, especially breast exams.

BUSINESS OPPORTUNITY

- Total MRI equipment market revenue in the U.S. is projected to be approximately $1.97 billion in 2009.
- The European MRI market revenue is projected to reach $810 million in 2009 and $856 million by 2012.

APPLICATIONS

- Breast, knee or abdominal MRI
- MRI of other areas where bright fat signals can compromise T_2-weighted images

KEY BENEFITS

- Improves robustness of VIPR-SSFP
- Provides high levels of fat suppression
- Fat suppressed images are acquired in shorter scan time, at higher resolution or at a higher signal-to-noise ratio.

STAGE OF DEVELOPMENT

The Dual Acquisition Phase Difference SSFP has been proven to greatly enhance both breast and knee MRI.

The development of this technology was supported by WARF Accelerator. WARF Accelerator selects WARF's most commercially promising technologies and provides expert assistance and funding to enable achievement of commercially significant milestones. WARF believes that these technologies are especially attractive opportunities for licensing.

ADDITIONAL INFORMATION

Related Portfolios

WARF Accelerator Program Technologies

Publications

Kijowski R., Blankenbaker D.G., Klaers J.L., Shinki K., De Smet A.A. and Block, W.F. 2009. Vastly Undersampled Isotropic Projection Steady-State Free Precession Imaging of the Knee: Diagnostic Performance Compared with Conventional MR. Rad. 251, 185-194.

Tech Fields
Medical Imaging - MRI

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