Rapid MRI Gradient Calibration Using Single-Point Imaging

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a new method enabling fast k-space trajectory measurement for improved image quality with no additional hardware.

OVERVIEW

In MRI, gradient distortions can cause image artifacts such as blurriness, ringing and phase error. Certain MRI techniques are more prone to the problem. In particular, gradient distortion is perhaps the most serious obstacle to clinical adoption of non-Cartesian techniques, where small k-space trajectory errors can lead to significant artifacts. Several solutions have been proposed but suffer various drawbacks (e.g., dependency on slice selection, resolution limitations, complex hardware, etc.).

Single-point imaging (SPI) is a potential answer. In this scan technique only one point in k-space is acquired at a fixed time after each excitation pulse. As a result, SPI is immune to the blurring, distortion and shift artifacts associated with other techniques. To date SPI is available on NMR spectrometers but not on clinical MRI systems.

THE INVENTION

UW–Madison researchers have developed a dynamic SPI-based method for MRI systems that allows simple, rapid and robust measurement of k-space trajectory.

To enable gradient measurement, they utilized the variable field-of-view (FOV) property of dynamic SPI, which is dependent on gradient shape. In the process, one-dimensional (1-D) dynamic SPI data are acquired from a targeted gradient axis, and then relative FOV scaling factors between 1-D images or k-spaces at varying encoding times are found. These relative scaling factors are the relative k-space position that can be used for image reconstruction.

The gradient measurement technique also can be used to estimate the gradient impulse response function for reproducible gradient estimation as a linear time invariant system.

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.

APPLICATIONS

- Software for MRI systems
- Reducing errors in non-Cartesian imaging
- Significantly reducing scan time in conventional Cartesian acquisitions (e.g., time-of-flight angiography, contrast-enhanced MRI sequences, breath-hold sequences [IDEAL], single shot fast spin echo)

KEY BENEFITS

- Simple to implement and applicable to any MRI scanner
- Can be performed in less than five seconds for many acquisitions
- Not dependent on 2-D slice selection
- Could reduce TR and scan time by up to 30 percent for many sequences

STAGE OF DEVELOPMENT

The proposed measurement technique was used to improve reconstructed image quality in 3-D ultrashort echo, 2-D spiral, and multi-echo bipolar gradient-echo imaging. In multi-echo bipolar gradient-echo imaging, measurement of the k-space trajectory allowed the use of a ramp-sampled trajectory for improved acquisition speed (approximately 30 percent) and more accurate quantitative fat and water separation in a phantom.

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
Jang H. and McMillan A.B. 2017. A Rapid and Robust Gradient Measurement Technique Using Dynamic Single-Point Imaging. Magn Reson Med. 78(3), 950-962.

Tech Fields
Medical Imaging - MRI

CONTACT INFORMATION

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