Method for Improved Efficiency and Image Quality of Parallel MRI using Radial Acquisition Trajectory

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WARF: P05348US

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing an improved method for reducing the processing time and enhancing image quality of parallel MRI using radial acquisition trajectory.

Overview

Magnetic resonance imaging (MRI) is a diagnostic imaging technique that is especially effective for soft tissues such as the brain or other organs. To produce an MR image the patient is subjected to a polarizing magnetic field, B_0, causing the protons of water molecules in tissues to align with the field in a random fashion characterized by the Larmor frequency. An excitation field, B_1, then is applied perpendicular to B_0 via radio frequency (RF) antenna or coils, which induces a slight excitation in the protons magnetic moment, or spin, as energy is absorbed. When the excitation signal B_1 is terminated, the excited spins fall down to the equilibrium energy state and produce very weak nuclear magnetic resonance (NMR) signals that are received by the RF coils, digitized and processed to reconstruct an image.

Fourier imaging, also known as spin-warp, is a common NMR data reconstruction technique that uses rectilinear trajectories to sample the k-space, a spatial coordinate system of phase-encoding lines which holds the digitized MR signals during data acquisition. The spin-warp sampling process may take many minutes to acquire the necessary data to produce an image.

UW-Madison researches have previously developed a parallel MRI (pMRI) method using radial trajectories to reduce image processing time (see WARF reference number P05361US). With this method the processing time can be reduced by undersampling the k-space using radial trajectories because the region of interest at the coordinate axis still is sampled thoroughly while the periphery outside the region of interest is sampled less. Parallel imaging further reduces processing time by skipping a number of phase-encoding lines in the k-space during data acquisition, then reconstructing the missing k-space data with simultaneously acquired signals and spatial information from distinct RF coils.

The Invention

UW-Madison researchers have developed an improved method for pMRI using a radial acquisition trajectory. In this method, undersampled k-space data is acquired in parallel using samples along a radial trajectory. The undersampled data then is used to reconstruct coil images, which in turn are used to produce coil sensitivity maps. The coil sensitivity maps and undersampled data are utilized to calculate reference reconstruction coefficients for a coil by matrix inversion. Additional reference reconstruction coefficients may be estimated by interpolation between those coefficients previously calculated. Then all reconstruction coefficients and acquired k-space data is used to estimate missing k-space data and complete the k-space data set for each coil. Individual coil images then are

The improved method for pMRI will reduce the time required to produce an image after acquisition of the MR data and improve the quality of the images by minimizing motion artifacts. The method is helpful for imaging organs in motion, such as the heart and lungs.

and imaging patients who may otherwise need to be restrained, such as children or the mentally disabled. Overall, the improved method of pMRI with radial acquisition trajectories will reduce imaging time and improve image quality, making MRI a more convenient and accurate tool in the medical field and other applications.

Applications

- Reduced duration MRI, particularly for pediatric or mentally disabled patients
- Cardiac or pulmonary imaging
- Structural evaluation in material sciences

Key Benefits

- Reduces scan times
- Increases patient throughput
- Improves patient comfort
- Improves image quality by reducing motion artifacts
- Improves efficiency in structural integrity evaluation

Additional Information

For More Information About the Inventors

- Walter Block

Related Technologies

- For more information about parallel magnetic resonance imaging method using a radial acquisition trajectory, see WARF reference number P05361US.

Publications

- Samsonov A. A., Arunachalam A. and Block W. F. 2006. Parallel Magnetic Resonance Imaging Method Using a Radial Acquisition Trajectory. Mag. Res. in Med. 55, 431-438.

Tech Fields

- Medical Imaging : MRI

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