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Clinical Quality MRI Image under Inhomogeneous Magnetic Field

Technology No. 20170013

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Clinical quality images

This technology is a new MRI (Magnetic Resonance Imaging) acquisition sequence implemented in software that provides clinical quality images under extremely inhomogeneous magnetic fields. The novel method employs radiofrequency (RF) pulse trains for signal excitation and acquires refocusing echoes generated by the RF pulse train excitations. It does not use refocusing RF pulses.

This new steady state sequence uses a train of low-flip-angle (e.g., 5°) short duration (e.g., tens to hundreds of microseconds) pulses and a wide bandwidth for signal excitation. It is specifically designed to yield robust data in the face of extreme B0 inhomogeneity while limiting RF peak power and specific absorption rate (SAR).

A modified version of this MP-SSFP sequence can also be used to map the three-dimensional (3D) distribution of B0, even when the degree of B0 inhomogeneity is extremely large. For example, high quality three-dimensional (3D) images and B0 mapping have been demonstrated using a magnet with 200 kHz of resonance frequency variation across the object of interest. In a clinical 1.5 Tesla magnet, this degree of B0 inhomogeneity corresponds to ~3000 ppm.

Overcomes limitations of inhomogeneous fields

Magnetic resonance imaging (MRI) under highly inhomogeneous static magnetic fields faces fundamental difficulties in signal excitation and data acquisition. The conventional approach of using spin-echo sequences is limited by the requirement to use short, high-flip-angle (180°) refocusing pulses which results in high SAR in subjects. This new approach introduces an MRI method under inhomogeneous magnetic fields that uses only short, low-flip-angle RF pulses. A 3D B0 map can be measured by using phase-encoding in all three spatial directions.

Phase of Development

- Prototype developed. Validation in humans using low-cost magnet.

Benefits

- Clinical quality images with low cost, extremely inhomogeneous magnets

Features

- Image-based method for 3D mapping of the MRI magnetic field
- Low flip angle pulses provide large bandwidth while maintaining low RF power and SAR
- Complements other MRI contrasts (eg, T1- and T2*-weighted MRI) by providing T2-weighted images and/or diffusion-weighted images

Applications

- Magnetic resonance imaging (MRI)
- Portable MRI scanners
- Image-based mapping of the magnetic field of MRI magnets

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