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(G*) Mapping Magnetic Field Around Metal with Pure Phase Encoding Magnetic Resonance Imaging

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Magnetic Resonance Imaging (MRI) detects signal from hydrogen nuclei in biological tissue. MRI requires a homogeneous static magnetic field to generate artifact-free images. The subject is spatially encoded with magnetic field gradients. The signal is acquired in the frequency domain and the image is reconstructed by inverse Fourier transform. Objects with high magnetic susceptibility, such as MRI-safe metallic implants, distort the surrounding magnetic field. This leads to severe artifacts that appear as signal voids in the conventional MRI images, due to rapid intravoxel dephasing, in addition to misregistration of frequencies to position.
Pure phase encoding techniques with short encoding times are largely immune to magnetic field inhomogeneity artifacts. This is because the constant signal evolution times can be sufficiently short that no appreciable dephasing has occurred. High quality artifact-free MRI images were acquired with pure phase encoding techniques, from which the magnetic field distribution around the metal was derived. This approach was compared with conventional MRI methods, which failed to map the magnetic field in high susceptibility regions. Although it is challenging to apply the proposed method in a routine clinical MRI scan, the measured magnetic field distribution could enable the development of novel nonlinear encoding techniques, where the metal induced magnetic field distortion is exploited to provide spatial information.

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