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Correcting Concomitant Gradient Distortion in Microtesla Magnetic Resonance Imaging WHITTIER MYERS, MICHAEL MÖßLE, NATHAN KELSO, ALEXANDER PINES, JOHN CLARKE, UC Berkeley and LBNL —
Progress in ultra-low field magnetic resonance imaging (MRI) using an untuned gradiometer coupled to a Superconducting Quantum Interference Device (SQUID) has resulted in three-dimensional images with an in-plane resolution of 2 mm. Protons in samples up to 80 mm in size were prepolarized in a 100 mT field, manipulated by $\sim$100 μT/m gradients for image encoding, and detected by the SQUID in the $\sim$65 μT precession field. Maxwell's equations prohibit a unidirectional magnetic field gradient. While the additional concomitant gradients can be neglected in high-field MRI, they distort high-resolution images of large samples taken in microtesla precession fields. We propose two methods to mitigate such distortion: raising the precession field during image encoding, and software post-processing. Both approaches are demonstrated using computer simulations and MRI images. Simulations show that the combination of these techniques can correct the concomitant gradient distortion present in a 4-mm resolution image of an object the size of a human brain with a precession field of 50 μT. Supported by USDOE.

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