Toward High Resolution Images with SQUID-based Ultra-low Field Magnetic Resonance Imaging

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Abstract - Magnetic resonance imaging (MRI) is the state-of-the art clinical method for imaging soft-tissue anatomy. Because signal scales with the applied magnetic field, the overwhelming trend in MRI has been to high magnetic fields, typically 1.5 or 3 T. However, there has been recent interest in ultra-low field (ULF) MRI using 10-100 mT magnetic fields. At ULF there are opportunities for novel imaging applications such as MRI combined with magnetoencephalography (MEG) in a single device, imaging through or in the presence of metal, and enhanced spin-lattice tissue contrast. Loss in signal is mitigated by sensitive detectors such as superconducting quantum interference devices (SQUIDs) and sample pre-polarization, typically from 10-100 mT. There have been several proof-of-concept demonstrations based on this approach. However, ULF MRI image quality still suffers from one or more of the following disadvantages compared to HF MRI: lower signal-to-noise ratio, poor spatial resolution, and longer imaging time. Here we present recent progress toward "clinically relevant" ULF MRI parameters: voxel SNR > 10, voxel size < 2×2×4 mm3. Data and simulations from a single channel system are presented and discussed.

Keywords - SQUID MRI, ULF MRI, MEG, SQUID array.

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