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Optimizing Radiofrequency Coils for Single-Sided Portable Magnetic Resonance

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Magnetic resonance imaging (MRI) is an imaging modality that offers superior soft tissue contrast without ionizing radiation. MRI requires a static magnetic field and a radiofrequency (RF) magnetic field. The static magnetic field is usually provided by a superconducting magnet, where the high cost limits its accessibility. A portable magnetic resonance device based on a permanent magnet is extremely cost-effective and could provide point-of-care diagnosis for near surface organs. However, the permanent magnet has a low magnetic field strength and severe field inhomogeneity, which bring new challenges for quantitative measurements. The RF magnetic field is generated by the RF coil, which should be designed for the individual MR system. In this work, RF coils are investigated in search for the optimal performance configuration.

A single-sided magnet, based on the design of a three-magnet array [1], provides a static magnetic field with a homogenous volume of approximately 1 cm3 centered 1cm from the surface. The static magnetic field (0.1T) is parallel to the magnet surface. Multiple RF coil configurations were investigated, including a surface loop coil, a D-loop coil, and a meander line coil. The RF magnetic fields were simulated. The coils were constructed and tuned to 4.4MHz. Magnetic resonance experiments were performed on a water phantom. The signal bandwidths and signal-to-noise ratios were evaluated.

The preliminary results indicate further optimization is required for this highly complex system. It will be beneficial to design an RF coil producing a radiofrequency magnetic field that matches the static magnetic field distribution. The open MR system provides an affordable complement to the traditional high field MRI.

Reference: [1] Marble, JMR 186, 100-104 (2007).

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