Progress on imaging using a 0.2 T whole-body Fast Field-Cycling system

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Fast Field-Cycling MRI (FFC-MRJ) [1] is an emerging technique that adds a new dimension to conventional MRI by making it possible to rapidly vary Bo during a pulse sequence.

By doing this it is possible to observe how the NMR relaxation rates of biological tissues vary with magnetic field strength - information which can be employed as a useful contrast mechanism.

In this work we describe progress on imaging using our 0.2 T whole-body sized FFC-MRI scanner.

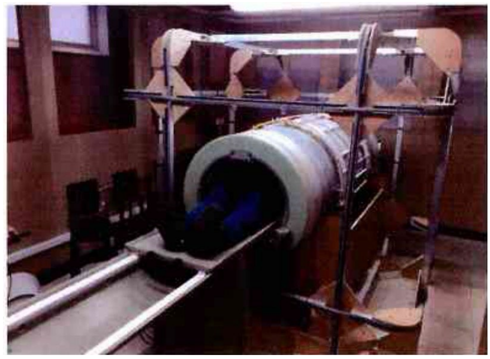

Figure 1: Photograph of the 0.2 T FFC-MRI scanner and Earth's-field compensation coils.

We will highlight some of the challenges we have encountered with FFC-MRI and strategies for overcoming them and present our latest imaging results.

We have previously described a dual magnet FFC-MRI system [2] comprised of a 59 mT permanent magnet for detection and a coaxial resistive magnet which enables field-cycling. Our latest system is a purely resistive design with a maximum field strength of 0.2 T (Fig. 1) and has the advantage over the dual magnet design of not suffering from magnetic hysteresis effects. Use of a resistive magnet to provide the detection field requires an extremely stable field. Failure to maintain this stability, whether due to temperature effects or instability in the current supply can result in severe image artefacts. We will present a post-processing method for reliably suppressing such artefacts, as well as a data acquisition strategy designed to minimise drift in the magnetic field during imaging.

Our system is also equipped with Earth's-field compensation coils, allowing relaxation effects to be probed at fields below 50 uT. Pilot data from experiments performed at such low magnetic fields will be presented. MRI at low magnetic fields suffers from inherently low SNR. The improvement in SNR from polarisation and detection at 0.2 T will help to realise the unique potential of FFC-MRJ as a diagnostic technique. We will present in-vivo images from our system to demonstrate our ability to obtain good quality anatomical images that do not suffer from geometric distortion or excessively poor SNR.

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References:
[l] Lurie D.J. et al. Fast field-cycling magnetic resonance imaging. *C.R.Phys.* 2010;11:136-148.
[2] Lurie, D.J. et al. Design, coustrudion and use of a large-sample field-cycled PEDRI imager. *Phys.Med.Biol.* **43,** 1877-86 (1998).