Fast Field-Cycling MRI

D.J. Lurie, L. Broche, C.-H. Choi, G.R. Davies, S.R. Ismail, D. O Hogain, K.J. Pine
Aberdeen Biomedical Imaging Centre, University of Aberdeen, UK
http://www.ffc-mri.org

The use of fast field-cycling (FFC) in magnetic resonance imaging (MRI) has so far been limited to relatively few applications, carried out in a small number of laboratories, but is gradually increasing.

The majority of work on FFC-MRI has been accomplished using dual magnet systems, where a homogeneous, stable magnet is used to read out NMR signals, while a less homogeneous magnet is used to boost (or reduce) the applied field during the evolution period. In our lab we have built a whole-body FFC-MRI system using a 59 mT permanent magnet for detection, with a coaxial resistive magnet for field offset [1]. This has the advantage of little or no eddy currents during field switching, as the ferrite permanent magnet is non-conductive. Our next-generation system used a 0.45 T superconducting magnet for readout, with an actively-shielded resistive field-offset magnet [2]. We are currently building a new FFC-MRI system that will employ a single magnet for polarisation, evolution and detection, which should afford significantly more flexibility in the design and execution of FFC-MRI pulse sequences.

Over recent years the range of applications of FFC-MRI has increased. Relaxometric imaging was first demonstrated by Carlson in 1992 [3], and since then relaxometric imaging methods have been implemented by the groups in Aberdeen [5], Stanford [6] and Ontario [7]. We have recently implemented localised, image-guided FFC relaxometry, whereby T_1 dispersion curves can be obtained from well-defined regions of a sample pre-selected from pilot images [8]. Another application of FFC-MRI being pursued in our lab is the combination of FFC-MRI with magnetisation transfer contrast (MTC) imaging [9].

This presentation will survey some of the methods and applications of FFC-MRI, in our own and other laboratories. Details of many aspects of this work from our laboratory can also be found on a number of posters at this meeting.

References:

[1] Lurie D.J., Foster M.A., *et al.*, Phys. Med. Biol. **43**, 1877-1886 (1998).
[2] Lurie D.J., Davies G.R., *et al.*, Magn.Reson.Imaging **23,** 175-181 (2005).
[3] Carlson J.W., Goldhaber D.M., *et al.*, Radiology **184,** 635-639 (1992).
[5] Lurie D.J., 1st Symposium on Field-Cycling NMR Relaxometry, Berlin, p5, July 1998.
[6] Ungersma S.E., Matter N.I., *et al.*, Magn.Reson.Med. **55,** 1362-1371 (2006).
[7] Alford J.K., Rutt B.K. *et al.*, Intl.Soc.Magn.Reson.Med., 17th Annual Meeting, Honolulu, USA, p811 (2009).
[8] Pine K.J., Davies G.R. and Lurie D.J., Intl.Soc.Magn.Reson.Med., 17th Annual Meeting, Honolulu, USA, p2743 (2009).
[9] Choi C.-H., Davies G.R. and Lurie D.J., Intl.Soc.Magn.Reson.Med., 17th Annual Meeting, Honolulu, USA, p2747 (2009).