Use of an insert coil and surface RF coil for *in vivo* whole-body relaxometry

K. J. Pine[1], G. R. Davies[1], F. Goldie[2], D. J. Lurie[1]

[1]Aberdeen Biomedical Imaging Centre, University of Aberdeen, Scotland, [2]Tesla Engineering Ltd, West Sussex, England
http://www.ffc-mri.org

In conventional biomedical MR applications, the relaxation behaviour of tissue is of central importance in determining a diagnosis. Field-cycling, with its ability to manipulate the main magnetic field strength during an examination, allows the study of T_1 dispersion in the body and will expose new sources of endogenous information. However, the availability of instruments capable of field-cycling on a human-sized scale is limited to a handful of home-built systems world-wide [1, 2]. A new approach is that of the 'insert coil' [3]: a removable electromagnetic field offset coil that can be installed in a conventional imager. In this work, we present the integration and use of such a coil, capable of *in vivo* relaxometry.

The coil was designed to suit an existing imager: a whole-body sized 59 mT ferrite permanent magnet with vertical field orientation. Built by Tesla Engineering Ltd (West Sussex, UK), our insert coil is portable and easily installed in the imager by one person in around 15 minutes. The disc shaped coil generates a projected homogeneous region (56 mT +/- 5% over a 50 mm DSV) located 50 mm from its front face, which offsets the main magnetic field of the imager. In this way, a small volume under investigation can be exposed to magnetic field strengths between 3 and 115 mT. Ramp times are less than 10 ms (0-100%) and the current is provided by a gradient amplifier and high-voltage DC power supplies [4].

After initial experiments with a solenoidal RF coil, it was thought that a surface RF coil placed in the same plane as the insert coil would enable more flexible geometry. A butterfly RF coil was built (N=10, Q=116) and used with an interleaved saturation-recovery / inversion-recovery pulse sequence (described in [4]) to measure the T_1 of a localised volume marked on a pilot image. With a volunteer's forearm placed over the homogenous region, a dispersion curve of T_1 versus magnetic field strength was measured. Quadrupole dips were observed where the ^{14}N and ^{1}H NMR frequencies are coincident – attributed to the presence of immobilised protein.

In summary, a compact and portable insert coil was used to vary the field over a localised region inside a whole-body sized imager. Together with a surface RF coil and localised T_1 relaxometry pulse sequence, it is possible to study T_1 dispersion *in vivo*. One concern is the noise coupled into the signal path via the current supply, which we intend to address in future work.

References

[1] Lurie, D.J. *et al*., *Physics in Medicine and Biology*, 43:1877, 1998.
[2] Scott, G. *et al*., *Proceedings of the 9th ISMRM*, p. 610, 2001.
[3] Alford, J. *et al*., *Proceedings of the 16th ISMRM*, p. 1171, 2008.
[4] Pine, K. *et al*., *Proceedings of the 19th ISMRM*, p. 1833, 2011.