An FFC-MRI system for *in vivo* relaxometric studies in mice

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The transfer of fast field-cycling relaxometric techniques to MRI (1) provides a valuable experimental tool for the characterization of relaxometric properties of biological tissues, potentially enabling finer *in vivo* validation of relaxometric models in complex tissue structures (2). The additional degree of freedom enabled by the rapid modification of the magnetic field also leads to innovative contrasts making use of the dispersive properties of tissues (3,4) or contrast agents (5,6). The combination of dispersive property characterization with the broad capability of MRI may offers a unique opportunity to improve specificity and evaluate new potential biomarkers in various diseases such as cancer or neurodegeneration.

We report here the current developments associated with an FFC-MRI system (7) designed for mice composed of an inserted solenoidal coil (Stelar s.r.l, Mede, Italy) inserted into and interfaced to a standard 1.5 T MRI system (Philips Achieva, located at CEA/SHFJ in Orsay). This unique FFC-MRI system that enables fast switching (few ms) of the magnetic field in the range 1 to 2T required the development of calibration and eddy-current compensation techniques (8,9), and motivated the implementation of various pulse sequences, to measure R_1-dispersion profiles or generate delta-relaxation MR (dreMR) (6,10,11) dispersive contrast, such as inversion-recovery or steady-state approaches (12) (Fig.1 and 2).
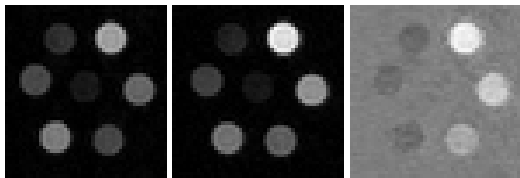

Figure 2 : Spin-echo images acquired at 1.5T on solutions of MS-325 with and without albumin after a saturation-recovery sequence with relaxation during 100 ms at 1.9 T (left) and 1.1 T (center) displaying different T1-recovery. The combined image (right) displays only dispersive contrast.
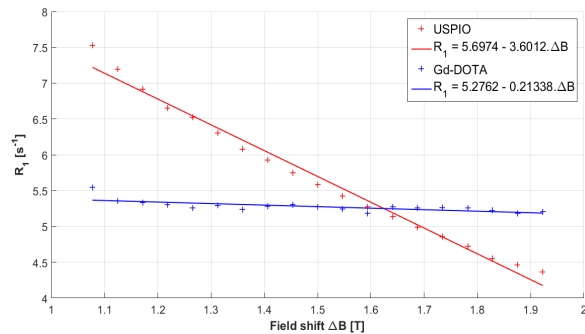

Figure 2 : NMRD profiles of Gd-DOTA and Molday-ION solutions with linear fitting of the dispersion in the range 1 to 2T measured by inversion recovery displaying a strong dispersion for USPIO as expected.

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