Early results show promising applications in stroke and cancer and other studies using cell models of breast cancer lines have already showed links with cellular activity[2,3]. Several studies are under way to exploit this new source of information.

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Fast Field-Cycling MRI for molecular dynamics imaging

L. Broche[1], J. Ross[1], G. Davies[1], M. J. Macleod[2], D. Lurie[1]
[1]*University of Aberdeen, Aberdeen Biomedical Imaging Centre, Aberdeen, UNITED KINGDOM,* [2]*NHS Grampian, Aberdeen, UNITED KINGDOM*

Purpose/Introduction: Fast Field-Cycling (FFC) MRI is a new non-invasive technology[1] that allows measuring quantitative information on molecular dynamics time scales, from tens of nanoseconds to a few milliseconds, by varying the magnetic field during a pulse sequence to generate T_1-based contrast. In the body T_1 is closely linked to the autocorrelation function of water and fatty molecules so its field-dependant spectrum, also called the T_1 dispersion curve, provides a direct view of molecular motions over a range of time scales that is determined by the strength of the magnetic field, via the Larmor frequency of the spin system observed. The T_1 dispersion curve has been used for decades to study materials and various models exist that predict the dispersion profiles in particular microscopic environments[2–6]. Our efforts over the last years have focused on developing a system able to measure T_1 dispersion curves in vivo to exploit this source of information in medicine and to provide unique insights of tissue architectures.

Subjects and Methods: The FFC-MRI scanner can reach any field from 0.2 T to 20 μT within 12.5 ms and T1-weigthed images are produced at five field strengths to complete the scan within 30 min. We have measured T_1 dispersion curve and contrast in vivo and non-invasively in volunteers, including patients from stroke and cancer, and compard with images from standard modalities, including CT and 3T MRI, and patient diagnostic.

Results: Image contrast derived on T_1 was found to be larger at lower field in general, with good correlation with clinical images and in particular with diffusion weighted imaging. Interestingly, T_1 contrast at 0.2 T was usually found to be less informative than at fields below 20 mT, at least in the pathologies investigated to date. Early results from T_1 dispersion curve measured in vivo show good agreement with ex vivo data, opening the way to in vivo molecular dynamics biomarkers and characterisation of molecular motions.

Discussion/Conclusion: The device we constructed is an excellent research tool to investigate T_1 contrast over a large range of magnetic fields that are difficult to reach using conventional imaging methods.