

### **Use of Contrast Agents with Fast Field-Cycling MRI**

D. Ó Hógáin<sup>1</sup>, G. R. Davies<sup>1</sup>, S. Baroni<sup>2</sup>, G. Ferrante<sup>3</sup>, S. Aime<sup>4</sup>, D. J. Lurie<sup>1</sup>

<sup>1</sup>Aberdeen Biomedical Imaging Centre, University of Aberdeen

<sup>2</sup>Invento S.r.l., spin-off of Turin University

<sup>3</sup>Stelar S.r.l., Mede (PV)

<sup>4</sup>Dep. of Chemistry I.F.M. and Molecular Imaging Center, University of Torino

Fast Field-Cycling (FFC) when combined with MRI allows switching of the magnetic field during an imaging scan [1]. FFC-MRI takes advantage of the  $T_1$  dispersion properties of contrast agents to improve contrast enhancement [2].

A new contrast agent designed specifically for use with FFC (a liposome encapsulating Mn(II) ions in its inner aqueous cavity) was imaged using a home built FFC-MRI system. Its  $T_1$  dispersion curves were obtained using a Stelar SMARtracer relaxometer. FFC-MRI Images were acquired at multiple field strengths, and evolution times. Images were processed and used to create a  $\Delta R_1$  image in which contrast depends on the change in  $R_1$  of the sample between two selected fields.

$T_1$  dispersion curves of Mn(II)-liposomes showed large changes in relaxation rate between fields. For contrast-optimised  $T_1$  weighted images the signal enhancement was seen to increase moderately when the evolution field strength was changed from 59 mT to 5 mT.  $\Delta R_1$  mapping increases the signal enhancement of the contrast agent, by allowing quantitative analysis of the change in  $R_1$  between different fields. The herein used liposome of 111 nm diameter contains ca.  $10^3$  Mn[II] ions. Thus suspensions containing 0.15 mM and 0.06 mM Mn[II] ions correspond to ca. 60 and 30 nM concentration of liposomes, respectively. The observed  $\Delta R_1$  enhancements clearly indicate that the proposed method (FFC-MRI and reporting probe) is well suited for molecular imaging applications. The present system has shown consistency in its measurements and has provided a useful test bed for new imaging techniques employing fast field-cycling. Currently a new FFC-MRI system is in its final preparation stages. This system has a much greater field range (between 0 and 0.5 tesla) which will provide larger  $\Delta R_1$  values. The system will have improved field homogeneity, and shorter ramp times, thus allowing more accurate and improved  $\Delta R_1$  mapping using FFC. This technique could eventually allow contrast agents to be detected with much greater sensitivity in vivo.

#### **References:**

[1] Lurie DJ et al.; Phys Med Biol. 43:1877 (1998)

[2] Aime S et al.; Acc Chem Res. 42:822 (2009)