

FAST FIELD-CYCLING MRI: T₁-DISPERSION FOR ENHANCED MEDICAL DIAGNOSIS

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Fast Field-Cycling Magnetic Resonance Imaging (FFC-MRI) exploits the variation of T_1 with magnetic field strength (T_1 -dispersion), with the aim of increasing the diagnostic potential of MRI [1].

NMR relaxometry is often implemented using FFC, by switching the magnetic field rapidly between levels during the pulse sequence. In this way, a single instrument can be used to measure T_1 over a wide range of magnetic field strengths. FFC-MRI aims to obtain spatially-resolved T_1 -dispersion data, by collecting images at a range of evolution field strengths [1-3]. We have demonstrated methods for implementing relaxometry on localised regions defined on a pilot image [4]. We have also shown that FFC relaxometry can detect the formation of cross-linked fibrin protein from fibrinogen *in vitro*, in a model of the blood clotting process, via the measurement of ^{14}N - ^1H cross-relaxation phenomena [5], and we have shown that FFC-MRI can detect changes in human cartilage induced by osteoarthritis [6]. Recent work has focussed on speeding up the collection of FFC-MRI images by incorporating rapid MRI scanning methods and improved pulse sequences and algorithms [7,8].

In our lab we have built a range of FFC-MRI equipment, including two whole-body human sized scanners, operating at detection fields of 0.06 T [9] and 0.2 T [10]. The 0.06 T scanner uses a double magnet, with field-cycling being accomplished by switching on and off a resistive magnet inside the bore of a permanent magnet; this has the benefit of inherently high field stability during the detection period. The recently-completed 0.2 T FFC-MRI system uses a single resistive magnet (albeit composed of three coaxial coils) [10]. This has the advantage of increased flexibility in B_0 programming, at the expense of poorer field stability during the detection period, necessitating a higher degree of instrumental complexity.

This presentation will cover the main techniques used in FFC-MRI and will summarise current and potential bio-medical applications of the methods.

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