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Title: Accelerated Field-Cycling MRI using the Keyhole Technique

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Abstract:

Purpose

Fast Field-Cycling MRI (FFC-MRI) is an emerging technique that adds a new dimension to conventional MRI by making it possible to rapidly vary B_0 during a pulse sequence. By doing this it is possible to observe how the NMR relaxation rates of biological tissues vary with magnetic field strength - information which can be employed as a useful contrast mechanism. In this work we have made use of the keyhole MRI technique in order to reduce FFC-MRI scan times. By only updating the low spatial-frequency region of k-space with each field-cycling experiment, contrast derived from the FFC technique is maintained while the scan time is dramatically reduced.

Methods

Imaging was carried out on a home-built, whole-body, field-cycling imager with a 59 mT detection field. The data collected using the technique were reconstructed by combining an initially acquired complete k-space matrix with a set of partial k-space matrices, obtained at each evolution field value. In this way a full-resolution image was constructed for each evolution field, requiring a scan time of 25% compared to conventional imaging.

Results and Discussion

R_1 dispersion curves derived from cross-linked bovine serum albumin using the keyhole technique show excellent agreement with results obtained using a conventional full k-space scan.

Conclusions

This work has demonstrated that the keyhole technique can readily be applied to FFC-MRI and used to obtain significant reductions in scan times while still retaining the same contrast as standard FFC-MRI methods. The reduction in scan time achieved by use of the keyhole technique will significantly improve the applicability of FFC-MRI in volunteer and clinical studies, which we are currently working towards.

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