Enhanced T1 Contrast Imaging with Region Growing Method

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Introduction

Phase-sensitive inversion-recovery (PSIR) imaging has demonstrated a number of benefits. Enhanced T1 contrast images with a relatively wide range of inversion recovery times (TI) can be obtained by using PSIR. However, its clinical application is limited for its non-robustness. Several phase error correction methods have been proposed recently [1-3]. Hargreaves *et al.* [4] have provided a region growing method to solve the phase problem in dual-acquisition fat/water separation SSFP. Our study is to solve phase errors by using this region growing method in PSIR imaging.

Theory

The objective of Hargreaves' method is to remove the slowly varying phase errors while preserving phase shifts from the chemical shift between fat and water. Images are broken up to small cells and the average phase of each cell is calculated. The technique leaves a 180-degree ambiguity in the detected phases, which are then resolved by adding the phase to neighboring cells. The algorithm achieves different calculation speed by selecting the cell size.

Method

Experiment was taken on a GE Signa Horizon 1.5 Tesla whole-body MR scanner using an IR fast spin-echo pulse sequence. Body coil acted as the transmitter coil and the quad extremity coil as the receiver coil. Images were acquired from a volunteer's knee, with parameters as follows: repetition time (TR) = 3600 ms, echo time (TE) = 13.3 ms, TI= 400 ms, echo train length (ETL)= 8, field of view (FOV) = 16 cm, slice thickness=4 mm. The PSIR image-reconstruction algorithms were implemented in Matlab 6.5 (The Math Works, Natick, Ma). Phase errors were then corrected by the above mentioned algorithms.

Result

The effect of the phase correction algorithm can be seen from Fig 1,2, which are the corrected images with cell size=4 and 8 respectively. Fig 3 is the source image. The background signal is set to be gray in our images. The maximal positive signal is set to be white, while the maximal negative signal is black. The black area shown by the arrow is mis-corrected, which may be caused by the abrupt change of static magnetic field inhomogeneity. Synovial fluid appears bright in the source image and appears dark in corrected images. Therefore, enhanced T1 contrast between synovial fluid and bone can be seen from the result. Considering the high speed of this phase correction algorithm, the mis-corrected area is moderate. Phase correction time is 38s for cell size=4 and 29s for cell size=8 on PC with Pentium(R)4 CPU, 1800 MHz, 1G memory.

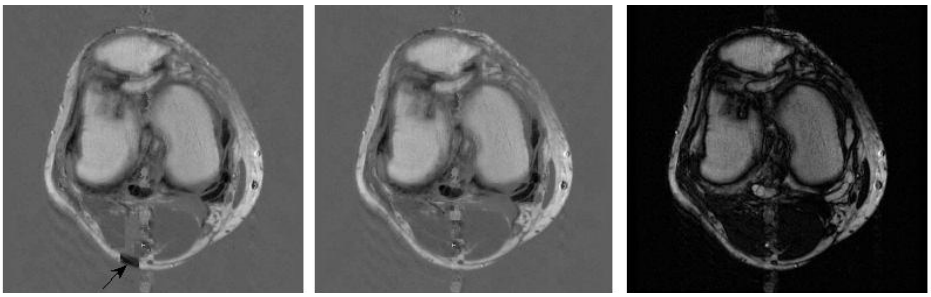

Fig1: corrected image with cell size=4; Fig2: corrected image with cell size=8; Fig3: source image

Discussion

The result shows that the region growing method provided by Hargreaves is an effective and fast phase correction technique. We successfully obtain enhanced T1 contrast images by combining the phase correction technique with PSIR imaging. Our primary experiment demonstrates that the method is useful for enhanced T1 contrast imaging and further work is in progress.

References

[1] *Borrello et al*, MRM, 14: 56-67, 1990; [2] *Xiang et al*, JMRI, 6: 775-782, 1996; [3] *Ma*, MRM, 53: 904-910, 2005; [4] *Hargreaves et al*, MRI, 24: 113– 122, 2006