ACCELERATED SPIRAL CHEMICAL SHIFT IMAGING FOR PROTON DENSITY AND T2* FAT-WATER QUANTIFICATION

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ABSTRACT

As an alternative to fat-water chemical shift encoding MRI, an accelerated spiral chemical shift imaging method is proposed for fat-water and T2* quantification.

1. INTRODUCTION

Usual chemical shift encoding water-fat MRI methods require strong constraints and prior knowledge of the water-fat spectral model to obtain fat quantification and approximation of a global T2*. In contrast, traditional Magnetic Resonance Spectroscopic Imaging (MRSI) method uses less constrained spectral model but faces long acquisition time [1, 2]. We propose an accelerated spiral MRSI method based on temporal irregular under-sampling [3] and demonstrate its applicability *in vivo* on the calf.

2. THEORY AND METHOD

2.1. Design of the temporal undersampling

Obtaining a spectrum from irregularly undersampled time domain signal is possible with least square (LS) reconstruction and assuming a known spectral support but results in a noise amplification. We minimize this noise amplification using the sequential backward selection (SBS) algorithm for time sample selection.

2.2. SBS based spiral MRSI

In spiral MRSI, multiple k-spaces are acquired over time with spiral trajectories [3]. Spiral trajectory determines the dwell time which can be too long compared to desired temporal resolution. As a result temporal interleaves are needed which lengthens the acquisition time. Even with this constraint SBS subsampling result in a shorter acquisition time. Spatially distributed spectra are obtained from the k-t data with a gridding and a 2D Fast Fourier Transform (FFT) for the spatial reconstruction, followed by a 1D FFT for the fully sampled case or LS minimization for the irregularly undersampled case.

2.3. Spectrum quantification

Water and fat amplitude (Aw, Af) and damping factor (dw and df) of were fitted on each time domain signal using a exponential decay model, enabling to create proton density (proportional to A) and T2* equal to (1/d) maps.

2.4. *in vivo* application: human calf

A Siemens PRISMA 3T machine has been used, with a 1H surface coil, a matrix 32x32, 6 spatial interleaves, FOV 20cm, 2.5ms spiral duration, 255ms readout duration, TR 2s for an acquisition time of 1min12s for the fully temporal sampled spiral MRSI, 48s for the under-sampled (reduction factor 2). T2* values are ranged between [15, 45] ms for water, [15, 80] ms for fat and the mean fit error is 10 (compared to reconstructed signal).

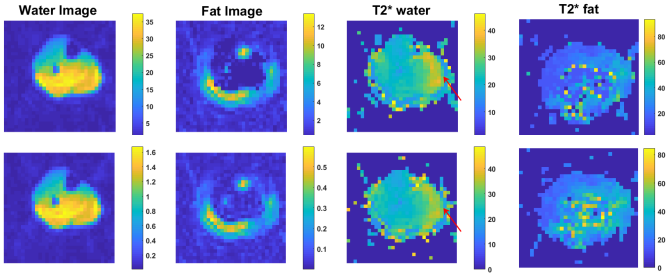


Fig. 1. Fat, water (amplitude in u.a) and T2* (in ms) maps, in fully sampled (first row) and under-sampled (second row) time domain acquisitions

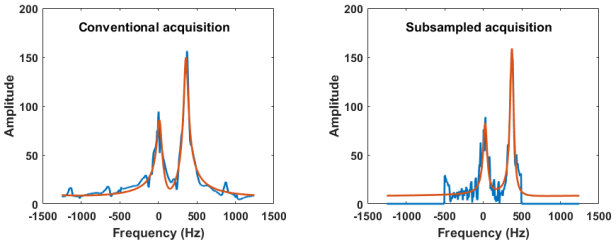


Fig. 2. Reconstructed, fitted spectra in red for pixel (12;12)

3. DISCUSSION AND CONCLUSION

Experiments showed proper spectra reconstructions in the case of our under-sampled method, as T2*, fat and water maps. This method would have a larger impact on time gain reduction both for multi-slice, larger matrices applications. Red arrow in Fig.1 highlights physiologic elevated T2* in previously exercised muscle.

4. REFERENCES

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