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Spurious Phase Correction in Multi-Shot MRSI

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Introduction

Spectral multi-shot (MS) MRSI sequences are used essentially to decrease the scan time and enlarge the spectral width. Here, the spectral information is encoded by acquiring several experiments while shifting the readout position relative to the echo time (TE). These techniques are highly exposed to phase errors with the phase evolution being indirectly sampled through the different echo time increments. During this sampling, phase coherency is crucial. Nowadays, MS techniques can lead up to image distortion because of the loss of phase coherency between the shots. The purpose of this work is to present theoretically and experimentally how to overcome this phase problem.

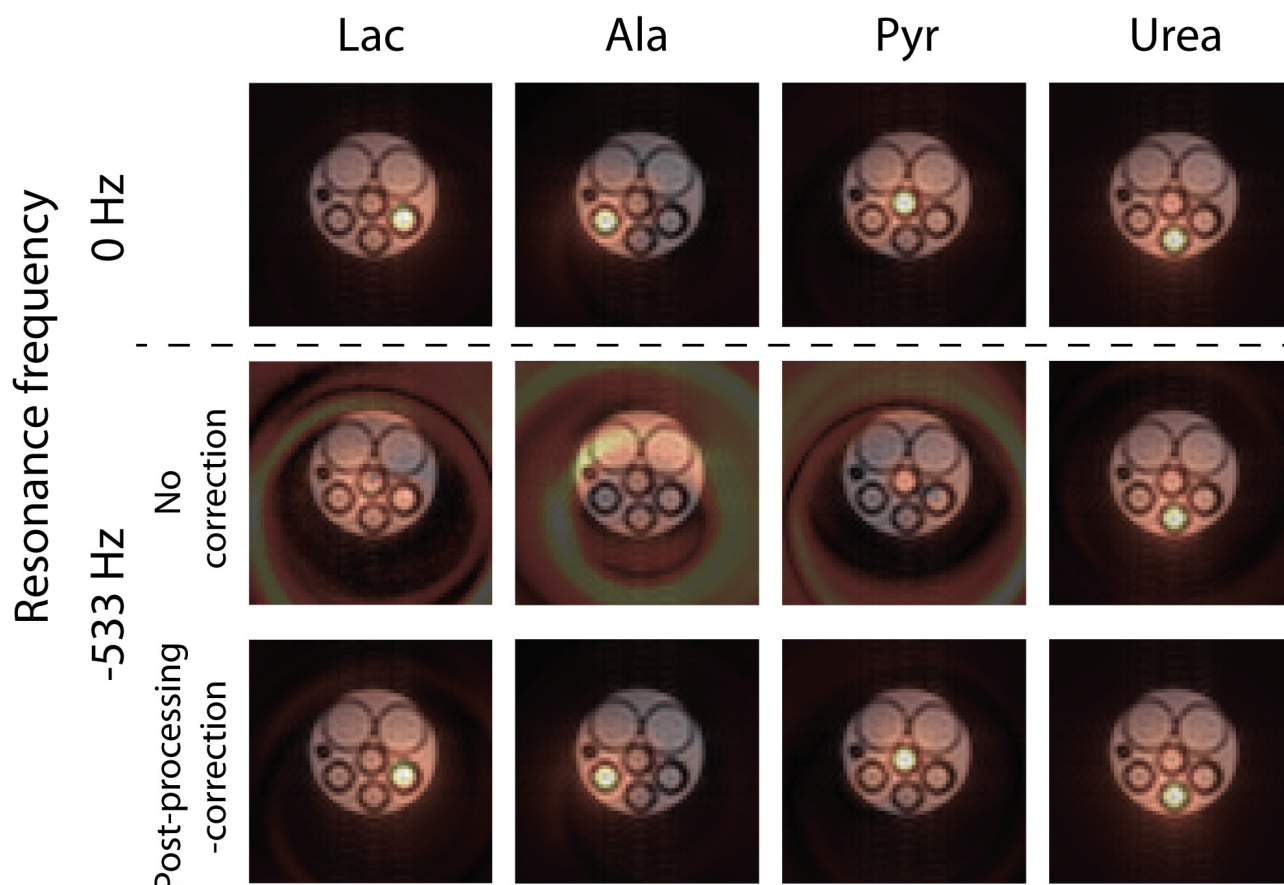
Subjects/Methods

We demonstrated that during the extra delay to shift the echo time for a 2D slice selection, the phase evolves depending on the chemical shift with respect to the excitation frequency. The latter is generally significantly higher than the chemical shift, and the phase will mostly depend on it. This phase shift can be corrected on either the acquired signal or the reconstructed image by subtracting the additional frequency excitation applied when shifting the slice position. These methods were applied to rapid metabolic imaging (1) of a ¹³C phantom and on the particular case of **B**₀ mapping.

Results/Discussion

Results showed phase errors in MS MRSI, leading to image distortion, therefore incorrect and inefficient studies. However, applying one of the provided correction methods cancels the phase errors, improving the image quality.

Unwanted phase shifts are susceptible to be accumulated in MS techniques during different echo time increments, especially when the slice position is shifted from a null resonance frequency. We were able to correct the phase-shifting through post-processing in the k-space dimension, by image phase correction according to the Nyquist frequency rule or even during a particular experimental case. The three proposed correction approaches were able to discard the spurious phase and then to reconstruct parametric maps accurately.



Reconstruction of the metabolite maps of ^{13}C -labeled Lactate, Alanine, Pyruvic acid and Urea, for different slice positions: centred 0Hz and shifted -533Hz. For proper reconstruction, post-processing phase correction is critical for a shifted slice.

References

1. Wiesinger F, Weidl E, Menzel M et al. IDEAL spiral CSI for dynamic metabolic MR imaging of hyperpolarized $[1-^{13}\text{C}]$ pyruvate. *Magn Reson Med* 2012;68(1):8-16.

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