2D spectroscopy using multi-channel array coil

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Introduction

Majority of the clinical MR spectroscopic (MRS) scans during the last two decades have included either one dimensional (1D) spectrum or one spectral combined with multiple spatial dimensions (1). Multi-dimensional MRS sequences have been proposed recently with selected applications in brain and prostate (2,3). The major goals of this work were two-fold: First, to implement and evaluate the 2D L-COSY sequence on the Siemens 1.5T and 3T MRI scanners with single channel head coil as well as 8-channel head array. Second, to develop an operator independent processing and quantification in order to improve the performance of 2D MRS in a clinical environment.

Materials and Methods

Two Siemens MRI Scanners were used: a 3T Trio and a 1.5T Symphony in combination with the following MRI Coils i) a quadrature head transmit/receive coil and ii) a 8-channel head phased array "receive" combined with a body "transmit" coil. A voxel size of 27ml was used and other parameters were: TE=30ms, TR=2s and 8 averages per Δt_1. The 2D raw data matrix consisted of 64, 96 or 128 by 2048 corresponding to the total-scans of 512, 768 and 1024. The data matrices were transferred to an SGI O2 workstation and processed using Felix 2000.

Results and Discussion

A 3T 2D L-COSY spectrum of a brain phantom containing NAA, creatine (Cr), choline (Ch), glutamate (Glu), myo-inositol (mI) and lactate (Lac) is shown in Fig.1 ($3\times3\times3$ cm^3 voxel). This spectrum was acquired with an 8-channel phased array "receive" head coil. The MR signals from the eight channels were sorted out and phase corrected in the time domain using a home developed algorithm. A spectrum from the same location was also acquired with the circularly polarized (CP) head transmit/receive coil. The respective values of the signal to noise ratio (SNR) for lactate cross-peak using different coils are summarized in Table 1. For voxels close to the perimeter of the 8-channel coil, addition of the 2 channels that are close to the selected voxel had superior SNR than addition of all the channels. This is due to the fact that weak channels contribute more to the noise than signal.

A linear prediction method was also added to post-processing that could produce spectra with a better resolution (128 rows) out of the acquired 96 rows of data. Compared to an equivalent acquisition of full 128 rows, this reduced the scanning time by 25%. An improved quantification method using a fixed predefined peak table eliminated the operator dependence and enhanced the accuracy of the volume integration measurement especially when the spectra SNR is low.

Conclusion

The 2D L-COSY has been successfully implemented on both 1.5T and 3T Siemens MRI scanners equipped with multi-channel head coil. The new processing method reduces the scanning time and makes the quantification, operator independent. An ultimate goal of this work is to optimize 2D L-COSY to be robust enough so that 2D MRS can be combined into any routine clinical protocol in any platform.

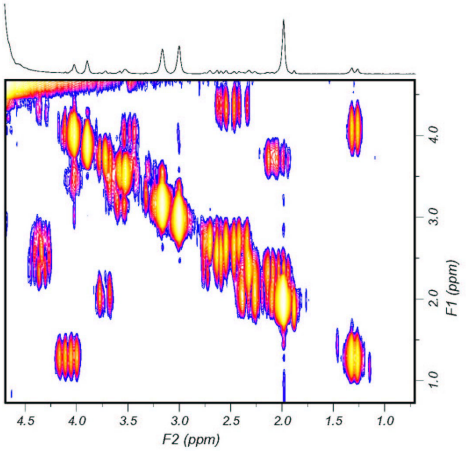

Fig1. The L-COSY spectrum of a brain phantom at 3T.

Coils / Channels	SNR
Best Channel PA	6.26
2nd Best Channel of PA	5.66
All Channels added	6.82
The best two added	7.77
CP Head Coil	4.75

Table 1. Signal to noise ratio of Lactate cross-peak.

References

1) Mason GF. Psychopharmacol Bull 2003;37:26-40
2) Thomas et al. Mag. Reson. Med. 2001:46;58-67.
3) Yue et al. Magn Reson Med 2002:47;1059-1064.