Towards Short-TE MR Spectroscopic Imaging: Spectral Decomposition and Removal of Baseline Signals

Qiang Ning[1,2], Chao Ma[1], Curtis L. Johnson[1], and Zhi-Pei Liang[1,2]
[1]Beckman Institute for Advanced Science and Techonology, University of Illinois at Urbana-Champaign
[2]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign

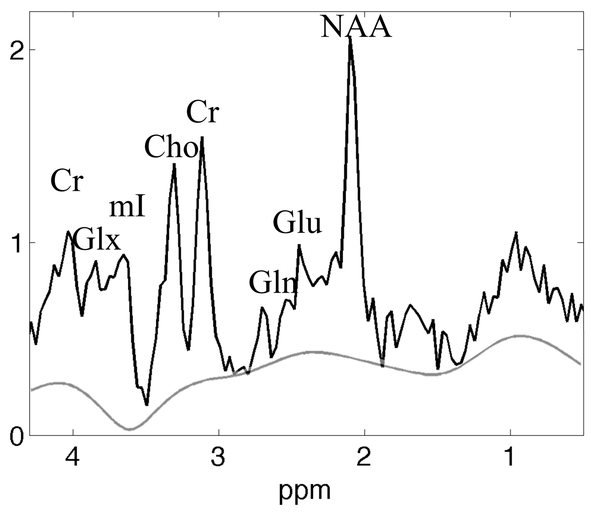
INTRODUCTION

Magnetic resonance spectroscopic imaging (MRSI)

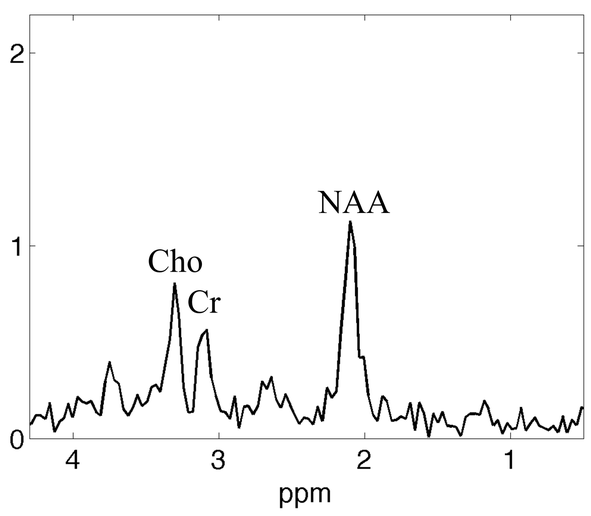
- **A powerful tool for mapping metabolite levels in vivo**
- **Challenge: very low SNR**

Short echo-time (TE) MRSI

- ✓ **High intrinsic SNR**
- ✓ **Rich metabolic information**
- X **Significant baseline signals**
- X **Difficult quantification problem**



Short-TE Signal



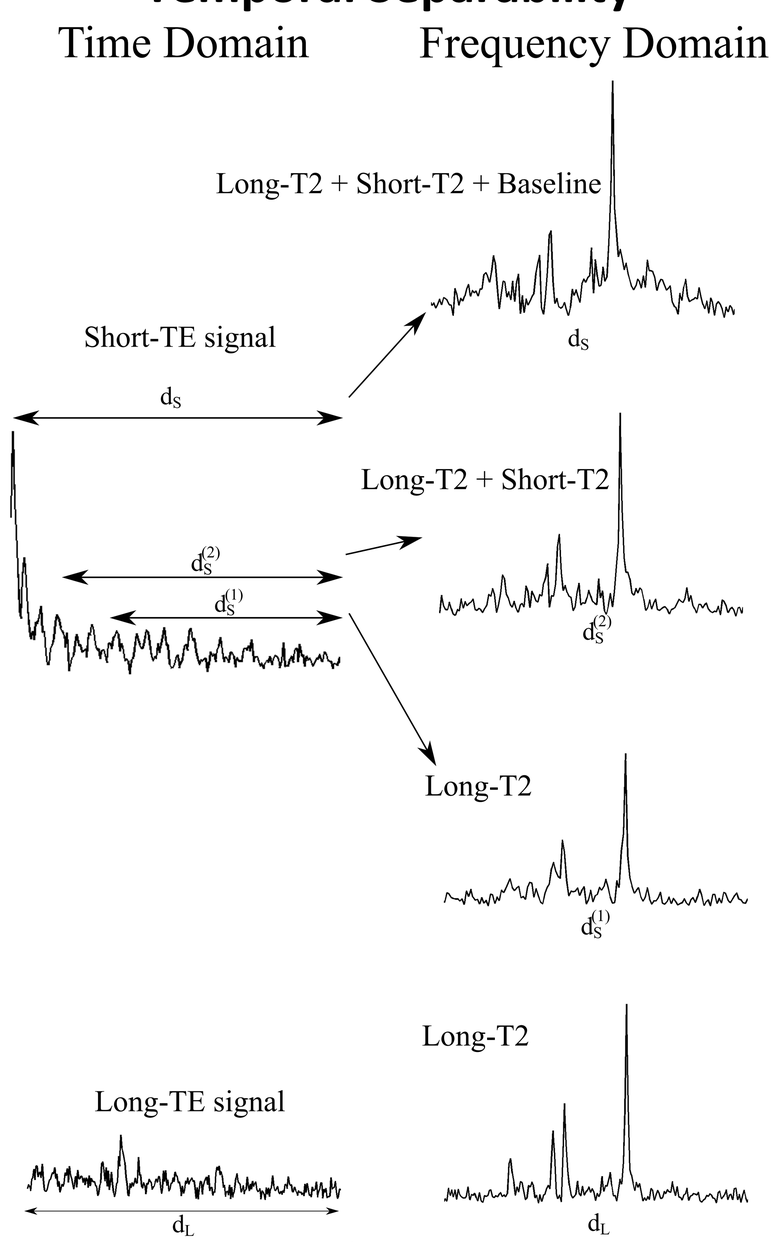
Long-TE Signal

To address these issues, we exploit the temporal separability of short-TE MRSI signals to decompose them into three components

- ***Long-T_2 metabolites***
- ***Short-T_2 metabolites***
- ***Baselines***

PROPOSED METHOD

Temporal Separability



Signal model of MRSI data

$$d(t)=\sum_{n=1}^{N} c_n e^{-\frac{t}{T_{2,n}}} e^{-i2\pi f_n (t-T_E)} g(t-T_E)+\xi(t)$$

- $g(\cdot)$ **-- signal decay caused by field inhomogeneity**

Proposed method

- **Estimate *long-T_2 metabolites* using the variable projection method[1]**

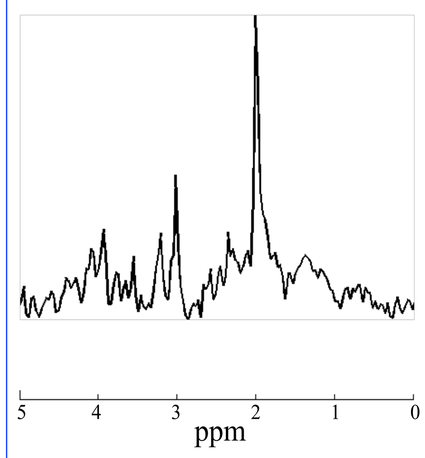
$$\min_{\alpha_L, c_L} \left\| \begin{bmatrix} d_S^{(1)} \\ d_L \end{bmatrix} - \begin{bmatrix} \Phi_S^{(1)}(\alpha_L) \\ \Phi_L(\alpha_L) \end{bmatrix} c_L \right\|_2$$

- **Esimate *short-T_2 metabolites* using HSVD[2]**
- **Estimate *baselines* using smooth splines fitting**

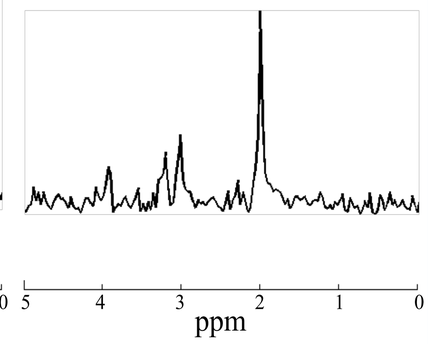
RESULTS

In vivo human brain data

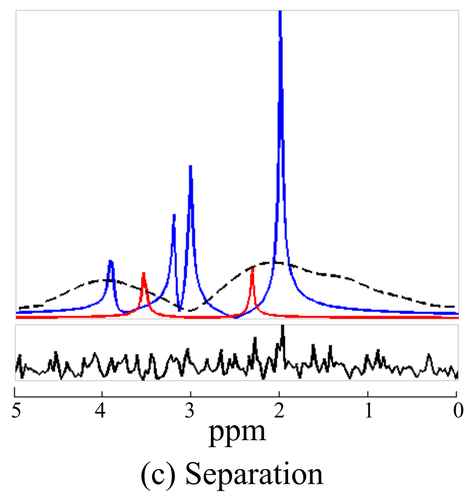
- **TE_1=30 ms, TE_2=135 ms**
- **Water and lipid signals are already removed**



(a) Short-TE (30ms)



(b) Long-TE(135ms)



(c) Separation

CONCLUSION

A novel method has been proposed for processing short-TE MRSI data, which may improve the practical utility of short-TE MRSI experiments.

REFERENCE

[1] G. H. Golub, *et al.*, SIAM J Numer Analy 1973; 10 (2): 413-432.
[2] H. Barkhuijsen, *et al.*, J Magn Reson 1987; 73: 553-557.

ILLINOIS