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P5

Assessment of LR-TGV reconstruction on preclinical compressed sensing ^{1}H-FID-MRSI at 14.1T

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BACKGROUND & AIMS

^{1}H-FID-MRSI is subject to limitations with regards to low signal-to-noise ratio (SNR), resolution and long acquisition times, especially for whole brain MRSI where acceleration strategies are necessary. **Compressed sensing (CS)** is a common acceleration technique[1,2,3] and has recently found application in the preclinical realm[4]. **CS** can be combined with spatial-spectral encoding techniques for increased acceleration[5] and/or **with reconstruction algorithms such as Low Rank Total Generalized Variation (LR-TGV)** for an SNR increase[2].

The purpose of the present study is to **compare two independent reconstruction techniques** applied for CS (LR-TGV and Bruker built-in Image Reconstruction) in their ability to generate reproducible metabolic maps from **in vivo preclinical ^{1}H-FID-MRSI dataset acquired at UHF**. We believe that this study will be of benefit for the MRSI community, more specifically for those who **focus on accelerated acquisition and reconstruction**.

METHODS

Acquisition Parameters :

- **2D FID ^{1}H-MRSI** (31x31 / FOV : 24x24 mm / VAPOR Water suppression / TR = 813ms / TE = 1.3ms / Hamming filter applied)
- **Under-sampling : 50%** (with 20% of volume sampled at the center)
- 13min/acq. (RAW) → **6.5min/acq.** (CS)

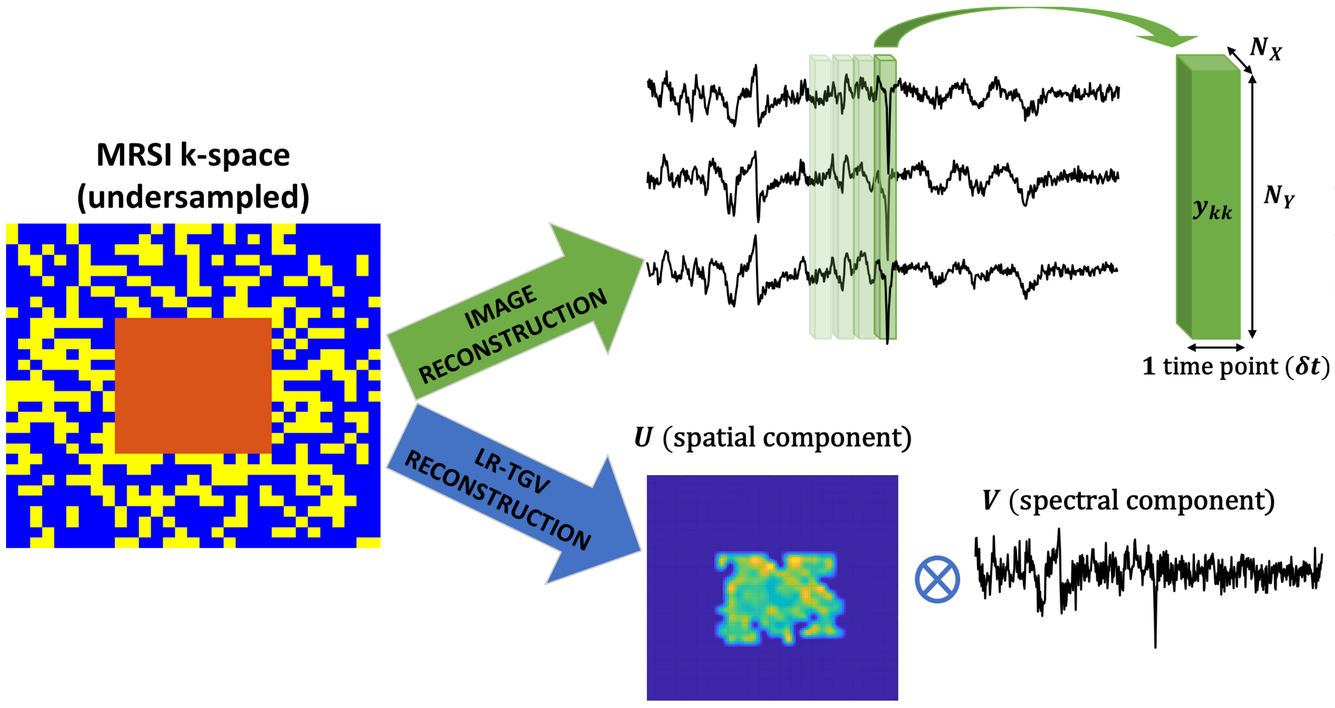
Processing done with the MRS4Brain Toolbox (HSVD water sup., with LipSup. for LR-TGV only, LCModel quantification & Atlas-based segmentation)

Image Reconstruction[6] : $\min_{S} \|\mathcal{F}_u S - y_{kk}\|_2^2 + \lambda \|\Psi S\|_1$

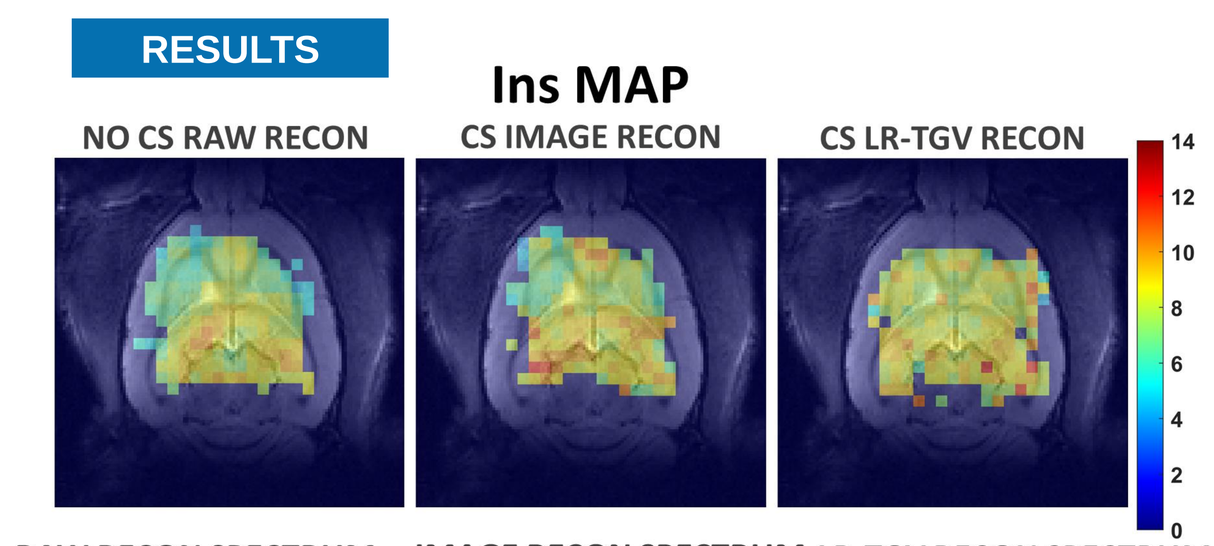
- Each time point treated as an image (y_{kk}), regularization by wavelet transform ($\lambda = 10^{-3}$)

LR-TGV Reconstruction[2] : $\min_{U,V} \|\mathcal{F}\mathcal{B}(UV) - y\|_2^2 + \lambda \sum_{n=1}^{K} TGV^2\{U_n\}$

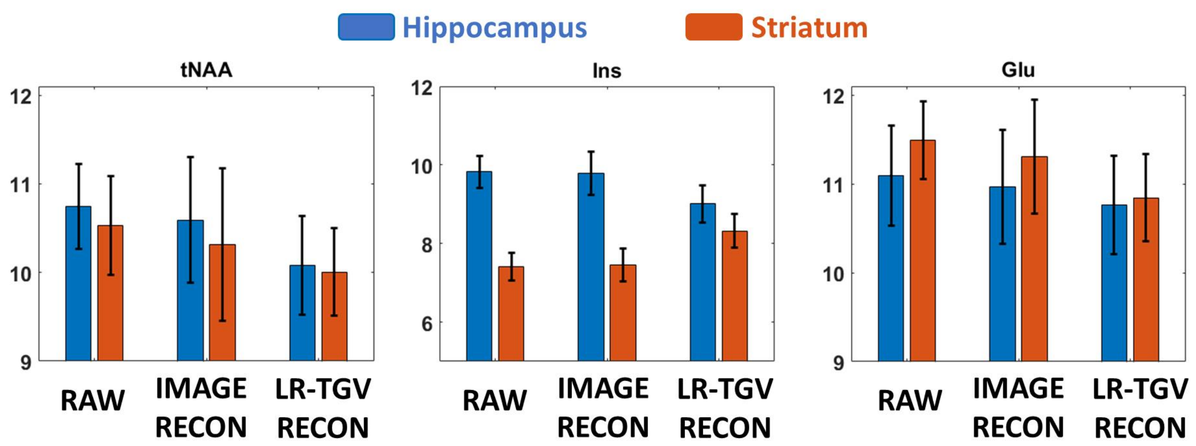
- Signal $\rho = UV$, Rank : $K = 20$
- Total Generalized Variation Regularization ($\lambda = 10^{-3}$)



RESULTS



	Rel. Diff. RAW/IMAGE	Rel. Diff. RAW/LR-TGV	Coverage Diff. (IMAGE)	Coverage Diff. (LR-TGV)
tNAA	8.56 %	9.42 %	- 12 %	+ 22 %
Ins	7.28 %	9.76 %	- 12 %	+ 22 %
Glu	6.98 %	7.88 %	- 12 %	+ 22 %



- **Difference** in concentration estimates **below 10%** for both reconstructions (over the slice)
- Increased coverage for LR-TGV Recon (denoising)
- **No significant differences between reconstructions** for tNAA, Ins & Glu
- Increase in concentration estimate SD for IMAGE Recon, decrease in SD for LR-TGV

CONCLUSION

Both reconstruction managed **to recover metabolite maps and estimates** comparable to the RAW set. IMAGE Recon allowed for a more consistent coverage, while LR-TGV Recon decreased the SD. Both allowed **sub-10 minutes acquisition**, enabling higher averages & resolution.

References:

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