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MP 710: Advanced MRI

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## Project Proposal: **Compressed Sensing Applied to MR Elastography**

Compressed sensing (CS) has recently become an important aspect of magnetic resonance (MR) imaging (and more generally the field of signal processing as whole), as it allows one to exploit sparsity of a signal (in some domain) to undersample. This, in turn, greatly reduces the amount of time needed to acquire an MR image while still preserving important imaging characteristics, such as the signal-to-noise ratio (SNR). MR elastography (MRE) is a relatively new application in MR, in which tissue stiffness can be quantitatively measured.

The primary goal of this project is to (1) determine the feasibility of compressed sensing applied to MRE and (2) determine the sampling scheme that maximizes undersampling if compressed sensing is indeed feasible (i.e. determine the domain in which elastograms are most sparse). This will be accomplished by retrospectively undersampling MRE data and reconstructing the images. Specifically, Matlab and Python will be the primary software tools to undersample the raw k-space data. Various pseudo-random sampling schemes will be applied to different (well-known) sparse domains (spatial finite-differences, discrete cosine transform, wavelet transform, etc.) for this project. The data that will be used is already-acquired MRE data of the liver that has been kindly provided by the Mayo Clinic, which will in turn be provided to me via Oliver Wieben. After an in-depth literature search, it seems that only few studies have been published on applying CS applied to MRE.

## References

2017 Master’s Thesis by Christopher Ebersole: Compressed Sensing (BEAM) applied to MRE

<https://etd.ohiolink.edu/!etd.send_file?accession=osu1494340605419894&disposition=inline>

Miki Lustig – Compressed Sensing

<https://onlinelibrary.wiley.com/doi/pdf/10.1002/mrm.21391>

Meenu Rani - Review of Applications in Compressed Sensing

<https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8260873>

Irene Orovic - Compressed Sensing Algorithms and Transform Domains

<https://www.hindawi.com/journals/mpe/2016/7616393/>

Cara Morin - Comparing CS, Breath-Hold, & Free-Breathing in Liver MRE

<https://www.ajronline.org/doi/abs/10.2214/AJR.18.19761>

Yogesh Mariappan – Review of MRE

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3066083/pdf/nihms278057.pdf>

MRI Questions – MRE

<http://mriquestions.com/mr-elastography.html>

Compressed Sensing MRI Phantom Algorith (David Smith) – Matlab File Exchange

<https://www.mathworks.com/matlabcentral/fileexchange/29364-compressed-sensing-mri-phantom-v1-1>