Critique of *Accelerated Fluorine-19 MRI Using Compressed Sensing* by Lawrence Lechuga

MP 710 – 12/20/2018

Abstract

* Abstract was presented very clearly. Very concise summary of the project that draws the reader in, especially after noting the strange SNR boost.
* May want to introduce full terminology of acronyms like SNR and MRI **depending on journal of submission**. Although I think for this purpose, it may be fine.
* Keep F-19 consistent with the body of the paper (where you use 19F). May also want to define that F-19 is Fluorine-19 initially.

Introduction

* CS needs to be defined initially. Also, I would introduce Fluorine-19 (19F). I noticed that you alternate between F-19 and 19F throughout the paper, would keep this consistent.
* Several small grammatical errors
  + susceptibility induced = susceptibility-induced
  + “using some image and compression quality metrics” = using *several* image quality metrics
  + IEEE considers data plural. Instead of “data *was* acquired”, say “data *were* acquired”.
* I really like the bridge sentence “Previous studies have validated 19F MRI in preclinical studies tracking various cell types”. I think that is a great intro to the next paragraph, in which you talk about the downsides of this technique. Which is where your tries to improve upon.
* It would probably be of interest to, at least briefly, define compressed sensing. What it is, what it does, and how it can apply to this work.

Methods and Materials

* You could mention why a 1D PDF was used, instead of 2D (because we can’t feasibly undersample in the frequency encode). Also define the acronym PDF initially.
* Some formatting issues in this section and onward (line spacing after paragraphs change).
* Include the “2” subscript in the objective function to specify it is the L2-norm ()
* Very nice, clean figures. Helped to illustrate the setup without overwhelming the reader.
* It was probably a good idea not to go into rigorous detail describing the scan and scan parameters. Can overwhelm the casual reader and eat up word count/page limit.
* Did you use SSIM or SNR to determine the optimum lambda? Or was this just based on what image looked best? This would be good to state briefly.
* I was slightly confused with the first part of the process to estimate SNR. Was this standard deviation found for each image separately? Or was the background noise obtained from the reference image and was each image normalized to that?
* Nice follow-up on how SNR is not entirely accurate (non-bivariate Gaussian noise distribution).

Results

* For Figure 3, I would make the font on the axes slightly larger. Again, very nice figure though.
* It would also be nice to see some summary values for the SSIM and SNR measurements, instead of strictly relying on visualizing the data trends.
* Figure 4 and Figure 5 are swapped.
* I really like Figure 4, as I feel it summarizes the bulk of this work and lets us visualize some of the CS output, as well as the original image. I feel like this is important to show the reader.
* I think that the mysterious SNR decrease is likely what you argue. As you mention, recons are highly dependent on lambda. As you increase your AF’s, you also increase your lambda. This implies a higher level of denoising. Since we are normalizing the image by noise, higher denoising levels will result in low standard deviation, which is likely driving up the SNR. I think it would be interesting to test each of the AF at the same lambda.

Conclusion

* Future work may also include additional ways to calculate SNR, such as SNRdiff or SNRmult. As we learned in class, SNR calculations based on acquiring noise from background ROI's are often prone to error, especially when using nonlinear reconstruction techniques.
* Did you also see this increased visibility in images that weren't normalized by the background noise? I.e. the raw grayscale CS reconstructed images. That would be interesting to state.

General notes

* Overall, I feel that this was an **excellent** report. It was easy to understand and straightforward, with very promising results. However, I feel that a couple of measures need to be considered more thoroughly, specifically SNR and measures of image quality. However (as I know from my experience) this is not a trivial task.
* I thought the figures were excellent, and did a great job explaining and elucidating some of the methods and results.
* I probably would have referenced Donoho and Lustig when introducing compressed sensing.
* I feel that these results are reproducible for the most part. For an outside research center to reproduce, however, they would need more details on the exact scan and scan parameters, which were not included (and I think for this paper that was a good thing, as listing scan parameters can be consuming in words and unnecessary for the casual reader.
* Some of the submission guidelines for formatting were off (line spacing after paragraphs, paragraph indentions, saying “Figure 3” instead of “Fig. 3”, and other small, easily fixable things.
* I would definitely recommend introducing full terminology (such as SNR, PDS, CS). To a reader not familiar with image science, these acronyms may not be tacit.