(Under)graduate Research Project: Compressive Sensing Algorithms

Monitored by Simon Foucart

Objective: Produce a toolbox containing algorithms used in Compressive Sensing.

Prerequisite: Linear Algebra, Programming, Interest in Mathematics, Academic Credential.

Description: The modern field of Compressed Sensing has revealed that it is possible to reconstruct vectors $\mathbf{x} \in \mathbb{C}^N$ using only $m \ll N$ pieces of information, provided that these vectors are sparse, i.e., that they only have few nonzero entries (at unknown locations). Two different tasks can be isolated:

1) if the m pieces of information are represented by a vector $\mathbf{y} = A\mathbf{x} \in \mathbb{C}^m$, how to choose 'good' matrices $A \in \mathbb{C}^{m \times N}$?

2) once the matrix A has been chosen, how to reconstruct the original vector $\mathbf{x}$ from $\mathbf{y}$?

For the second task, a plethora of algorithms have been proposed — optimization techniques, greedy methods, thresholding algorithms, etc. This project consists in selecting very efficient algorithms from the Compressive Sensing (and adjacent) literature and in importing them (with possible improvements) into a single MATLAB bundle. This bundle will become a convenient tool when investigating the better suited algorithms for a particular application or when testing a newly devised algorithm against old ones. Besides strengthening programming skills, the project will provide exposure to the theoretical and computational aspects of the popular field of Compressive Sensing, as well as connected fields such as optimization or pooling design.

Outcome: A stand-alone toolbox and a user guide written in mathematical style.

To Apply: Contact Prof. Foucart at `foucart@math.drexel.edu` to schedule a face-to-face appointment. Funding for this research experience is not available at the moment.

References

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`http://www-stat.stanford.edu/~candes/software.html`

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[5] W. Yin, softwares downloadable from
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