Department of Electrical and Computer Engineering
The Johns Hopkins University
520.648 Compressed Sensing and Sparse Recovery – Spring 2018

Suggested Project Topics

Compressed Sensing (CS) and Sparse Recovery (SR). This recently emerging framework shows that sparse signals can be sampled via a dimensionality-reduction random linear projection and reconstructed via basis pursuit (also known as ℓ_1-norm minimization via linear programming) or matching pursuit. The framework is particular attractive in situations when the encoder is resource-poor whereas the decoder is resource-rich. Recent works also show that the sparsity-driven approach can be extended to other interesting areas such as classification, matrix completion, tensor completion, robust data analysis and robust data recovery. Current active research in this area typically involves multiple measurements, multiple modality, measurements from multiple dimensions, and high-dimensional large data sets containing structured correlation.

- Web and mobile apps demonstration for CS

- Robust speech recognition using sparsity/CS

- Multi-modal fusion using structured sparsity, correlated sparsity, and/or clustered sparsity

- Robust object recognition/categorization and scene analysis using CS

- Distributed CS of video sequences

- Dynamic sequential/progressive/streaming CS transmission and reconstruction

- Dictionary learning / best basis selection algorithms for specific applications

- CS techniques for robust multimedia transmission and error correction

- Multi-view image/video CS. High dynamic range (HDR) image fusion/super-resolution.

- CS for sensor networks or highly correlated/connected sources

- CS of biomedical images and data or CS for radar and other applications

- Sensor design for CS acquisition or sensing matrix design

- Direct signal processing/classification from CS measurements without reconstruction

- Parallel implementation for multi-task CS reconstruction. GPU-based sparse recovery.

- Applications of low-rank matrix completion or matrix approximation

- Connection between sparsity and deep learning

Project Guideline

1. **Project Proposals**

   - Submit via email by March 20nd.
   - Content: team members, project topic, brief description, preliminary plan and goals. Maximum length is one page of text.
   - Private discussion with the instructor and/or the TAs is highly encouraged.

2. **Project Presentation**

   - Last week of lecture in class. Each group will have 15 minutes for an oral presentation.

3. **Project Report**

   - Due date: May 17th at 4 PM in 215 Barton Hall (Prof. Tran's Office).
   - Length: 5 to 6 double-column single-spaced pages including figures, tables, pseudo-codes, references...
   - Materials expected in a typical project report: project topic, motivation and relevance, previous works, assumptions, general strategy, your innovation (if any), final solutions, final results, brief comparison with previous works, future research directions, lessons learned and conclusion. A sample report from the past can be downloaded from the course web page.
   - For group projects, please include on a separate sheet the division of labor along with the signatures of all group members.

4. **Project Grading Criteria**

   - Effort
   - Demonstration of subject understanding
   - Originality
   - Technical quality
   - Elegant solution
   - Efficient implementation
   - Presentation quality