Guide to the MATLAB Codes for StructOMP

Junzhou Huang, Tong Zhang, Dimitris Metaxas
Rutgers, The State University of New Jersey

December 20, 2009

Abstract

This guide briefly introduces the MATLAB codes which are aimed at introducing how to obtain the experimental results in the paper "Learning With Structured Sparsity" [1]

1 Introduction

The MATLAB codes in this package are aimed at solving problems of the form:

$$\beta_0 = \arg\min_{\beta\in\mathbb{R}^p} Q(\beta) \quad \text{subject to } c(\beta) \leq s. \tag{1}$$

where $Q(\beta)$ is the loss function, $c(\beta)$ is the coding length for the structured sparse β and s is the given value or tuning parameter.

Since the graph sparsity is a generalization of standard sparsity, group sparsity and tree sparsity. This package gives the implementation of graph sparsity. It is based on the following proposition (Proposition 4.2 in the paper [1]):

Proposition 1.1 *Let G be a graph with maximum degree d_G, and $p = |G|$. Consider any number $L = \delta log_2 p$ is an even integer. Let $\mathcal{B}$ be the set of connected nodes of size up to L; that is, $B \in \mathcal{B}$ is a connected region in G such that $|\mathcal{B}| \leq p^{1+C_G\delta}$. If we consider the uniform code-length $cl_0(B) = (1 + C_G\delta)log_2 p$ for all $B \in \mathcal{B}$, then the induced block-coding scheme $cl_{\mathcal{B}}$ satisfies*

$$cl_{\mathcal{B}}(F) \leq 2(C_G + \delta^{-1})[\frac{1}{2}\delta g log_2 p + |F|],$$

where g is the number of connected regions of F.

The package includes 4 directories:

- **"LineStrongSparsity"**

  The codes in this directory are aimed at reproducing the experimental result in section 7.1 for strong-sparse & line-structured data.

- **"LineWeakSparsity"**

  The codes in this directory are aimed at reproducing the experimental result in section 7.1 for weak-sparse & line-structured data.

- **"TreeSparsity"**

  The codes in this directory are aimed at reproducing the experimental result in section 7.2 for 2D Image Compressive Sensing with Tree-structured sparsity.

- **"Background"**

  The codes in this directory are aimed at reproducing the experimental result in section 7.3 for Background subtracted images with graph sparsity.

2 Key Functions

In our paper, the structured sparsity is implemented with function: **GraphOMP_CS.m**, which includes sub-function **GraphPrune.m**.

2.1 GraphOMP_CS.m

- **Input**

  cl0: the coding complexity
  Phi: projection matrix
  y: measurements
  Bm: the defined block matrix, where the i-th row denotes all index entices in sparse x included in the i-th block.
  BC: the connected relations between blocks, where the i-th row denotes all index of blocks connected to the i-th blocks
  lambda: weights in the coding complexity

- **Output** xest: the unknown structured sparse data

3 Examples

In this section, we will introduce how to reproduce the experimental results in [1].

3.1 Strongly line-structured sparsity

In the directory of "LineStrongSparsity", we can find the main function Main_LineStrong_Example.m and function Main_LineStrong_Stat.m. They are used to experimental results for this subsection.

The Lasso and Group Lasso codes are downloaded from the public webs of corresponding authors.

3.2 Weakly line-structured sparsity

In the directory of "LineWeakSparsity", we can find the main function Main_LineWeak_Example.m and function Main_LineWeak_Stat.m. They are used to experimental results for this subsection.

The Lasso and Group Lasso codes are downloaded from the public webs of corresponding authors.

3.3 Tree-structured Sparsity

In the directory of "TreeSparsity", we can find the main function Main_2DTree_Example.m and function Main_2DTree_Stat.m. They are used to experimental results for this subsection.

The Lasso code is downloaded from the public webs of the corresponding author.

3.4 Background subtracted images with Graph-structured sparsity

In the directory of "Background", we can find the main function Main_Background_Example.m and function Main_Background_Stat.m. They are used to experimental results for this subsection.

The Lasso code are downloaded from the public webs of the corresponding author.

References

[1] Junzhou Huang, Tong Zhang, and Dimitris Metaxas. Learning with structured sparsity. Technical report, Rutgers University, March 2009.