

## Module 4 - Homework Assignment

**Reading Assignment:** Lecture Notes and Davenport *et al.* – Section 1.6.

*Computer Assignment: Sparse Signal Recovery via  $\ell_1$ -minimization.*

1. We will mostly repeat what we have done in Assignment I by replacing  $\ell_0$ -minimization with  $\ell_1$ -minimization. Please use the same sparse signal generator and the same sensing matrix  $\mathbf{A}$  as in Module 3 Assignment.

Use Matlab's linear programming function *linprog* to set up the  $\ell_1$ -minimization problem

$$\hat{\mathbf{x}} = \operatorname{argmin}_{\mathbf{x}} \|\mathbf{x}\|_1 \text{ subject to } \mathbf{y} = \mathbf{A}\mathbf{x}.$$

Again, vary the value of  $M$  (say  $M = \{10, 20, 30, \dots, 100\}$ ) and perform  $\ell_1$ -minimization at 100 different instances of the signal  $\mathbf{x}$  by varying the location and magnitude of its nonzero samples. Let's say if  $\|\hat{\mathbf{x}} - \mathbf{x}\|_2 \leq 10^{-6}$ , then we regard the signal recovery as perfect. Plot the performance curve in which  $x$ -axis represents the number of measurements  $M$  while  $y$ -axis denotes the probability of perfect signal recovery. At each of the 100 instances, the signal as well as the sensing matrix should be different.

2. Compare your results here with those of greedy pursuit from the previous assignment.