Big Data Analytics - Spring 2015 - Homework #4

In this homework you are asked to write a program which would implement and demonstrate various aspects of optimal linear estimation. The underlying process imitates a simple signal measurement experiment.

1 Measurement Simulation.

(a) Choose some profile x or generate it randomly.

(b) Create a matrix A.

(c) Simulate a measurement $y = Ax + \nu$.

2 Estimation: Construct an optimal linear estimate $\widehat{x}$ and the variance matrix $\mathrm{Var}(\widehat{x} - x)$. Show on the same graph:

(a) The original signal x (a curve with components x_i),

(b) Its estimate $\widehat{x}$ (a curve with components $\widehat{x}_i$),

(c) Standard deviations for the estimates $\widehat{x}_i$ $(= \sqrt{\mathrm{Var}(\widehat{x} - x)}_{ii}$, can be illustrated by showing the corresponding "corridor" around $\widehat{x}_i$).

3 Illustrate estimation (Phase 2) in different settings:

(a) Single measurement (y, A, S).

i. Transform (y, A, S) to canonical form (T, v).

ii. Construct the estimate, based on the canonical information.

(b) Single measurement (y, A, S) with a prior information: $x \sim (0, F)$.

i. Transform the measurement and the prior information to canonical form.

ii. Combine pieces of canonical information.

iii. Construct the estimate, based on the combined canonical information.

(c) Many measurements (y_j, A_j, S_j).

i. Extract canonical information from each measurement.

ii. Combine pieces of canonical information.

iii. Construct the estimate, based on the combined canonical information.

(d) Many measurements (y_j, A_j, S_j) with a prior information: $x \sim (0, F)$. Same as in item (c).

For more details please see Lecture 8 (8b - starting from 22:20 and 8c - first 11 minutes) and do not hesitate to ask questions.