Parameter estimation – Homework 7

Deadline: 6th of May, 11:59:59 pm

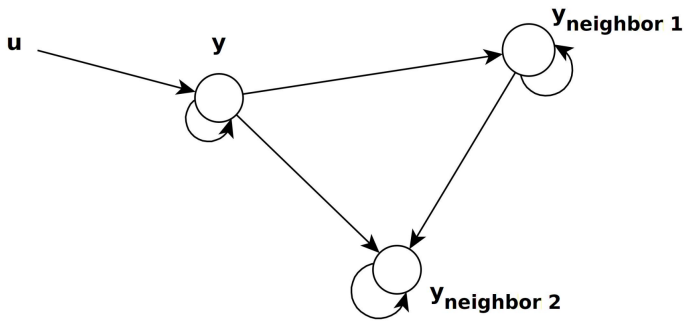
Submission at: Moodle page to the respective homework's submission site

Task

We consider a simple mathematical model of a communication network involving 3 interacting nodes. The dynamic behavior (i.e. observable information) of the overall system is described by the following difference equation system:

$$
\begin{aligned}
y(k) &= \theta_1 y(k-1) + \theta_2 u(k-1) \\
y_{neighbour_1}(k) &= \theta_3 y_{neighbour_1}(k-1) + \theta_4 y(k-1) \\
y_{neighbour_2}(k) &= \theta_5 y_{neighbour_1}(k-1) + \theta_6 y(k-1) + \theta_7 y_{neighbour_2}(k-1)
\end{aligned}
$$

The system is assumed to be perturbed with zero-mean Gaussian noise at certain nodes (see figure below).



The communication network is static in space, i.e. all the nodes are of some fixed local position. We can assume that the communicating nodes are located close to each other in space, hence it is possible that the same perturbation ($\varepsilon(k)$) affects all of them with some time-delay.

1. Load the system data from `data.xlsx`.
2. Estimate the system parameters using simple LSQ approach.
3. Simulate the system with the estimated parameters. Plot the resulting trajectories along the measured data.

4. Estimate the parameters, taking into consideration that the noise might be correlated (ie. use the IV method discussed during the lecture).

5. Simulate the system with the estimated parameters and plot the new trajectories along the already plotted ones.

6. Compare your results. Which estimation is better?

Note: the purpose of this exercise is practicing the concepts discussed during the lectures. Please implement the estimation methods according to the lecture slides, and do not try to replace them with built-in matlab functions like `lsqnonlin`, `fmincon`, etc, which might achieve similar result, but produce this using a totally different approach.