Aalto University
School of Electrical
Engineering

Exercise Round 10

The deadline of this exercise round is **Wednesday April 1st, 2020**. Due to the COVID-19 disease, we move the exercise session to online (Slack workspace http://elec-e8105-2020.slack.com/) according to policies by Aalto University and Finnish government.

The problems should be *solved before the exercise session*, and during the session those who have completed the exercises may be asked to present their solutions on the board/screen.

Exercise 1. (EM for Gaussian random walk)

(a) Implement the EM algorithm for estimation of the measurement noise variance in the Gaussian random walk model.

(b) Simulate data with 256 time steps and test the algorithm. How many iterations are needed for convergence?

Exercise 2. (Energy function approach)

(a) Implement the algorithm for computing the energy function for the Gaussian random walk model as well as its derivative with respect to the noise variance (via the sensitivity equations in Appendix A.3 in the course book).

(b) Generate some simulated data (you can use the same data in both Exercise 1 and 2) and use a gradient based optimization method (*e.g.* `fminunc` in Matlab) to find the ML estimate of the parameter.

(c) Plot the likelihood curve for values around the true value.

Exercise 3. (Parameter estimation in non-linear models)

(a) Implement a random walk Metropolis based MCMC method for estimating the noise variance in the Gaussian random walk model. Use the Kalman filter for evaluating the energy function.

(b) Generate some simulated data (you can use the same as in 1 and 2) and test your sampler implementation.

(c) Plot the sample histogram and—if applicable—compare the result to Exercise 1 and 2. Which method would you choose to use in a 'real' situation?