Intelligent Control – Interactive Session on Linear Regression

January 31, 2018

Problem 1:

Consider a pendulum with the equation of motion:

$$\frac{ml^2\ddot{\theta}}{3} + \frac{mgl\cos\theta}{2} = \tau$$

where m is the mass of the pendulum, l is the length, θ is the angle from horizontal, and τ is the torque applied at the base of the pendulum.

(a) Get data. Load the file "pendulumdata.mat" into your Matlab workspace. It contains vectors of joint positions, velocities, and accelerations along with torques sampled from the motion of a single pendulum.

(b) Batch. With all of the samples compute the maximum likelihood estimates of the parameters of the model $\frac{1}{ml^2}$ and $\frac{1}{l}$. You will need to compute the vector $\mathbf{t}$ and the matrix Φ that we discussed in the lecture on Monday.

(c) Online. Now compute the same parameters using Bayesian regression and taking the data one sample at a time. This means you will have the same number of parameters estimates as you have data points. Plot the values of the parameters as a function of the number of samples used. Also plot the variance of each parameter as a function of the number of samples used. Use a prior estimate of $w_0 = [11]$ with a prior covariance of $S_0 = 10I$ where I is a 2×2 identity matrix. The sensor variance is $\beta^{-1} = 0.01$.