MEAM 620 Advanced Robotics: Assignment 5

Due: Monday April 13th, 11:59PM

Problem 1 Consider the fourth-order linear system

$$x^{(iv)} = u + n \tag{1}$$

with a minimum snap input (see MATLAB code) designed to drive the system from

$$x(0) = \dot{x}(0) = \ddot{x}(0) = \dddot{x}(0) = 0,$$

to

$$x(1) = 1,\ \dot{x}(1) = \ddot{x}(1) = \dddot{x}(1) = 0.$$

with $n(t)$ modeled by a zero mean, Gaussian, white noise. Assume a linear observation model,

$$z = Cx + v$$

with C full rank and $v(t)$ modeled by a zero mean, Gaussian, white noise.

You are provided the measurement data where each row, z, includes measurements of position, velocity, acceleration and jerk.

(a) Write a Kalman filter to estimate the 4-dimensional state $\mathbf{x}(t) = [x, \dot{x}, \ddot{x}, \dddot{x}]^T$.

(b) Modify your filter to reflect a sensor that only yields the position. In other words, C is 1×4.

(c) Discuss the case when your sensors only yield estimates of velocity, acceleration and jerk (C is 3×4).