CE697 Adv. Data Adj. Homework 5

Assigned 25 July, Due 5 Aug. 2016

1/2

1. Target tracking in 2D : state vector is $X = \begin{bmatrix} X_{pos} \\ X_{vel} \\ Y_{pos} \\ Y_{vel} \end{bmatrix}$, the dynamic model (constant velocity) is expressed as :

$$\begin{bmatrix} \dot{X}_{pos} \\ \dot{X}_{vel} \\ \dot{Y}_{pos} \\ \dot{Y}_{vel} \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} X_{pos} \\ X_{vel} \\ Y_{pos} \\ Y_{vel} \end{bmatrix}, \quad \dot{x} = Ax$$

$$dt = 1, \quad Q = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \quad \sigma_x, \sigma_y \text{ (measurement)} = \sqrt{1},$$

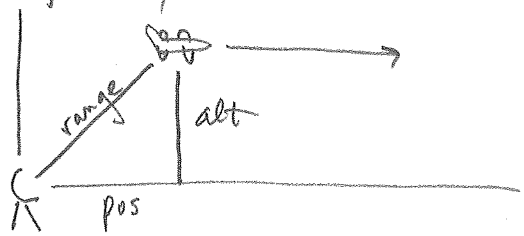
$$R = \begin{bmatrix} 50 & 0 \\ 0 & 50 \end{bmatrix}, \quad \text{initial } x = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 6 \end{bmatrix}, \quad \text{initial } P = \begin{bmatrix} 100 & & & \\ & 100 & & \\ & & 100 & \\ & & & 100 \end{bmatrix}$$

find the measurement data for 24 epochs in hw5pr1.mat

Solve the differential equation $\dot{x} = Ax$, to obtain Φ for $x_{i+1} = \Phi \cdot x_i$. Then implement the linear Kalman filter for the given data. Show the estimated position values at each epoch, and plot the measured points and the estimated points on the same graph. (use "load hw5pr1" to get measurements).

2/~~3~~ 2

2. A 2D radar tracking task arises from range observations to a vehicle moving away from the range sensor.



state vector $x = \begin{bmatrix} pos \\ vel \\ alt \end{bmatrix}$

dynamic model (constant velocity, constant altitude) is expressed as,

$$\begin{bmatrix} \dot{pos} \\ \dot{vel} \\ \dot{alt} \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} pos \\ vel \\ alt \end{bmatrix}, \quad \dot{x} = Ax,$$

dynamics are linear

$$dt = 0.05, \quad Q = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}, \quad \sigma_{obs} = 5 \Rightarrow R = 25$$

$$\text{initial } x_0 = \begin{bmatrix} 100 \\ 90 \\ 1100 \end{bmatrix}, \quad \text{initial } P_0 = \begin{bmatrix} 10 & & \\ & 10 & \\ & & 10 \end{bmatrix}$$

range observation $r = \sqrt{x_1^2 + x_3^2}$ (nonlinear! ⇒ use EKF)

Find the measurement data for 401 epochs in hw5pr2.mat
Solve the differential equation $\dot{x} = Ax$ to obtain Φ for $x_{i+1} = \Phi x_i$. Then implement the extended Kalman filter for the given observations. Show, on separate plots, the position, velocity, and altitude vs. epoch or time.