

## ECE-533 Homework 2

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### 1. Parameters

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$$X_{initial} = [0 \ 0]^T; X_{guess} = [10 \ 0 \ 0]^T$$
$$Q = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 10^{-8} \end{bmatrix}; R = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}; P_{guess} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

### 2. Methodology

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**Propagated Model:** Computation of  $X_{true}$

$$\begin{bmatrix} \dot{x} \\ \dot{v} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} x \\ v \end{bmatrix} + \begin{bmatrix} 0 \\ a_{true}(t) \end{bmatrix} + \begin{bmatrix} 0 \\ w(t) \end{bmatrix}$$

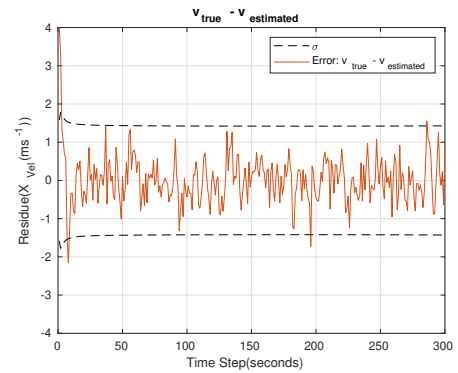
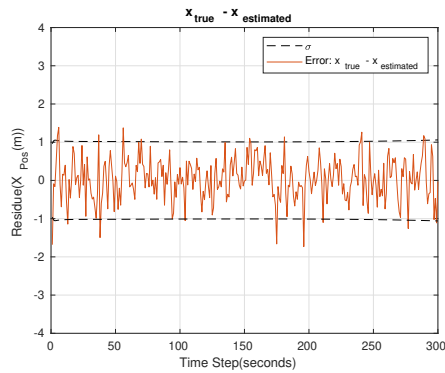
**Augmented Model:** State Estimation

$$\begin{bmatrix} \dot{x} \\ \dot{v} \\ \dot{b} \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & -1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x \\ v \\ b \end{bmatrix} + \begin{bmatrix} 0 \\ a_{meas}(t) \\ 0 \end{bmatrix}$$
$$H = \begin{bmatrix} \frac{x-x_1}{r_1} \\ \frac{x-x_2}{r_2} \\ \frac{x-x_3}{r_3} \end{bmatrix}$$

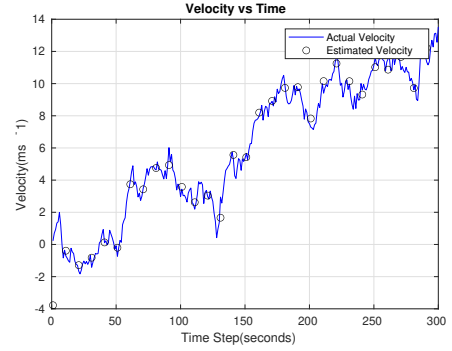
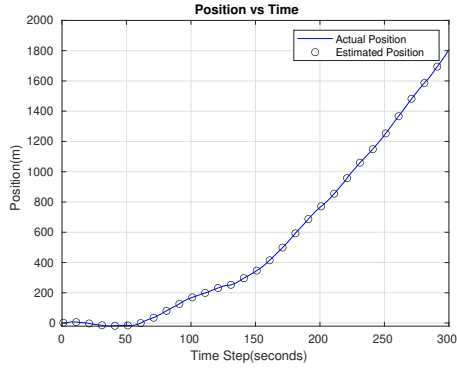
### 3. Result

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Implementation of Extended kalman filter to estimate position and velocity of truck in 1D space, given the euclidean distances from 3 known positions and measurement of acceleration.



**Remark**



- Matlab Version: R2020a
- $X_{guess}$  and  $P_{guess}$  are initial estimates
- b: estimated bias parameter in measured acceleration
- seed value(random number) is set to 32.