The State-Space modeling,

Variables,

$x_t \rightarrow$ Position at time t. , $\omega_t \rightarrow$ Disturbances,

$V_t \rightarrow$ Velocity at time t.

$u_t \Rightarrow$ Control input (acc (or) braking (retardition)).

linear model, - (Considering).

$$x_{t+1} = x_t + T_s \times V_t.$$

$$V_{t+1} = V_t + \omega_t.$$

$$X_{t+1} = \begin{bmatrix} 1 & T_s \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_t \\ V_t \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} \omega_t$$

$h(x_t, v_t)$

The Matrix A (State transition),

$$A = \begin{bmatrix} 1 & T_s \\ 0 & 1 \end{bmatrix}$$

Input Matrix B,

$$B = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

Disturbance Vector,

$$W_t = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

The output $y(t)$,

$$y(t) = h(x_t) + Z_t \rightarrow \text{noise}$$

The sensor measures the distance to each beacon,

$$y(t) = \sqrt{(x_t - x_b)^2 + \cancel{(v_t - v_b)}^2} + Z_t \rightarrow \text{noise.}$$

$(x_b, \cancel{y_b})$ → beacon coordinates.

EKF operates in 2 stages,

(1) prediction   (2) updation.

State ↔ (i) $\hat{X}_{t+1|t} = A\hat{x}_{t|t}$

Error Cov ↔ (ii) $P_{t+1|t} = AP_{t|t}A^T + Q$ → State covariance at time t.

$$H_t = \left.\frac{\delta h(x)}{\delta(x)}\right|_{\hat{x}_{t+1|t}}$$