

HW1

$$\dot{X} = \begin{bmatrix} \dot{x} \\ \dot{y} \end{bmatrix} = \frac{r}{2} \begin{bmatrix} u_r + u_l + w_x \\ u_r + u_l + w_x \end{bmatrix} \quad \begin{matrix} w_x \sim N(0, 0.1) \\ w_y \sim N(0, 0.15) \end{matrix} \quad u_r + u_l = u$$

1m \rightarrow at 0.1m/s \rightarrow 10s
 $T = 1/8$

Update every $\frac{1}{8}$ second
 Measure every second

Steps:

① Initialize: $X_0 = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ $P_0 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

② Predict: $\check{X}_k = \frac{r}{2} \begin{bmatrix} u + w_x \\ u + w_y \end{bmatrix}$, $\check{X}_k = \frac{(X_k - X_{k-1})}{T} \rightarrow X_k = X_{k-1} + T\check{X}_k$ (prior)
 $\check{X}_k = \hat{A}_{k-1}\hat{X}_{k-1} + \check{V}_k \quad \therefore A_{k-1} = I$

For \check{P}_k : $\check{P}_k = A_{k-1}\hat{P}_{k-1}A_{k-1}^T + Q_k$
 $= \hat{P}_{k-1} + Q_k$, $Q_k = \begin{bmatrix} w_x & 0 \\ 0 & w_y \end{bmatrix}$

Repeat 8 times

③ Correction

$z_k = \underbrace{\begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}}_C \underbrace{\begin{bmatrix} x \\ y \end{bmatrix}}_X + \underbrace{\begin{bmatrix} r_x & 0 \\ 0 & r_y \end{bmatrix}}_n \quad \begin{matrix} r_x \sim N(0, 0.05) \\ r_y \sim N(0, 0.075) \end{matrix}$

$K_k = \check{P}_k C^T (C \check{P}_k C^T + R_k)^{-1}$ $R_k = \begin{bmatrix} R_x & 0 \\ 0 & R_y \end{bmatrix}$

$\hat{P}_k = (I - K_k C) \check{P}_k$

$\hat{X}_k = \check{X}_k + K_k (z_k - C \check{X}_k)$

④ Alternate between ② & ③