

## I. PREDICTION

### 1. state

### 2. state variance/covariance

## II. UPDATE

### 3. state

### 4. state variance/covariance

#### single state

$$\begin{aligned}\mu_1 &= A \overset{\text{from previous time}}{\mu_{fused}} + Bu \\ \sigma_1^2 &= A \sigma_{fused}^2 A + Q \\ &= A^2 \sigma_{fused}^2 + Q\end{aligned}$$

$$\begin{aligned}\mu_{fused} &= \mu_1 + K(\mu_2 - C\mu_1) \\ &\quad \downarrow = \sigma_1^2 C (C\sigma_1^2 C + \sigma_2^2)^{-1} \\ &= \frac{C\sigma_1^2}{C^2\sigma_1^2 + \sigma_2^2}\end{aligned}$$

$$\sigma_{fused}^2 = (1 - KC)\sigma_1^2$$

#### multiple states

$$\begin{aligned}\hat{\mathbf{x}}_{k|k-1} &= A \overset{\text{from previous time}}{\hat{\mathbf{x}}_{k-1|k-1}} + B\mathbf{u}_{k-1} \\ \mathbf{P}_{k|k-1} &= A \mathbf{P}_{k-1|k-1} A^T + \mathbf{Q}_k\end{aligned}$$

$$\begin{aligned}\hat{\mathbf{x}}_{k|k} &= \hat{\mathbf{x}}_{k|k-1} + \mathbf{K}_k \underbrace{(\mathbf{y}_k - C\hat{\mathbf{x}}_{k|k-1})}_{\text{innovation: measurement}} \\ &\quad \downarrow = \mathbf{P}_{k|k-1} C^T \underbrace{(C\mathbf{P}_{k|k-1} C^T + \mathbf{R}_k)^{-1}}_{\text{innovation: covariance}}\end{aligned}$$

$$\mathbf{P}_{k|k} = (\mathbf{I} - \mathbf{K}_k C) \mathbf{P}_{k|k-1}$$

prediction

measurement

update