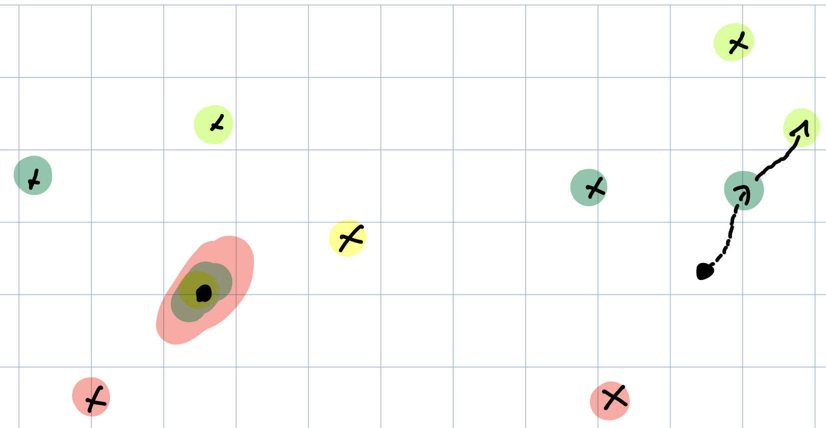
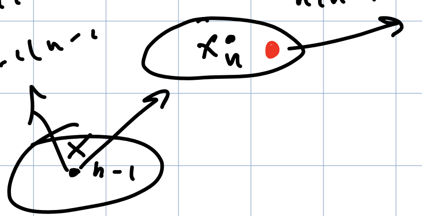


$$\hat{x}_{n-1|n-1} \quad P_{n-1|n-1} \Longrightarrow \hat{x}_{n|n-1} \quad P_{n|n-1} \Longrightarrow \hat{x}_{n|n} \quad P_{n|n}$$

$\vec{y}_n$



$\Delta t = t_n - t_{n-1}$

$$F_n = \exp(A \cdot \Delta t_n), \quad Q_n = \int e^{A\ldots} B \cdot \Sigma B^T e^{A^T} \, dt'$$

$\Longrightarrow$

$$\vec{x}_n = F_n \vec{x}_{n-1} + q_n, \qquad E[q_n] = 0, \quad \mathrm{Cov}[q_n] = Q_n$$

$$y_n = G_n x_n + r_n, \qquad E[r_n] = 0, \quad \mathrm{Cov}[r_n] = R_n$$

$$E[x_0] = m_0$$

$$\mathrm{Cov}(x_0) = P_0$$

$$E[\vec{x}_{n-1} \mid \vec{y}_{1:n-1}] = \hat{x}_{n-1|n-1}$$

$$\mathrm{Cov}[\vec{x}_{n-1} \mid \vec{y}_{1:n-1}] = P_{n-1|n-1}$$

$$\hat{x}_{n|n-1} = E[\vec{x}_n | \vec{y}_{1:n-1}] = E[F_n \vec{x}_{n-1} + \vec{q}_n | \vec{y}_{1:n-1}]$$

$$= F_n \underbrace{E[\vec{x}_{n-1} | \vec{y}_{1:n-1}]}_{\hat{x}_{n-1|n-1}} + \underbrace{E[\vec{q}_n | \vec{y}_{1:n-1}]}_{=0}$$

$$= F_n \hat{x}_{n-1|n-1}$$

$$E[\vec{x}] = \vec{m}, \quad Cov[\vec{x}] = P$$

$$E[F\vec{x} + \vec{b}] = F E[\vec{x}] + \vec{b} = F\vec{m} + \vec{b}$$

$$Cov[F\vec{x} + \vec{b}]$$

$$= E[(F\vec{x} + \vec{b} - \overbrace{E[F\vec{x} + \vec{b}]}^{F\vec{m} + \vec{b}})(F\vec{x} + \vec{b} - E[F\vec{x} + \vec{b}])^T]$$

$$= E[(F\vec{x} - F\vec{m})(F\vec{x} - F\vec{m})^T]$$

$$= F\, E[(\vec{x} - \vec{m})(\vec{x} - \vec{m})^T]\, F^T$$

$$= F P F^T$$

$\vec{z}$ and $\vec{q}$ indep.

$$Cov[\vec{z} + \vec{q}] = Cov(\vec{z}) + Cov[\vec{q}]$$

say $\vec{z} = F\vec{x} + b$, $E[\vec{q}] = 0$, $Cov(\vec{q}) = Q_n$

$$Cov[\underline{F\vec{x} + \vec{b}} + \underline{\vec{q}}] = F P F^T + Q_n$$

$$P_{n|n-1} = Cov[\vec{x}_n | y_{1:n-1}]$$

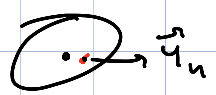
$$= Cov[F_n \vec{x}_{n-1} + q_n | y_{1:n-1}]$$

$$= F_n\, Cov[\vec{x}_{n-1}]\, F_n^T + Q_n$$

$$= F_n P_{n-1|n-1} F_n^T + Q_n$$

$$\left\{\begin{array}{l}\hat{x}_{n-1|n-1} \\ P_{n-1|n-1}\end{array}\right. \Rightarrow \begin{array}{l}\hat{x}_{n|n-1} = F_n \hat{x}_{n-1|n-1} \\ P_{n|n-1} = F_n P_{n-1|n-1} F_n^T + Q_n\end{array}$$

$$\hat{x}_{n|n-1}, \quad P_{n|n-1}$$



$$\begin{aligned} J_{RLS}(x_n) &= (y_n - G_n x_n)^T R_n^{-1} (y_n - G_n x_n) \\ &\quad + (x_n - \hat{x}_{n|n-1})^T P_{n|n-1}^{-1} (x_n - \hat{x}_{n|n-1}) \end{aligned}$$

$$\hat{x}_{n|n} = \min_{x_n} J_{RLS}(x_n)$$

$$\vec{x}_n = \underbrace{\begin{pmatrix} 1 & 0 & \Delta t & 0 \\ 0 & 1 & 0 & \Delta t \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}}_{e^{F \cdot \Delta t}} \vec{x}_{n-1}$$

$$\vec{x}_n = F_n \vec{x}_{n-1} + u_{n-1} + q_n$$

$$\Rightarrow \quad \hat{x}_{n|n-1} = F_n \hat{x}_{n-1|n-1} + u_{n-1}$$