Review L11 - L16

EECS 1003

P1 wrapping π.

prediction $\in \mathbb{R}^3 \begin{bmatrix} x \\ y \\ \theta \end{bmatrix}$

① $\bar{\mu}_t = g(\mu_{t-1}, u_t)$

~~$\rightarrow \bar{\mu}_t(3) = \pi 2\pi(\bar{\mu}_t(3))$~~

update:

② $\hat{z} = \boxed{h(\bar{\mu}_t)}$ $\quad (\operatorname{atan2}(y, x) - \bar{\theta}_t)$

$\mu_t = \boxed{\bar{\mu}_t} + K \boxed{(z - \hat{z})}$ $\pi 2\pi$

$\rightarrow$ ② ③

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① $\alpha + c \cdot 2\pi \qquad c \in \mathbb{Z}$

$\cos(\alpha) = \cos(\alpha + c \cdot 2\pi)$

② $\underset{(\operatorname{atan2})}{\alpha + c \cdot 2\pi} - \underset{(\bar{\theta}_t)}{\beta + c' 2\pi} = \alpha - \beta + \underline{(c+c')} 2\pi$

③ $(\alpha_z + c_z 2\pi - \alpha_{\hat{z}} - c_{\hat{z}} 2\pi) \cdot K = \qquad K \in \mathbb{R}$

$\checkmark \boxed{K(\alpha_z - \alpha_{\hat{z}})} + \underbrace{(c_z - c_{\hat{z}})}_{\in \mathbb{Z}} K \cdot 2\pi \quad \in \mathbb{R} \quad ⚠ \quad \cancel{\in \mathbb{Z}} \quad \mathbb{R}\, 2\pi$

EKF new landmark.

given. $\Sigma = \begin{bmatrix} \Sigma_x & \Sigma_{xm} \\ \Sigma_{mx} & \Sigma_m \end{bmatrix}$

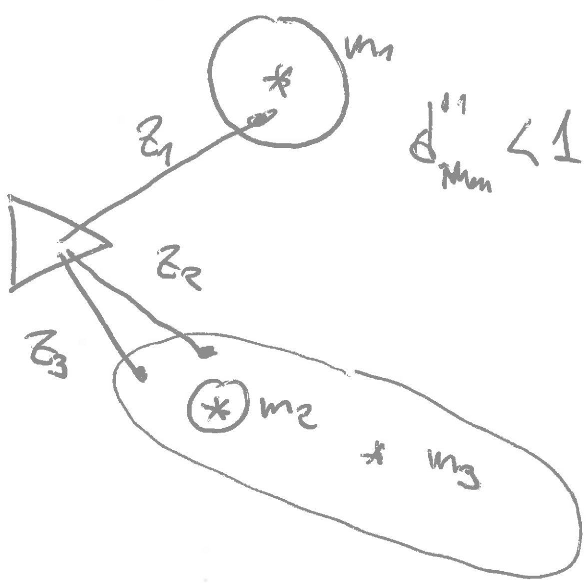
indicate the new augmented covariance and what elements have been updated.

$$h^{-1}(z_t, y_t) \simeq h^{-1}(z_t, \mu_t) + \underline{L \cdot \Delta x} + \underline{W \Delta z}$$

$$\begin{bmatrix} \Sigma_x & \Sigma_{xm} & \\ \Sigma_{mx} & \Sigma_m & \Sigma_{y,new} \\ \Sigma_{m,y_0} & & \Sigma_{new} \end{bmatrix}$$

EKy

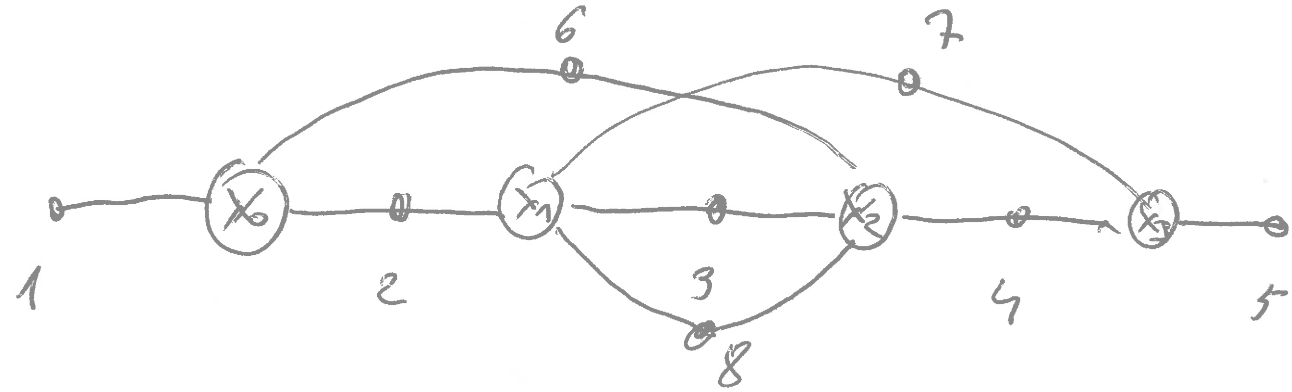
$$\Sigma_{new} = L \Sigma_x L^T + W Q W^T$$



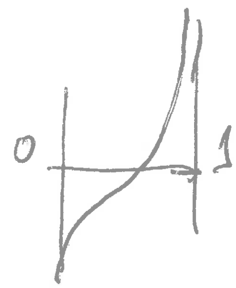
$d''_{Mm} < 1$

$$\begin{array}{cccc} & (z^1) & (z^2) & (z^3) \\ c_t = & [c^1, & c^2, & c^3] \end{array}$$

$$= [c^1 = m_1,\ c^2 = m_3,\ c^3 = m_3]$$

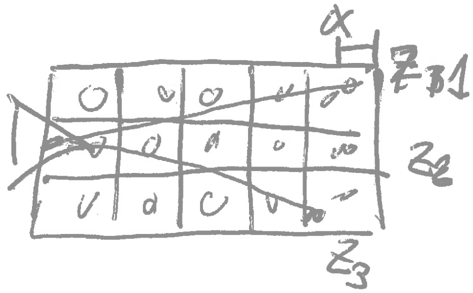


$$A = \begin{array}{c|cccc|c} & x_0 & x_1 & x_2 & x_3 & \\ \hline & \bullet & & & & 1 \\ & \bullet & \bullet & & & 2 \\ & & \bullet & \bullet & & 3 \\ & & & \bullet & \bullet & 4 \\ & & & & \bullet & 5 \\ & \bullet & & \bullet & & 6 \\ & & \bullet & & \bullet & 7 \end{array}$$



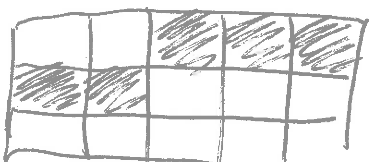
$$l = \log \frac{p(x)}{1-p(x)}$$

Calculate OGM



$l_0 = 0$, $l_{occ} = 2$ $l_{free} = -0.6$

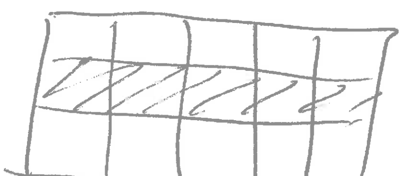
z_{max} $p(m=$



		-0.6	-0.6	2
-0.6	-0.6			

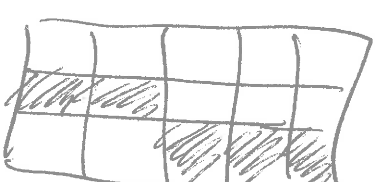
z_1

z_2



		-0.6	-0.6	2
-1.2	-1.2	-0.6	-0.6	2

z_3



		-0.6	-0.6	2
-1.8	-1.8	-0.6	-0.6	2
		-0.6	2	2

Givens rotation

$$R = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 3 & 1 \end{bmatrix}$$

$$\boxed{\Phi} \cdot R = R''$$

$$\begin{bmatrix} \cos\phi & \sin\phi \\ -\sin\phi & \cos\phi \end{bmatrix} \cdot \begin{bmatrix} \alpha \\ \beta \end{bmatrix} = \begin{bmatrix} r \\ 0 \end{bmatrix}$$

$$\underbrace{\begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\phi & \sin\phi \\ 0 & -\sin\phi & \cos\phi \end{bmatrix}}_{\Phi} \cdot \underbrace{\begin{bmatrix} 1 & 0 & 0 \\ 0 & 2\ \alpha & 0 \\ 0 & 3\ \beta & 1 \end{bmatrix}}_{R} = \begin{bmatrix} r_1 & r_4 & r_6 \\ 0 & r_2 & r_5 \\ 0 & 0 & r_3 \end{bmatrix}$$

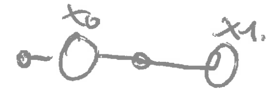
$$0 \cdot 0 + \alpha \cdot (-\sin\phi) + \beta\cos\phi = 0$$

$$\beta\cos\phi = \alpha\sin\phi \rightarrow \tan\phi = \frac{\beta}{\alpha} = \frac{3}{2}$$

$$\phi \text{ atan} \Rightarrow (\cos\phi, \sin\phi)$$

$$\left(\frac{\alpha}{\beta\sqrt{1+(\alpha/\beta)^2}}, \frac{1}{\sqrt{1+(\alpha/\beta)^2}} \right) = (\cos\phi, \sin\phi)$$

NLLSQ $\quad \| x_0 - x_0^\circ \|^2_{\Sigma_0} +$



For 1 factor $\| g_1(x_0, u_1) - x_1 \|^2_{\Sigma_1}$ ~~demonstrate the equivalence~~ demonstrate the equivalence to a norm-2 factor $\| A\, d_x - b \|_2^2$. Derive the ~~describe~~ terms in A and b to be equivalent.

$$g_1(x_0, u_1) \simeq g_1(x_0^\circ, u_1) + G_1^\circ \big|_{x_0^\circ} \Delta x_0$$

$$A = \begin{array}{c} \\ w_0 \\ w_1 \end{array} \begin{bmatrix} \Delta x_0 & \Delta x_1 \\ -I & 0 \\ G_1^\circ & -I \end{bmatrix}$$

$$\| g_1(x_0^\circ, u_1) + G_1^\circ \Delta x_0 - x_1^\circ - I \Delta x_1 \|^2_{\Sigma_1}$$

$$w_1 = \left(\sqrt{\left(\Sigma_1^{-1}\right)}\right)^T - \Sigma_1^{-T/2} \qquad (R_1)$$

$$\| w_1 (G_1^\circ \Delta x_0 - I \Delta x_1) + w_1 \underbrace{\left(g_1(x_0^\circ, u_1) - x_1^\circ \right)}_{a_1} \|_2^2 \qquad \delta x = \begin{bmatrix} \Delta x_0 \\ \Delta x_1 \end{bmatrix}$$

$$= \| w_1 \begin{bmatrix} G_1^\circ & -I \end{bmatrix} \begin{pmatrix} \Delta x_0 \\ \Delta x_1 \end{pmatrix} + w_1 \cdot a_1 \|^2$$

$$\| x_0^\circ - x_0 \|^2_{\Sigma_0} = \| w_0 (\overbrace{x_0^\circ - x_0^\circ}^{0} - I \Delta x_0) \|_2^2$$

$$= \| w_0 (-I \Delta x_0) \|_2^2 = \| w_0 \left(\begin{bmatrix} -I & 0 \end{bmatrix} \begin{pmatrix} \Delta x_0 \\ \Delta x_1 \end{pmatrix} \right) \|_2^2$$

$$A = \begin{pmatrix} -w_0 \cdot I & 0 \\ w_1 G_1^\circ & -w_1 I \end{pmatrix}, \qquad b = \begin{pmatrix} w_0 \cdot 0 \\ w_1 a_1 \end{pmatrix}$$