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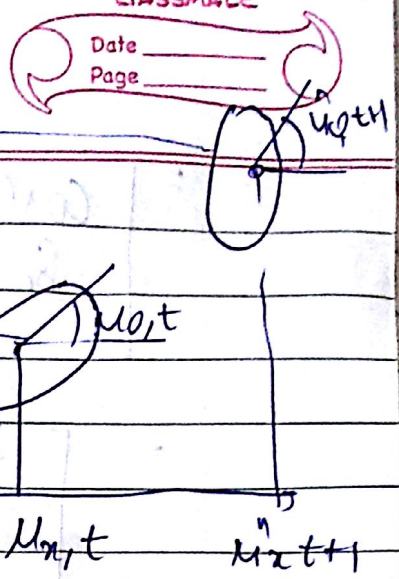
MR Assignment 3



$\mu_{x,t=0}$
$\mu_{y,t=0}$
$\sigma_x^2 = 0$
$\sigma_y^2 = 0$
$\mu_{\theta,t=0}$
$T = 1$
$\phi = 30$

$$\begin{bmatrix} \hat{\mu}_{x,t+1} \\ \hat{\mu}_{y,t+1} \\ \hat{\sigma}_{2,t+1} \end{bmatrix} = \begin{bmatrix} \mu_{x,t} \\ \mu_{y,t} \\ \mu_{\theta,t} \end{bmatrix} + \begin{bmatrix} T\cos(\mu_{\theta,t} + \phi) \\ T\sin(\mu_{\theta,t} + \phi) \\ \phi \end{bmatrix}$$

$$= \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} \cos(0+30^\circ) \\ \sin(0+30^\circ) \\ 30^\circ \end{bmatrix}$$

$$= \begin{bmatrix} \sqrt{3}/2 \\ 0.5 \\ 30^\circ \end{bmatrix}$$

$\Sigma_t = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ because there is no uncertainty in initial pos

$\Sigma_{t+1} = \begin{bmatrix} \sigma_T^2 & 0 \\ 0 & \sigma_\phi^2 \end{bmatrix} = \begin{bmatrix} 0.2 & 0 \\ 0 & 4 \end{bmatrix}$

$G_t = \dfrac{\delta f}{\delta \mu_{t-1}} = \begin{bmatrix} \cos(\mu_{\theta,t} + \phi) & -T\sin(\mu_{\theta,t} + \phi) \\ \sin(\mu_{\theta,t} + \phi) & T\sin(\mu_{\theta,t} + \phi) \\ 0 & 1 \end{bmatrix}$

$$= \begin{bmatrix} \cos(0+30^\circ) & -\sin(0+30^\circ) \\ \sin(0+30^\circ) & \cos(0+30^\circ) \\ 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} \sqrt{3}/2 & -1/2 \\ 1/2 & \sqrt{3}/2 \\ 0 & 1 \end{bmatrix}$$

$$\hat{\Sigma}_{t+1} = F \Sigma_t F^T + G_t \Sigma_{u_t} G_t^T$$

$$= 0 + \begin{bmatrix} \sqrt{3}/2 & -1/2 \\ 1/2 & \sqrt{3}/2 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 0.2 & 0 \\ 0 & 4 \end{bmatrix} \begin{bmatrix} \sqrt{3}/2 & 1/2 & 0 \\ -1/2 & \sqrt{3}/2 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} -0.85 & -1.688 & -2 \\ -1.688 & 3.05 & 3.46 \\ -2 & 3.46 & 4 \end{bmatrix}$$

and $\hat{\mu}_t = \begin{bmatrix} 0.866 \\ 0.5 \\ \pi/6 \end{bmatrix}$

$$\Sigma_{t+1}^{-1} = \begin{bmatrix} -0.532 & 0.391 & -0.604 \\ 0.39 & 17.22 & -14.704 \\ -0.604 & -14.704 & 12.667 \end{bmatrix}$$

Manhalabis distance =

$$\begin{bmatrix} 0.6 - 0.866 \\ 0.4 - 0.5 \\ \frac{\pi}{6} - \pi/6 \end{bmatrix}^T \begin{bmatrix} -0.532 & 0.391 & -0.604 \\ 0.391 & 17.225 & -14.704 \\ -0.604 & -14.705 & 12.667 \end{bmatrix} \begin{bmatrix} -0.24 \\ -0.1 \\ 0 \end{bmatrix}$$

$= 0.1554$ (Matlab

$$P(x) = \frac{1}{2\pi \sqrt{\det \Sigma}} \exp\left(\frac{-1}{2}(\text{Mahanabolis}\right)$$

$$= \frac{1}{2\pi (2.32)} (0.469)$$

$$= 0.0314$$