A]

$$g_i(x_{i-1}, u_i) - x_i \simeq \left[g_i(x_{i-1}^o, u_i) + G_i^{i-1}\,\delta x_{i-1}\right] - \left[x_i^o + \delta x_i\right] = \left(G_i^{i-1}\,\delta x_{i-1} - \delta x_i\right) - a_i$$

$$G_i^{i-1} = \left.\frac{\partial g_i(x_{i-1}, u_i)}{\partial x_{i-1}}\right|_{x_{i-1}^o} = \begin{bmatrix} 1 & 0 & -\delta_{tran}\cdot\sin(\theta+\delta_{rot1}) \\ 0 & 1 & \delta_{tran}\cdot\cos(\theta+\delta_{rot1}) \\ 0 & 0 & 1 \end{bmatrix}$$

$$h_k(x_{ik}, m_{jk}) - z_k \simeq h_k(x_{ik}^o, m_{jk}^o) + H_k^{ik}\,\delta x_{ik} + J_k^{jk}\,\delta m_{jk} - z_k$$

$$H_k^{ik} = \left.\frac{\partial h}{\partial x_{ik}}\right|_{(x_{ik}^o, m_{jk}^o)} = \begin{bmatrix} -\frac{x\_pose[lm] - x}{\sqrt{q}} & -\frac{y\_pose[lm] - y}{\sqrt{q}} & 0 \\ \frac{y\_pose[lm] - y}{q} & -\frac{x\_pose[lm] - x}{q} & -1 \end{bmatrix}$$

, where

$$q = (y\_pose[lm] - y)^2 + (x\_pose[lm] - x)^2$$

$$Q = \begin{bmatrix} beta1^2 & 0 & 0 \\ 0 & beta2^2 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$M = \begin{bmatrix} \alpha_1 \cdot \delta_{rot1}^2 + \alpha_2 \cdot \delta_{tran}^2 & 0 & 0 \\ 0 & \alpha_3 \cdot \delta_{tran}^2 + \alpha_4 \left(\delta_{rot1}^2 + \delta_{rot2}^2\right) & 0 \\ 0 & 0 & \alpha_1 \cdot \delta_{rot1}^2 + \alpha_2 \cdot \delta_{tran}^2 \end{bmatrix}$$

$$\Sigma_0 = \begin{bmatrix} 10^{-12} & 0 & 0 \\ 0 & 10^{-12} & 0 \\ 0 & 0 & 10^{-12} \end{bmatrix}$$

$$\delta^* = \operatorname{argmin} \left\{ \sum_{i=1}^{M} \left\| \Sigma_i^{-\frac{T}{2}} \left(G_i^{i-1} \delta x_{i-1} - I \, \delta x_{i-1} \right) - \Sigma_i^{-\frac{T}{2}} a_i \right\|_2^2 + \right.$$

$$\left. + \sum_{k=1}^{K} \left\| \Sigma_k^{-T/2} \left(H_k^{ik} \delta x_{ik} + J_k^{jk} \delta m_{jk} \right) - \Sigma_{ik}^{-\frac{T}{2}} c_k \right\|_2^2 \right\}$$

B] Matrix $\Sigma^{-\frac{T}{2}}$ at $t=1$ for transition

$$M^{-\frac{T}{2}} = \begin{bmatrix} 3,16 & 0 & 0 \\ 0 & 0,447 & 0 \\ 0 & 0 & 3,16 \end{bmatrix}$$

for observation:

$$Q^{-\frac{T}{2}} = \begin{bmatrix} 0,316 & 0 \\ 0 & 2,39 \end{bmatrix}$$

A] Matrix A at $t=1$

$$A = \begin{bmatrix}
1e-12 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1e-12 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1e-12 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
3,16 & 0 & 0 & -3,16 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0,447 & 4,47 & 0 & -0,47 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 3,16 & 0 & 0 & -3,16 & 0 & 0 & 0 & 0 & \\
0 & 0 & 0 & -0,311 & 0,057 & 0 & 0 & 0 & 0,311 & 0,057 & \\
0 & 0 & 0 & -0,0016 & -0,008 & -2,4 & 0 & 0 & -0,0016 & 0,008 & \\
0 & 0 & 0 & -0,29 & 0,114 & 0 & 0,29 & -0,114 & 0 & 0 & \\
0 & 0 & 0 & -0,006 & -0,016 & -2,4 & 0,006 & 0,016 & 0 & 0 &
\end{bmatrix}$$