$$\begin{pmatrix} x_t = x_{t-1} + (v_t \cos\theta_{t-1}) dt \\ y_t = y_{t-1} + v_t \sin\theta_{t-1}) dt \\ \theta_t = \theta_{t-1} + \omega_t dt \end{pmatrix} = g(u_t, x_{t-1})$$

$$G_t = \frac{\partial g(u_t, \mu_{t-1})}{\partial x_{t-1}} = \begin{matrix} \frac{\partial x'}{\partial \mu_{t-1,x}} & \frac{\partial x'}{\partial \mu_{t-1,y}} & \frac{\partial x'}{\partial \mu_{t-1,\theta}} \\ \frac{\partial y'}{\partial \mu_{t-1,x}} & \frac{\partial y'}{\partial \mu_{t-1,y}} & \frac{\partial y'}{\partial \mu_{t-1,\theta}} \\ \frac{\partial \theta'}{\partial \mu_{t-1,x}} & \frac{\partial \theta'}{\partial \mu_{t-1,y}} & \frac{\partial \theta'}{\partial \mu_{t-1,\theta}} \end{matrix}$$

$$\boxed{G_t = \begin{bmatrix} 1 & 0 & -v_t \sin\theta_{t-1} \Delta t \\ 0 & 1 & v_t \cos\theta_{t-1} \Delta t \\ 0 & 0 & 1 \end{bmatrix}}$$

$$V_t = \frac{\partial g(u_t, \mu_{t-1})}{\partial \mu_t} = \begin{bmatrix} \frac{\partial x'}{\partial v_t} & \frac{\partial x'}{\partial w_t} \\ \frac{\partial y'}{\partial v_t} & \frac{\partial y'}{\partial w_t} \\ \frac{\partial \theta'}{\partial v_t} & \frac{\partial \theta}{\partial w_t} \end{bmatrix}$$

$$\boxed{M_t = \begin{bmatrix} \sigma_v^2 & 0 \\ 0 & \sigma_w^2 \end{bmatrix} = \begin{bmatrix} 0.15^2 & 0 \\ 0 & 0.1^2 \end{bmatrix}}$$

$$\boxed{V_t = \begin{bmatrix} \cos\theta_{t-1} \Delta t & 0 \\ \sin\theta_{t-1} \Delta t & 0 \\ 0 & \Delta t \end{bmatrix}}$$

$$h(\bar{\mu}_t) = \begin{bmatrix} r_t \\ \phi_t \end{bmatrix} = \begin{pmatrix} \sqrt{(m_{j,x} - x)^2 + (m_{j,y} - y)^2} \\ \operatorname{atan2}(m_{j,y} - y, m_{j,x} - x) - \theta \end{pmatrix}$$

$$H_t = \begin{bmatrix} \frac{\partial r_t^i}{\partial \bar{\mu}_{t,x}} & \frac{\partial r_t^i}{\partial \bar{\mu}_{t,y}} & \frac{\partial r_t^i}{\partial \bar{\mu}_{t,\theta}} \\ \frac{\partial \phi_t^i}{\partial \bar{\mu}_{t,x}} & \frac{\partial \phi_t^i}{\partial \mu_{t,y}} & \frac{\partial \phi}{\partial \bar{\mu}_{t,\theta}} \end{bmatrix}$$

$$\boxed{H_t = \begin{bmatrix} \frac{-(m_{j,x} - \bar{\mu}_{t,x})}{\sqrt{q}} & -\frac{(m_{j,y} - \bar{\mu}_{t,y})}{\sqrt{q}} & 0 \\ \frac{m_{j,y} - \bar{\mu}_{t,y}}{q} & -\frac{(m_{j,x} - \bar{\mu}_{t,x})}{q} & -1 \end{bmatrix}}$$