

3 E. Model Propagation.

$$\begin{bmatrix} x \\ y \\ \theta \end{bmatrix}_t = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ \theta \end{bmatrix}_{t-1} + \begin{bmatrix} \cos \theta \Delta t & 0 \\ \sin \theta \Delta t & 0 \\ 0 & \Delta t \end{bmatrix} \begin{bmatrix} v \\ w \end{bmatrix} + \begin{bmatrix} \cos \theta \Delta t & 0 \\ \sin \theta \Delta t & 0 \\ 0 & \Delta t \end{bmatrix} \begin{bmatrix} \eta_v \\ \eta_w \end{bmatrix}$$

$$X_t = AX_{t-1} + Bu + B_\eta \eta$$

$$J = \begin{bmatrix} \frac{\partial f(X_{t-1}, \eta)}{\partial X_{t-1}} & \frac{\partial f(X_{t-1}, \eta)}{\partial \eta} \end{bmatrix}$$

$$\begin{matrix} J_x & J_\eta \end{matrix}$$

$$J_x = \begin{bmatrix} 1 & 0 & -\sin \theta \Delta t (v + \eta_v) \\ 0 & 1 & \cos \theta \Delta t (v + \eta_v) \\ 0 & 0 & 1 \end{bmatrix}$$

$$J_\eta = \begin{bmatrix} \Delta t \cos(\theta) & 0 \\ \Delta t \sin(\theta) & 0 \\ 0 & \Delta t \end{bmatrix}$$

$$\mu_{X_{t+1}} = A \mu_{X_t} + B(\mu_{X_t}) u + B(\mu_{X_t}) \eta, \quad \eta \sim \mathcal{N} \left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 2 & 0 \\ 0 & 0.1 \end{bmatrix} \right)$$

$$\Sigma_{X_t} = J_x \Sigma_{X_{t-1}} J_x^T + J_\eta \Sigma_\eta J_\eta^T$$