System dynamics:

$$\theta_k = \begin{bmatrix} x_\theta \\ y_\theta \\ \alpha_\theta \end{bmatrix} \quad s_k = \begin{bmatrix} x_s \\ y_s \\ \alpha_s \end{bmatrix} \quad z_k = \begin{bmatrix} x_z \\ y_z \\ \theta_z \end{bmatrix}$$

$$\theta_{k+1} = \theta_k \qquad w(k) \sim N(0, R(k))$$

$$z_k = h(\theta_k, s_k) + w(k)$$

Prediction:

$$\hat{\theta}_{k+1|k} = \hat{\theta}_{k|k}$$

$$\Sigma_{k+1|k} = \Sigma_{k|k}$$

$$h(\theta_k, s_k) = -\begin{bmatrix} x_s \\ y_s \\ \alpha_s \end{bmatrix} + \begin{bmatrix} \cos(\alpha_s) & \sin(\alpha_s) & 0 \\ -\sin(\alpha_s) & \cos(\alpha_s) & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_\theta \\ y_\theta \\ \alpha_\theta \end{bmatrix}$$

$$= \begin{bmatrix} -x_s + \cos(\alpha_s)\, x_\theta + \sin(\alpha_s)\, y_\theta \\ -y_s - \sin(\alpha_s)\, x_\theta + \cos(\alpha_s)\, y_\theta \\ -\alpha_s + \alpha_\theta \end{bmatrix}$$

Correction / update:

$$\hat{\theta}_{k+1|k+1} = \hat{\theta}_{k+1|k} + K_{k+1} \cdot \left(z_{k+1} - h(\hat{\theta}_{k+1|k}, s_{k+1}) \right)$$

$$\Sigma_{k+1|k+1} = \left(I - K_{k+1} H_{k+1} \right) \Sigma_{k+1|k}$$

$$K_{k+1} = \Sigma_{k+1|k} H_{k+1}^T \cdot \left(H_{k+1} \Sigma_{k+1|k} H_{k+1}^T + R_{k+1} \right)^{-1}$$

$$H_{k+1} = \begin{bmatrix} \cos(\alpha_s) & \sin(\alpha_s) & 0 \\ -\sin(\alpha_s) & \cos(\alpha_s) & 0 \\ 0 & 0 & 1 \end{bmatrix}$$