Initialisation of parameters $x_0, P_0, H, Q, R_0,$ Time update Compute fundamental matrix: $\mathbf{\Phi}_{k-1}^{[1]} \approx \mathbf{I}_n + \mathbf{F}_{k-1} T_s$ Compute a priori estimate: $\hat{\mathbf{x}}_{k}^{-} = \hat{\mathbf{x}}_{k-1} + \mathbf{f}(\hat{\mathbf{x}}_{k-1})T_{s}$ Compute a priori error covariance: $\mathbf{P}_{k}^{-} = \mathbf{\Phi}_{k-1}^{[1]} \mathbf{P}_{k-1} \mathbf{\Phi}_{k-1}^{[1]T} + \mathbf{Q}_{k-1}$ Correct sensor readings Compute acceleration due to motion: $a_x = -l_1[\omega_1^2\cos(\theta_1) + \alpha_1\sin(\theta_1)] - l_2[(\omega_1 + \omega_2)^2]$ $\cdot\cos(\theta_1+\theta_2)+(\alpha_1+\alpha_2)\sin(\theta_1+\theta_2)$ $a_z = -l_1[\alpha_1 \cos(\theta_1) - \omega_1^2 \sin(\theta_1)] - l_2[(\alpha_1 + \alpha_2)]$ $\cos(\theta_1 + \theta_2) + (\omega_1 + \omega_2)^2 \sin(\theta_1 + \theta_2)$ Compute gravity estimate: $\mathbf{g} \approx \begin{bmatrix} a_{X_2m} \\ 0 \\ a_{Z_2m} \end{bmatrix} - \mathbf{T}_y(\theta_1 + \theta_2 + 90^\circ) \begin{bmatrix} a_x \\ 0 \\ a_z \end{bmatrix} \|\mathbf{g}\|^{-1}$ ompute corrected angle estimate: $\theta_1 + \theta_2 = \operatorname{atan2}(g_z, g_x) - 180^{\circ}$ Set measurement covariances: $\sigma_3^2 = \begin{cases} \sigma_{3s}^2 & m_k = 0 \\ \sigma_{3f}^2 & m_k = 1 \end{cases}, \quad \sigma_4^2 = \begin{cases} \sigma_{4s}^2 & m_k = 0 \\ \sigma_{4f}^2 & m_k = 1 \end{cases}$ Measurement update Compute Kalman gain: $\mathbf{K}_k = \mathbf{P}_k^- \mathbf{H}_k^T [\mathbf{H}_k \mathbf{P}_k^- \mathbf{H}_k^T + \mathbf{R}_k]^{-1}$ Compute a posteriori estimate: $\hat{\mathbf{x}}_k = \hat{\mathbf{x}}_k^- + \mathbf{K}_k [\mathbf{z}_k - \mathbf{H}_k \hat{\mathbf{x}}_k^-]$ Update error covariance: $\mathbf{P}_k = [\mathbf{I} - \mathbf{K}_k \mathbf{H}_k] \mathbf{P}_k^-$ Output