SARKKA

$$x_k = A_{k-1} x_{k-1} + q_{k-1}$$
$$y_k = H_k x_k + r_k$$

$$r_k \sim N(0, R_k)$$
$$q_{k-1} \sim N(0, Q_{k-1})$$

prediction step.

$$m_k^- = A_{k-1} m_{k-1}$$
$$P_k^- = A_{k-1} P_{k-1} A_{k-1}' + Q_{k-1}$$

update step

$$v_k = y_k - H_k m_k^- \quad \text{innovation}$$
$$S_k = H_k P_k^- H_k' + R_k$$
$$K_k = P_k^- H_k' S_k^{-1}$$
$$m_k = m_k^- + K_k v_k$$
$$P_k = P_k^- - K_k S_k K_k'$$

backward smoothing

$$G_k = P_k A_k' (P_{k+1}^-)^{-1}$$
$$m_k^s = m_k + G_k (m_{k+1}^s - m_{k+1}^-)$$
$$P_k^s = P_k + G_k (P_{k+1}^s - P_{k+1}^-) G_k'$$