restated here:

$$\bar{\Sigma}_t = G_t \, \Sigma_{t-1} \, G_t^T + R_t \tag{3.99}$$

$$\bar{\mu}_t = g(u_t, \mu_{t-1}) \tag{3.100}$$

Substituting Σ_{t-1} by Ω_{t-1}^{-1} and $\bar{\mu}_t$ by $\bar{\Omega}_t^{-1}\bar{\xi}_t$ gives us the prediction equations of the extended information filter:

$$\bar{\Omega}_t = (G_t \, \Omega_{t-1}^{-1} \, G_t^T + R_t)^{-1} \tag{3.101}$$

$$\bar{\xi}_t = \bar{\Omega}_t \, g(u_t, \Omega_{t-1}^{-1} \, \xi_{t-1}) \tag{3.102}$$

The measurement update is derived from Equations (3.60) and (3.61). In particular, (3.61) defines the following Gaussian posterior:

$$bel(x_t) = \eta \, \exp\left\{-\tfrac{1}{2} \, (z_t - h(\bar{\mu}_t) - H_t \, (x_t - \bar{\mu}_t))^T \, Q_t^{-1} \right. \\ \left. (z_t - h(\bar{\mu}_t) - H_t \, (x_t - \bar{\mu}_t)) - \tfrac{1}{2}(x_t - \bar{\mu}_t)^T \bar{\Sigma}_t^{-1}(x_t - \bar{\mu}_t)\right\} \tag{3.103}$$

Multiplying out the exponent and reordering the terms gives us the following expression for the posterior:

$$\begin{aligned} bel(x_t) &= \eta \;\; \exp\left\{-\tfrac{1}{2} \, x_t^T \, H_t^T \, Q_t^{-1} \, H_t \, x_t + x_t^T \, H_t^T \, Q_t^{-1} \, [z_t - h(\bar{\mu}_t) + H_t \, \bar{\mu}_t] \right. \\ &\quad \left. -\tfrac{1}{2} x_t^T \, \bar{\Sigma}_t^{-1} \, x_t + x_t^T \, \bar{\Sigma}_t^{-1} \, \bar{\mu}_t \right\} \\ &= \eta \;\; \exp\left\{-\tfrac{1}{2} \, x_t^T \, \left[H_t^T \, Q_t^{-1} \, H_t + \bar{\Sigma}_t^{-1}\right] \, x_t \right. \\ &\quad \left. + x_t^T \left[H_t^T \, Q_t^{-1} \, [z_t - h(\bar{\mu}_t) + H_t \, \bar{\mu}_t] + \, \bar{\Sigma}_t^{-1} \, \bar{\mu}_t\right] \right. \end{aligned} \tag{3.104}$$

With $\bar{\Sigma}_t^{-1} = \bar{\Omega}_t$ this expression resolves to the following information form:

$$bel(x_t) = \eta \;\; \exp\left\{-\tfrac{1}{2} \, x_t^T \, \left[H_t^T \, Q_t^{-1} \, H_t + \bar{\Omega}_t\right] \, x_t \right. \\ \left. + x_t^T \left[H_t^T \, Q_t^{-1} \, [z_t - h(\bar{\mu}_t) + H_t \, \bar{\mu}_t] + \bar{\xi}_t\right] \right. \tag{3.105}$$

We can now read off the measurement update equations by collecting the terms in the squared brackets:

$$\Omega_t = \bar{\Omega}_t + H_t^T \, Q_t^{-1} \, H_t \tag{3.106}$$

$$\xi_t = \bar{\xi}_t + H_t^T \, Q_t^{-1} \, [z_t - h(\bar{\mu}_t) + H_t \, \bar{\mu}_t] \tag{3.107}$$

3.5.6 Practical Considerations

When applied to robotics problems, the information filter possesses several advantages over the Kalman filter. For example, representing global uncertainty is simple in the information filter: simply set $\Omega = 0$. When using moments, such global uncertainty amounts to a covariance of infinite