11.4.4 Constructing the Information Form

We can read off these terms directly from (11.19), and verify that they are indeed implemented in the algorithm **GraphSLAM_linearize** in Table 11.2:

- **Prior.** The initial pose prior manifests itself by a quadratic term Ω_0 over the initial pose variable x_0 in the information matrix. Assuming appropriate extension of the matrix Ω_0 to match the dimension of $y_{0:t}$, we have

(11.21)
$$\Omega \longleftarrow \Omega_0$$

  This initialization is performed in lines 2 and 3 of the algorithm **GraphSLAM_linearize**.

- **Controls.** From (11.19), we see that each control u_t adds to Ω and ξ the following terms, assuming that the matrices are rearranged so as to be of matching dimensions:

(11.22)
$$\Omega \longleftarrow \Omega + \begin{pmatrix} -G_t^T \\ 1 \end{pmatrix} R_t^{-1} \, (-G_t \;\; 1)$$

(11.23)
$$\xi \longleftarrow \xi + \begin{pmatrix} -G_t^T \\ 1 \end{pmatrix} R_t^{-1} \, [g(u_t, \mu_{t-1}) - G_t \, \mu_{t-1}]$$

  This is realized in lines 4 through 9 in **GraphSLAM_linearize**.

- **Measurements.** According to Equation (11.19), each measurement z_t^i transforms Ω and ξ by adding the following terms, once again assuming appropriate adjustment of the matrix dimensions:

(11.24)
$$\Omega \longleftarrow \Omega + H_t^{iT} \, Q_t^{-1} \, H_t^i$$

(11.25)
$$\xi \longleftarrow \xi + H_t^{iT} \, Q_t^{-1} \, [z_t^i - h(\mu_t, c_t^i) + H_t^i \mu_t]$$

  This update occurs in lines 10 through 21 in **GraphSLAM_linearize**.

This proves the correctness of the construction algorithm **GraphSLAM_linearize**, relative to our Taylor expansion approximation.

We also note that the steps above only affect off-diagonal elements that involve at least one pose. Thus, all between-feature elements are zero in the resulting information matrix.