LQR Weight Matrix Selection

- Good ROT (typically called Bryson's Rules) when selecting the weighting matrices Q and R is to normalize the signals:

$$Q = \begin{bmatrix} \frac{\alpha_1^2}{(x_1)^2_{\max}} & & & \\ & \frac{\alpha_2^2}{(x_2)^2_{\max}} & & \\ & & \ddots & \\ & & & \frac{\alpha_n^2}{(x_n)^2_{\max}} \end{bmatrix}$$

$$R = \rho \begin{bmatrix} \frac{\beta_1^2}{(u_1)^2_{\max}} & & & \\ & \frac{\beta_2^2}{(u_2)^2_{\max}} & & \\ & & \ddots & \\ & & & \frac{\beta_m^2}{(u_m)^2_{\max}} \end{bmatrix}$$

- The $(x_i)_{\max}$ and $(u_i)_{\max}$ represent the largest desired response or control input for that component of the state/actuator signal.

- $\sum_i \alpha_i^2 = 1$ and $\sum_i \beta_i^2 = 1$ are used to add an additional relative weighting on the various components of the state/control

- ρ is used as the last relative weighting between the control and state penalties $\Rightarrow$ gives a relatively concrete way to discuss the relative size of Q and R and their ratio Q/R