Comando lq do Scilab

Sistema na forma usual:

$$\left.\begin{array}{l}\dot{\mathbf{x}} = \mathbf{A}\mathbf{x} + \mathbf{B}\mathbf{u} \\ \mathbf{y} = \mathbf{C}\mathbf{x} + \mathbf{D}\mathbf{u} \\ J = \int \left(\mathbf{x}^{\mathrm{T}}\mathbf{Q}\mathbf{x} + \mathbf{u}^{\mathrm{T}}\mathbf{P}\mathbf{u}\right)dt\end{array}\right\} \rightarrow \begin{cases}\mathbf{R}\mathbf{A} + \mathbf{A}^{\mathrm{T}}\mathbf{R} + \mathbf{Q} - \mathbf{R}\mathbf{B}\mathbf{P}^{-1}\mathbf{B}^{\mathrm{T}}\mathbf{R} = \mathbf{0} \\ \mathbf{u} = -\underbrace{\mathbf{P}^{-1}\mathbf{B}^{\mathrm{T}}\mathbf{R}}_{\mathbf{K}}\mathbf{x}\end{cases}$$

Por exemplo: $\mathbf{Q} = \mathrm{diag}([.5,.2,.5,5])$ $\qquad$ $\mathbf{P} = .2$

Sistema na nova forma:

$$\left.\begin{array}{l}\dot{\mathbf{x}} = \mathbf{A}\mathbf{x} + \mathbf{B}_1\mathbf{w} + \mathbf{B}_2\mathbf{u} \\ \mathbf{z} = \mathbf{C}_1\mathbf{x} + \cancel{\mathbf{D}_{11}}\mathbf{w} + \mathbf{D}_{12}\mathbf{u} \\ \mathbf{y} = \mathbf{C}_2\mathbf{x} + \mathbf{D}_{21}\mathbf{w} + \cancel{\mathbf{D}_{22}}\mathbf{u}\end{array}\right\} \rightarrow J = \int \left(\mathbf{x}^{\mathrm{T}}\underbrace{\mathbf{C}_1{}^{\mathrm{T}}\mathbf{C}_1}_{\mathbf{Q}}\mathbf{x} + \mathbf{u}^{\mathrm{T}}\underbrace{\mathbf{D}_{12}{}^{\mathrm{T}}\mathbf{D}_{12}}_{\mathbf{P}}\mathbf{u}\right)dt$$

Comando lq do Scilab

- Big=sysdiag(Q,P); → cria matriz diagonal com **Q** e **P**
- [w,wp]=fullrf(Big); → fatorar **Q** e **P**
- C1=w(:,1:4);
- D12=w(:,5);
- H=syslin('c',A,B2,C1,D12)
- [K,R]=lqr(H)→ K matriz de ganhos de controle

  R matriz de Riccati

Exemplo

$$Big = \begin{bmatrix} q_{11} & q_{12} & q_{13} & q_{14} & 0 \\ q_{21} & q_{22} & q_{23} & q_{24} & 0 \\ q_{31} & q_{32} & q_{33} & q_{34} & 0 \\ q_{41} & q_{42} & q_{43} & q_{44} & 0 \\ 0 & 0 & 0 & 0 & p \end{bmatrix}$$

$$\mathbf{W} = \begin{bmatrix} c_{11} & c_{12} & c_{13} & c_{14} & d_1 \\ c_{21} & c_{22} & c_{23} & c_{24} & d_2 \\ c_{31} & c_{32} & c_{33} & c_{34} & d_3 \\ c_{41} & c_{42} & c_{43} & c_{44} & d_4 \\ c_{51} & c_{52} & c_{53} & c_{54} & d_5 \end{bmatrix}$$

$$\boldsymbol{Q} = \boldsymbol{W}^{\boldsymbol{T}}\boldsymbol{W}$$

$$P = \boldsymbol{D_{12}}^{\boldsymbol{T}}\boldsymbol{D_{12}}$$