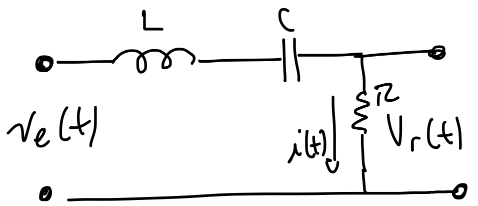
Modelado de circuito RLC en variables de estado



input $u = V_e(t)$

output $y = V_r(t)$

Ecuaciones del sistema:

- $V_e(t) = L \cdot \frac{di(t)}{dt} + V_c(t) + i(t) \cdot R$

$$\Rightarrow \frac{di(t)}{dt} = -\frac{i(t) \cdot R}{L} - \frac{V_c(t)}{L} + \frac{V_e(t)}{L}$$

- $V_c = \frac{Q}{C} \Rightarrow V_c(t) = \frac{1}{C} \cdot \int i(t)\,dt \Rightarrow \frac{dV_c(t)}{dt} = \frac{1}{C}\, i(t)\,dt$

Asignación de variables de estado:

$$X = \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} i \\ V_c \end{bmatrix} \Rightarrow \dot{X} = \begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} \dot{i} \\ \dot{V}_c \end{bmatrix}$$

$$\dot{X}_1 = -X_1 \cdot \frac{R}{L} - \frac{X_2}{L} + \frac{u}{L} = f(X_1, X_2, u)$$

$$\dot{X}_2 = \frac{1}{C} \cdot X_1 = f(X_1, X_2, u)$$

Matricialmente:

Matriz del sistema "A"

Matriz de entrada "B"

$$\begin{bmatrix} \frac{\partial i(t)}{\partial t} \\ \frac{\partial V_c}{\partial t} \end{bmatrix} = \begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -\frac{R}{L} & -\frac{1}{L} \\ \frac{1}{C} & 0 \end{bmatrix} \cdot \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} \frac{1}{L} \\ 0 \end{bmatrix} \cdot [u]$$

$$[V_r(t)] = [y] = \begin{bmatrix} R & 0 \end{bmatrix} \cdot \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

Matriz de salida "C"

$$\Rightarrow \boxed{\begin{array}{l} \dot{X}(t) = A \cdot X(t) + B \cdot u(t) \\ Y(t) = C \cdot X(t) \end{array}}$$