Practice 9

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Compose identifiable analysis

- **Differential equations of the model**

$$Q'_k(t) = \sum_{i=1}^{n} k_{iq(k)} u_i(t) + \sum_{\substack{j=1 \\ j\neq k}}^{k} k_{jk} Q_j(t) - \sum_{\substack{j=1 \\ j\neq k}}^{k} k_{kj} Q_k(t) - \sum_{i=1}^{m} k_{q(k)i} Q_k(t)$$

$$\dot{X}_1 = U_1 + K_{21} \cdot X_2 - (K_{12} + K_{13}) \cdot X_1$$

$$\dot{X}_2 = X_1 \cdot K_{12} - K_{21} \cdot X_2$$

$$\dot{X}_3 = X_1 \cdot K_{13}$$

$$Y_1 = \frac{X_1}{V_1}$$

$$Y_2 = X_2$$

- **Matrix A,B,C**

$$A = \begin{pmatrix} -K_{12} - K_{13} & K_{21} & 0 \\ K_{12} & -K_{21} & 0 \\ K_{13} & 0 & 0 \end{pmatrix} \quad B = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \quad C = \begin{pmatrix} \frac{1}{V_1} & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

- **Define the transfer function**

$$\frac{L\{Y_1\}}{L\{U_1\}} = \frac{K_{21} + s}{V_1 * (K_{13} * K_{21} + K_{12} * s + K_{13} * s + K_{21} * s + s^2}$$

$$\frac{L\{Y_2\}}{L\{U_1\}} = \frac{K_{13} * (K_{21} + s)}{V_1 * (K_{12} * s^2 + K_{13} * s^2 + K_{21} * s^2 + s^3 + K_{13} * K_{21})}$$

- **Define the observation parameters**

$$a_0 = K_{21}$$
$$b_0 = V_1 * K_{13} * K_{21}$$
$$b_1 = V_1 * (K_{12} + K_{13} + K_{21})$$
$$b_2 = V_1$$

OR

$$c_0 = K_{13} * K_{21}$$
$$c_1 = K_{13}$$
$$d_0 = V_1 * K_{13} * K_{21}$$
$$d_2 = V_1 * (K_{12} + K_{13} + K_{21})$$
$$d_3 = V_1$$

- **Define the model parameters**

$$K_{21} = a_0 \qquad K_{13} = c_1$$

$$K_{13} = \frac{b_0}{V_1 * K_{21}} = \frac{b_0}{b_2 * a_0} \qquad K_{21} = \frac{c_0}{K_{13}} = \frac{c_0}{c_1}$$

or

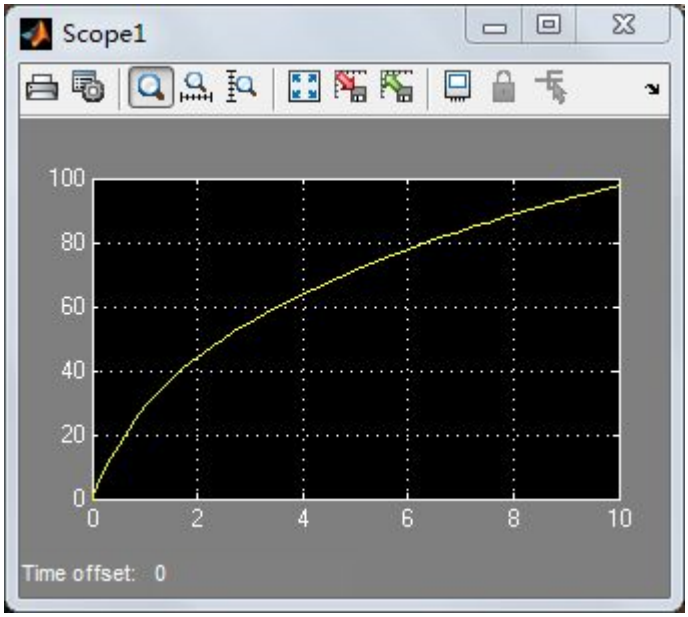
$$K_{12} = \frac{b_1}{V_1} - K_{21} - K_{13} = \frac{b_1}{b_2} - a_0 - \frac{b_0}{b_2 * a_0} \qquad K_{12} = \frac{d_2}{V_1} - K_{13} - K_{21} = \frac{d_2}{d_3} - c_1 - \frac{c_0}{c_1}$$

$$V_1 = b_2 \qquad V_1 = d_3$$

Compose model in Simulink

- **Graphical output of the simulation**

Y1:



Y2: