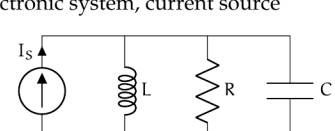


ss.exe Exercises for Chapter ss

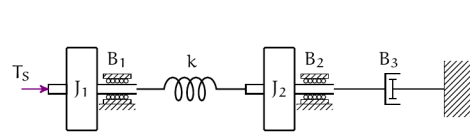
Exercice ss.7

Draw necessary sign coordinate arrows, a linear graph, a normal tree, and identify state variables and system order for each of the following schematics.

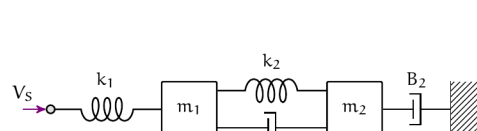
a. electronic system, current source



b. rotational mechanical system, torque source



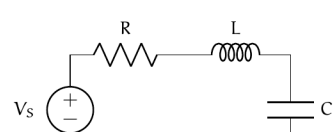
c. translational mechanical system, velocity source



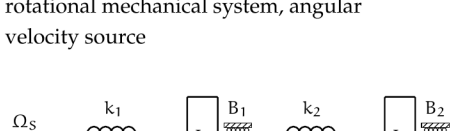
Exercice ss.8

Draw necessary sign coordinate arrows, a linear graph, a normal tree, and identify state variables and system order for each of the following schematics.

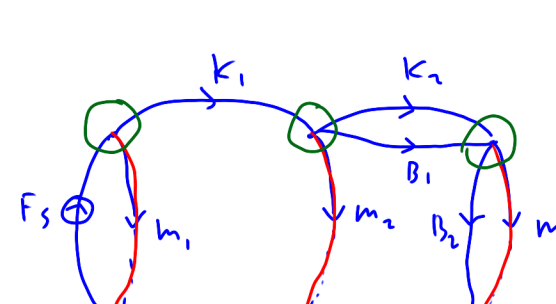
a. electronic system, voltage source



b. rotational mechanical system, angular velocity source



c. translational mechanical system, force source

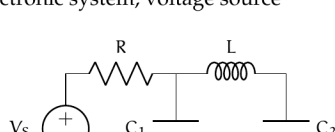


Primary: $v_{m1}, v_{m2}, v_{m3}, F_s, F_{k1}, F_{k2}, F_{B1}, F_{B2}$
 Secondary: $F_{m1}, F_{m2}, F_{m3}, v_s, v_{k1}, v_{k2}, v_{B1}, v_{B2}$
 State: $v_{m1}, v_{m2}, v_{m3}, F_{k1}, F_{k2}$
 $n=5$

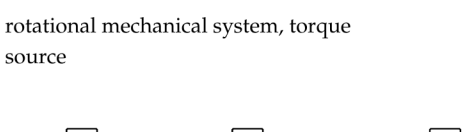
Exercice ss.9

Draw necessary sign coordinate arrows, a linear graph, a normal tree, and identify state variables and system order for each of the following schematics.

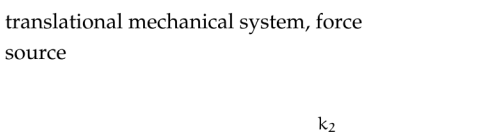
a. electronic system, voltage source



b. rotational mechanical system, torque source



c. translational mechanical system, force source



Elemental

$$\frac{dv_{m1}}{dt} = \frac{1}{m_1} F_{m1} = \frac{1}{m_1} (F_s - F_{k1})$$

$$\frac{dv_{m2}}{dt} = \frac{1}{m_2} F_{m2} = \frac{1}{m_2} (F_{k1} - F_{k2} - F_{B1}) = \frac{1}{m_2} (F_{k1} - F_{k2} - B_1(v_{m2} - v_{m1}))$$

$$\frac{dv_{m3}}{dt} = \frac{1}{m_3} F_{m3} = \frac{1}{m_3} (F_{k2} + F_{B1} - F_{B2}) = \frac{1}{m_3} (F_{k2} + B_1(v_{m1} - v_{m2}) - B_2 v_{m3})$$

$$\frac{dF_{k1}}{dt} = k_1 v_{k1} = k_1 (v_{m1} - v_{m2})$$

$$\frac{dF_{k2}}{dt} = k_2 v_{k2} = k_2 (v_{m2} - v_{m3})$$

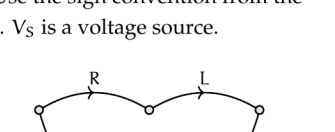
$$x = \begin{bmatrix} v_{m1} \\ v_{m2} \\ v_{m3} \\ F_{k1} \\ F_{k2} \end{bmatrix}$$

$$y = [v_{m3}]$$

$$u = [F_s]$$

Exercice ss.10

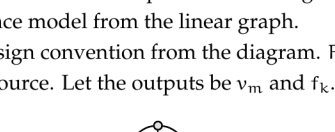
Use the following linear graph for a circuit to answer the questions below, which are the steps to determining a state-space model of the circuit. Use the sign convention from the diagram. V_s is a voltage source.



- Determine the normal tree, state variables, system order, state vector, input vector, and output vector for the outputs i_L and v_C .
- Write the required elemental, continuity, and compatibility equations.
- Solve for the state equation in standard form.
- Solve for the output equation in standard form.

Exercice ss.11

Use the following linear graph for a mechanical translational system to answer the questions below, which are the steps to determining a state-space model from the linear graph. Use the sign convention from the diagram. F_s is a force source. Let the outputs be v_{m1} and f_{k1} .



- Determine the normal tree, state variables, system order, state vector, input vector, and output vector.
- Write the required elemental, continuity, and compatibility equations.
- Solve for the state equation in standard form.
- Solve for the output equation in standard form.

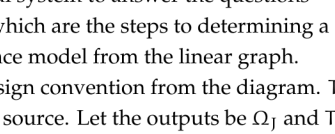
$$\dot{x} = \begin{bmatrix} 0 & 0 & 0 & -1/m_1 & 0 \\ 0 & -B_1/m_2 & B_1/m_2 & 1/m_2 & -1/m_2 \\ 0 & B_1/m_2 & -B_1/m_2 & 0 & 1/m_2 \\ k_1 & -k_1 & 0 & 0 & 0 \\ 0 & 0 & k_2 & -k_2 & 0 \end{bmatrix} x + \begin{bmatrix} 1/m_1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 0 & 1 & 0 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \end{bmatrix} u$$

$$H(s) = C(sI - A)^{-1}B + D$$

Exercice ss.blowhard

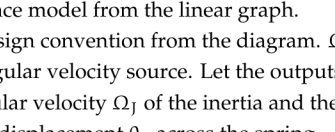
Use the following linear graph for a mechanical rotational system to answer the questions below, which are the steps to determining a state-space model from the linear graph. Use the sign convention from the diagram. T_s is a torque source. Let the outputs be Ω_1 and T_B .



- Determine the normal tree, state variables, system order, state vector, input vector, and output vector.
- Write the required elemental, continuity, and compatibility equations.
- Solve for the state equation in standard form.
- Solve for the output equation in standard form.

Exercice ss.blowhard

Use the following linear graph for a mechanical rotational system to answer the questions below, which are the steps to determining a state-space model from the linear graph. Use the sign convention from the diagram. Ω_s is an angular velocity source. Let the outputs be the angular velocity Ω_1 of the inertia and the angular displacement θ_1 across the spring.

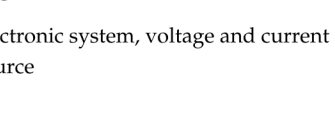


- Determine the normal tree, state variables, system order, state vector, input vector, and output vector.
- Write the required elemental, continuity, and compatibility equations.
- Solve for the state equation in standard form.
- Solve for the output equation in standard form.

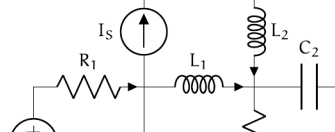
Exercice ss.chunker

Use the assigned coordinate arrows to draw a linear graph, a normal tree, and identify state variables and system order for each of the following schematics.

1. electronic system, voltage and current source



2. rotational mechanical system, torque source, coordinate arrow



3. translational mechanical system, force sources (2)

