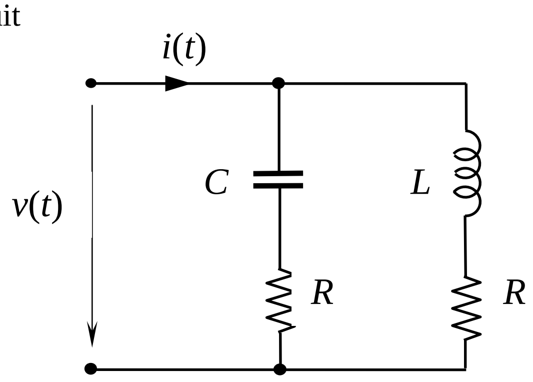
Příklady k přednášce 7
Exercises for Lecture 7

1. Consider the circuit



where the voltage $v(t)$ and current $i(t)$ are the input and output variables of the system. Determine state equations, the impulse response and the transfer function of the system. Then assume that $RC = L/R$ is satisfied, reduce the state equations to Kalman's canonical form, and identify the uncontrollable and/or unobservable eigenvalues of the system. What are the impulse response and the transfer function of the system in this case?

2. Given is the transfer function matrix

$$H(s) = \begin{bmatrix} \frac{s-1}{s} & 0 & \frac{s-2}{s+2} \\ 0 & \frac{s+1}{s} & 0 \end{bmatrix}.$$

Determine the Smith-McMillan form of $H(s)$. What are the poles of $H(s)$? What are the zeros of $H(s)$?

3. Consider the system

$$\dot{x} = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} u, \quad y = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix} x + u.$$

Determine the zeros (invariant, input-decoupling, output-decoupling, and input-output-decoupling) of the system as well as the zeros of its transfer function.

4. Given is the transfer function matrix

$$H(s) = \begin{bmatrix} \frac{s-1}{s+1} & 1 \\ \frac{2}{s^2-1} & 0 \end{bmatrix}.$$

Determine a polynomial matrix fractional representation of $H(s)$, namely $H(s) = \tilde{D}^{-1}(s)\tilde{N}(s)$, in which the matrices $\tilde{D}, \tilde{N}$ are left coprime and $\tilde{D}$ is row reduced.

5. Given is the system $\dot{x} = Ax + Bu,\ y = Cx + Du$ with

$$A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}, \quad B = \begin{bmatrix} 0 & 1 \\ 2 & 1 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & -1 \\ 0 & 0 \end{bmatrix}, \quad D = \begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix}.$$

Determine the transfer function of the system in a polynomial matrix fractional form, namely $H(s) = N(s)D^{-1}(s)$, in which the matrices N, D are right coprime and D is column reduced.