Příklady k přednášce 11
Exercises for Lecture 11

1. Consider two systems, $S_1 = (A_1, B_1, C_1, D_1)$ and $S_2 = (A_2, B_2, C_2, D_2)$, given by $A_1 = -1, B_1 = 1, C_1 = -2, D_1 = 1$ and $A_2 = -1, B_2 = 2, C_2 = 1, D_2 = 0$ that are connected in parallel. Determine a state description, (A, B, C, D), of the overall system. Is the overall system controllable? Is it observable? Calculate the transfer function of the overall system.

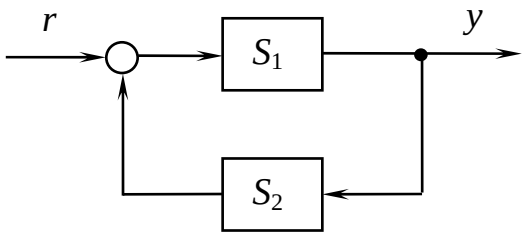
2. Consider two systems, $S_1 = (A_1, B_1, C_1, D_1)$ and $S_2 = (A_2, B_2, C_2, D_2)$, given by $A_1 = 0, B_1 = 1, C_1 = 1, D_1 = 0$ and $A_2 = -1, B_2 = -1, C_2 = 1, D_{12} = 1$.

   (a) Connect the two systems in series so that S_1 *precedes* S_2 and determine a state representation, (A, B, C, D), of the overall system. Is the overall system controllable? Is it observable?

   (b) Connect the two systems in series so that S_1 *follows* S_2 and determine a state representation, $(\overline{A}, \overline{B}, \overline{C}, \overline{D})$, of the overall system. Is the overall system controllable? Is it observable?

   Calculate the transfer functions of the overall systems under (a) and (b).

3. Consider the feedback interconnection of two systems, S_1 and S_2, shown below



   Given the state representations of S_1 and S_2 by

$$A_1 = -1, B_1 = 1, C_1 = -1, D_1 = 1 \quad \text{and} \quad A_2 = 0, B_2 = 1, C_2 = 1, D_2 = 0,$$

   (a) determine a state representation of the feedback configuration, S,

   (b) determine stability, controllability and observability properties of S,

   (c) obtain the transfer function of S between y and r.

4. Consider the double integrator

$$H_1(s) = \frac{1}{s^2}.$$

   Characterize the set of all stabilizing controllers H_2 for H_1, with H_2 proper rational. Does this set contain a stabilizing controller of McMillan degree zero?

5. Consider

$$H_1(s) = \begin{bmatrix} \frac{1}{s^2} \\ \frac{1}{s} \end{bmatrix}.$$

Derive doubly coprime proper and stable matrix fraction representations of H_1 and characterize all proper stabilizing controllers H_2 for H_1.