Homework 6: Feedback Control

Note: This homework assignment is due on Thursday 29.03.2012, 15:40.

Problem 12:

The following plant is given

$$G(s) = \frac{s-2}{s-4}$$

a. Determine (without computation) which of the following controller transfer functions lead to an instable feedback loop

$$C_1(s) = \frac{s-4}{s+2} \qquad C_2(s) = \frac{s+5}{s-2} \qquad C_3(s) = -1.5$$

b. Verify that the remaining controller transfer function leads to an internally stable feedback loop.

Problem 13:

Show that the following statement is true: If the controller transfer function $C(s)$ cancels an instable zero of the plant $G(s)$, then the control sensitivity $S_u(s)$ is instable.

Problem 14:

Consider the plant transfer function

$$G(s) = \frac{s+4}{(s+7)(s^2+3\,s+3)}$$

Assume that somebody designed a controller $C(s)$ with the transfer function

$$C(s) = \frac{s+7}{(s+1)s}$$

a. Show that the basic feedback loop with $G(s)$ and $C(s)$ as given above is internally stable.

b. Assume that you found that $1 + C(s)\,G(s)$ has the following dominant pair of zeros: $s_{1,2} = -0.16 \pm 0.84\,j$. Determine the estimated rise time, peak time and settling time (2%) of the sensitivity.

c. Which static position error do you expect for the feedback loop?