

Exercise 11

This exercise is the exam of 08 February, 2008. Do the homework under exam conditions, i.e. individual solutions, no teamwork, finish after 90 Minutes.

Problem 1 (max 40 points)

For the crane example with uncertain load mass m_L and rope length ℓ an output feedback controller was designed for simultaneous Γ -stabilization of the four vertices (m_L^-, ℓ^-) , (m_L^-, ℓ^+) , (m_L^+, ℓ^-) , (m_L^+, ℓ^+) of the Q -box. The robustness analysis for the continuum Q can be done by the parameter space approach (see Fig. 3.16) or by checking the edges of Q (see Fig. 8.14).

Now assume that these two analysis approaches are applied to other problems with the following characteristics:

- 1) Variation of the operating domain Q ,
- 2) Variation of the definition of Γ -stability,
- 3) Parameters entering nonlinearly into the coefficients of the characteristic polynomial,
- 4) 3,4, many uncertain parameters.

For each of these four problem variations discuss, which of the two analysis approaches is superior and why.

Problem 2 (max 60 points)

The plant

$$G(s) \frac{1 + s}{3 + s + 6s^2 + s^3 + 2s^4}$$

is controlled by a PID-controller

$$PID(s) \frac{K_I + K_P s + K_D s^2}{s}$$

For what range of K_P -values do there exist stabilizing K_I , K_D values ?