

Exercise Sheet 5: Youla Parametrization**Problem 11:**

We consider a plant with the transfer function

$$G(s) = \frac{3001(1 + s/109)}{s^3 + 3s^2 + 3s + 1}$$

- a. Is this plant suitable for a Youla parameterization design?
- b. Perform a Youla parametrization design for $G(s)$ such that the complementary sensitivity $T(s)$ has the form $T(s) = \frac{1}{(1 + 10s)^r}$ for an appropriate value of r .
- c. Realize the block diagram of the feedback loop with $G(s)$ and $C(s)$ in Simulink and perform a reference step response of $r = \sigma(t)$ and a disturbance step response of $F_Z = 0.05\sigma(t)$.
Hint: Use the Simulink block of the plant on the course webpage.
- d. Discuss the advantages of the controller design procedure. What is the disadvantage of the Youla parametrization design and how does it show in the experiment?

Problem 12:

Show the following statements for the Youla Parametrization.

- a. If Q has non-negative relative degree, then also C has non-negative relative degree
- b. Assume that the relative degree of G is r . Then, the relative degree of C is only non-negative if the relative degree of T is larger or equal than r