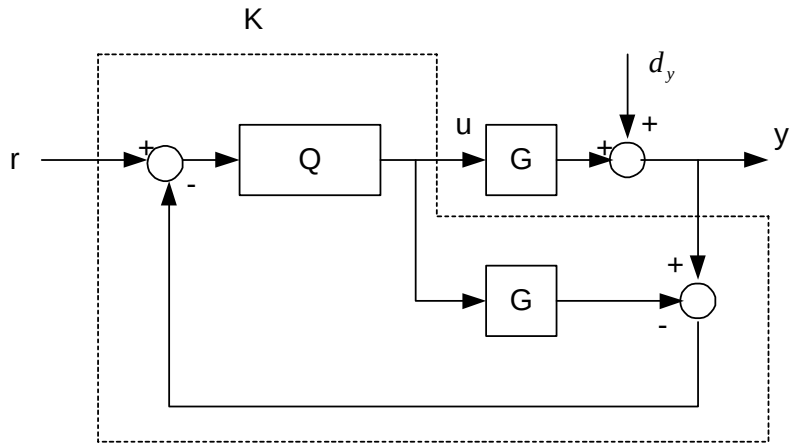
ELEC-E8116 Model-based control systems /exercises 9

Problem 1: Consider the following IMC-control configuration, in which the process G is assumed stable.



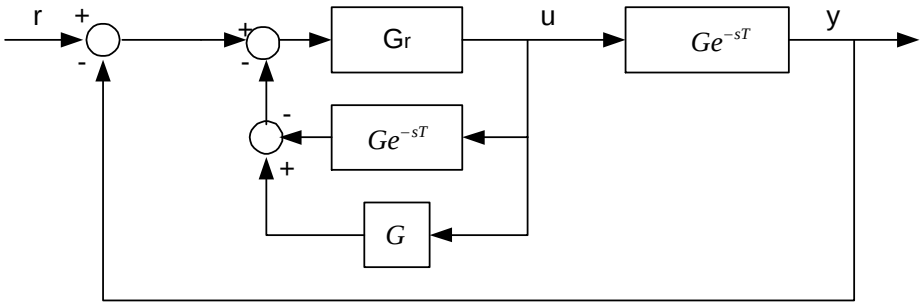
a. Prove that to study the internal stability, the stability of the transfer functions

$$K(I+GK)^{-1} = Q$$
$$(I+GK)^{-1} = I - GQ$$
$$(I+KG)^{-1} = I - QG$$
$$G(I+KG)^{-1} = G(I-QG)$$

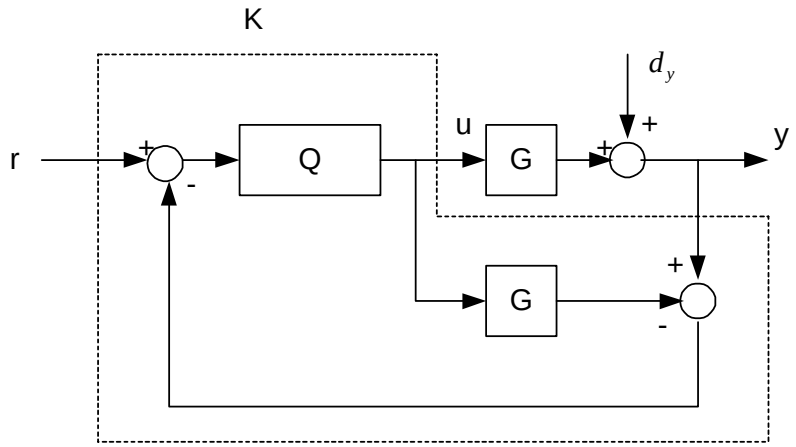
must be investigated. Prove that the system is internally unstable, if either Q or G is unstable.

b. Let a stable controller K be given. How can you characterize those processes, which can be stabilized with this controller? (Hint: Change the roles of the controller and process.)

Problem 2. Consider the control configuration shown in the figure (known as the *Smith-predictor*). Calculate the closed loop transfer function and verify the idea behind this controller. Compare to the *IMC*-controller and prove that the Smith predictor always leads to an internally unstable system, if the process is unstable.



Problem 3. Consider the IMC control structure, which is used to control a stable and minimum phase SISO process *G*.



Note that in addition to the reference *r* a disturbance signal d_y is modelled to enter at the output of the process. By using the IMC design discussed in the lectures analyse the response to step inputs at *r* and d_y.