University Badji Mokhtar-Annaba
Department of Electronics
3rd year License in Automatique L3 (S5)
Academic year: 2025/2026

TP on Linear Systems Control (CSL)

TP 2 Study and synthesis of regulators in the frequency domain

Part 1: Proportional Controller (P)

Objective of the Lab

This lab aims to understand the effect of the actions of a proportional P controller in the frequency domain. Context: This lab aims to understand the effect of a proportional P controller in the frequency domain. We will use Matlab/Simulink software to simulate the P controller. Context: We will use Matlab/Simulink software to simulate the P controller. Definitions:

The transfer function of the corrector

$C(p) = K_p$ with K_p a positive constant.

Effect on Gain

$$|FTBO_C(j\omega)|_{db} = 20log(K_P\,.\,|FTBO(j\omega)|)$$

$$|FTBO_C(j\omega)|_{db} = 20\log(K_P) + |FTBO(j\omega)|_{db}$$

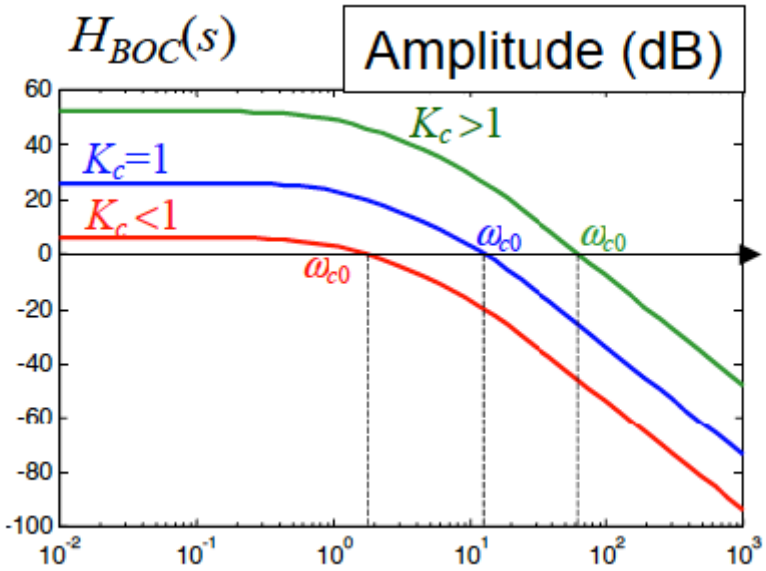
Effect on phase

$$arg(FTBO_C\,(j\omega)) = arg(K_P\,.FTBO(j\omega))$$

$$arg(FTBO_C\,(j\omega)) = arg(K_P) + arg\ FTBO(j\omega)$$

$$arg(FTBO_C\,(j\omega)) = 0 + arg\ FTBO(j\omega)$$

Aucun effet sur la phase



The corrector is a simple adjustable gain amplifier C(p) = Kp whose mission is to modify the initial static gain of the system. The influence of the static gain on the performance can be deduced from the Bode diagram illustrated in Figure 1:

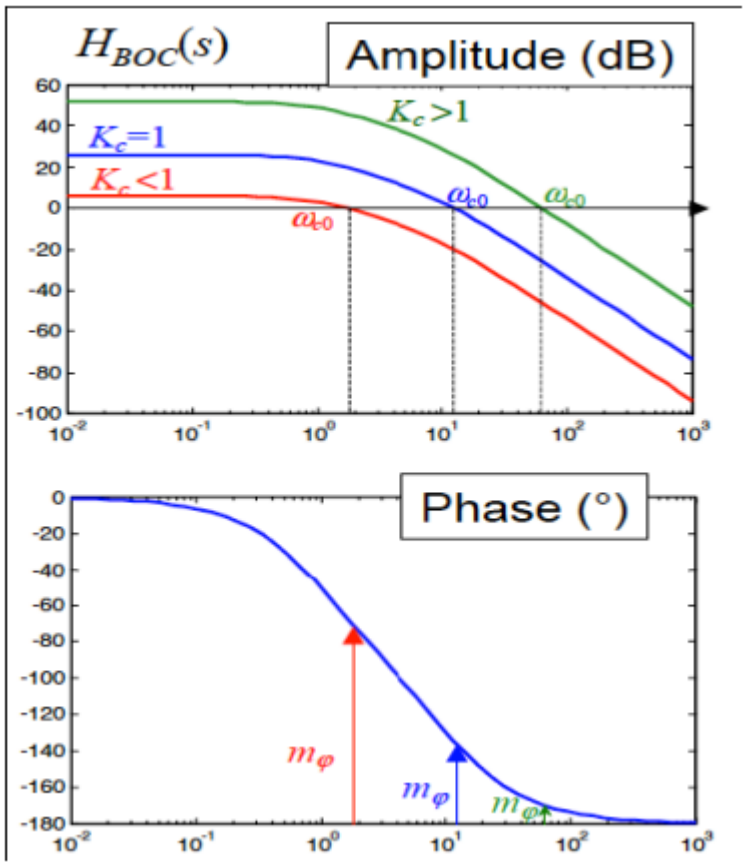


Figure 1 Influence of static gain on performance

Characteristics of the proportional controller:

Kp>1 Translation of the gain upwards
KP<1 Translation of the gain downwards ++ Acceleration of the system's dynamics
Decrease in stability Kp>1
Impossibility of simultaneously adjusting precision and dynamic performances

Decrease in stability (illustration)
The larger Kp is, the "faster" and more precise the system is, but the smaller the phase margin in BO becomes.

Manipulation :
With Matlab/Simulink software, program in an m-file the system given by the transfer function of the following system:

$$G(p) = \frac{1}{p^2 + 3p + 3}$$

1. *Simulate the system in open loop BO.*
2. *Plot the step response of the system G(p)*
   What can we observe?
3. *Simulate the closed-loop system BF with unity feedback F(p)*
   Plot the system's response.
   What can we notice?
4. *Insert a corrector C= Kp*
5. *Plot the response of the system with the closed-loop controller. Fc(p).*
   What can we notice
6. *Plot the Bode diagram of the system F(p) and Fc(p),*
   We want to speed up the system, what can we do?
7. *What conclusion can you draw about the performance of the P regulator? What conclusion can you draw about the performance of the P controller?*

   Work to do:

   Redo the same work with this function H(p):

$$H(p) = \frac{1}{p^2 + 2p + 12}$$