Lab 3 – Analysis with Bode Plots

XMUT315 Control Systems Engineering

Laboratory 3 - Analysis with Bode Plots

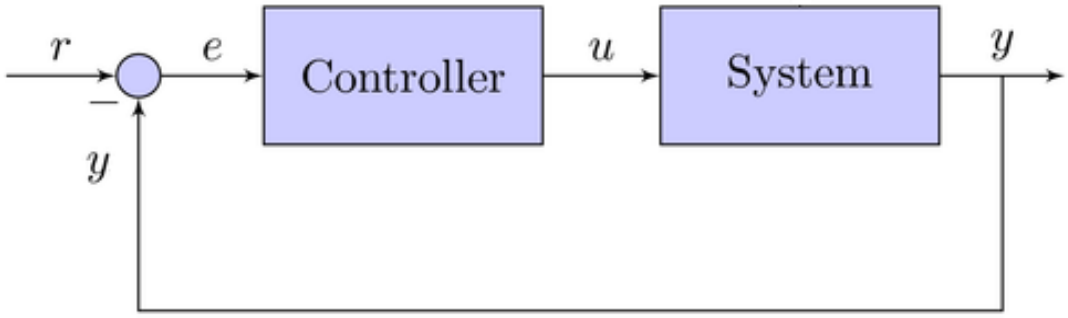
1. Controllers and compensators.
2. Analysis with Bode plots.

1. There are a number of standardised controllers and compensators in control systems (see the appendix section). You are given the open-loop transfer function of a unity feedback control system as shown below.

$$G(s) = \frac{1}{(s^2 + 10s + 20)}$$

   a. Simulate the step response of the system in Matlab and describe at least two issues experienced by the system. [10 marks]

   b. By using simulation in Matlab, describe how any of these controllers listed below when implemented as shown in the figure below are able to influence the system:



i. Proportional controller. [10 marks]
ii. Derivative controller. [10 marks]
iii. Integral controller. [10 marks]

c. Like part (b), replacing the controller with compensator, by using simulation in Matlab, describe on how any of the compensators listed below are able to influence the system:

i. Lag compensator. [10 marks]
ii. Lead compensator. [10 marks]

2. A system has the open-loop transfer function:

$$G(s) = -\frac{500(s - 2000)}{(s + 100)(s + 1000)}$$

   a. Sketch the Bode plots of the system by hand. [15 marks]

   b. Simulate the Bode plots and gain and phase margin of the system in Matlab. [10 marks]

   c. From results of parts (a) and (b), what are the gain margin, phase margin and unity gain frequency of the system? The presence of the non-minimum phase zero makes this system somewhat challenging. How does the presence of this zero make things tricky? Compare and discuss the differences between results of sketching and simulation. By referring to the results that you obtained, describe at least two differences of manual sketching and simulation of the system. [15 marks]