ELEC 341 – Graded Assignments

Assignment A8
PI-Control & Phase Margin

10 Marks

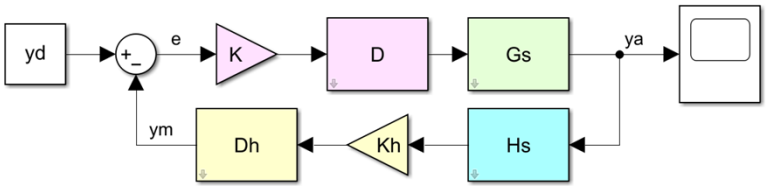
Learning Objectives

PI (Lag) Control
Gain & Phase Margins
Nyquist Plots

Matlab
nyqlog()

*In Fig 1, a controller **KD** controls a system **Gs** using a sensor **Hs**.*
***Gs** and **Hs** have the Open-Loop characteristics specified in Assignment #6.*
*The micro-controller ISR executes at the Control Frequency **CF** specified in Assignment #7.*
*The weighted-sum filter **Dh** designed in Assignment #7 is used to address sensor noise.*

Figure 1



The application of the control system has the following RCGs:
Requirement ***GOS** = 10%*
***Ess** = 0*

Q1 2 mark(s) PI-Controller Design #1

Design a PI-controller that cancels the most dominant real **system** pole and satisfies the RCGs.
Specify the master gain **K** , proportional gain **Kp**, phase margin **Pm,** and settle time **Ts**.

- Q1.K (V/m) Scalar
- Q1.Kp (pure) Scalar
- Q1.Pm (deg) Scalar
- Q1.Ts (ms) Scalar

Q2 2 mark(s) PI-Controller Design #2

Design a PI-controller that cancels the 2nd most dominant real **system** pole and satisfies the RCGs.
Specify the master gain **K** , proportional gain **Kp**, phase margin **Pm,** and settle time **Ts**.

- Q2.K (V/m) Scalar
- Q2.Kp (pure) Scalar
- Q2.Pm (deg) Scalar
- Q2.Ts (ms) Scalar

What phase margin is needed to satisfy the RCGs ???
How much does it change when the zero is moved ???

Use the Nyquist zero optimization method to choose the zero location.
*Tune the master gain **K*** to satisfy the RCGs.

Q3 3 mark(s) PI-Controller Design #3

Specify the master gain **K**, proportional gain **Kp**. and settle time **Ts**.

- Q3.K (V/m) Scalar
- Q3.Kp (pure) Scalar
- Q3.Ts (ms) Scalar

Does the choice of controller zero have a significant effect on settle time ???
Which method delivers the best results ???

Q4 3 mark(s) PD-Controller Design

Design a PD-Controller using the RCGs from Assignment #7.
Specify the master gain **K** , derivative gain **Kd**, and steady-state error **Ess**.

- Q4.K (V/m) Scalar
- Q4.Kd (pure) Scalar
- Q4.Ess (%) Scalar

Did Nyquist zero optimization improve steady-state error for PD-Control ???