ENG 4550 – Introduction to Control Systems
Lab 7

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Lab 7: SRV02 Speed Control
– Step Response with LEAD Control

Week of	Activity	Student Workbook	Items Due (Before Lab Session)
3-Sep-18	No Labs, First Week of Classes		
10-Sep-18	Tutorial 1: Introduction to Matlab		
17-Sep-18	Tutorial 2: Introduction to Simulink		
24-Sep-18	**Tutorial 3: SRV02 QUARC Integration presented by Arman Molki of Quanser Inc.** Tuesday, September 25th, 2018, LSB 103, 10:00 am – 11:30 am		
1-Oct-18	Lab 1: SRV02 Modeling Part 1 – Frequency Response Experiment	Section 1.3.1	Sec 1.2 Pre-Lab Questions
8-Oct-18	No Labs, Reading Week		
15-Oct-18	Lab 2: SRV02 Modeling Part 3 – Bump Test & Model Validation Experiment	Section 1.3.2 Section 1.3.3	
22-Oct-18	Lab 3: SRV02 Position Control – Step Response Using PV Controller	Section 2.3.1	Lab 1/2 (Single Report Only) Sec 2.2 Pre-Lab Questions
29-Oct-18	Lab 4: SRV02 Position Control – Ramp Response Using PV Controller	Section 2.3.2	Lab 3 Report
5-Nov-18	Lab 5: SRV02 Position Control – Ramp Response v	Section 2.3.3	Lab 4 Report
12-Nov-18	Lab 6: SRV PI Step Res		
19-Nov-18	Lab 7: SRV02 Speed Control Part 2 – LEAD Step Response	Section 3.3.2	Lab 6 Report
26-Nov-18	Make Up Lab Sessions (if necessary)		Lab 7 Report
3-Dec-18	No Labs, Last Week of Classes		

If you need the make-up lab session, please email Dr. Ti Chen (tichen@yorku.ca)

What we have done in Lab 6

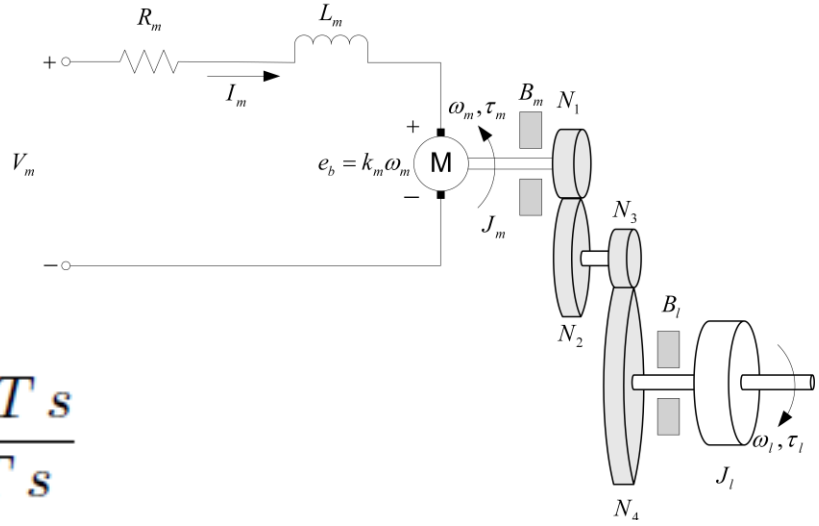
SRV02 Speed Control – Step response with PI control

$$P(s) = \frac{K}{\tau s + 1}$$

$$V_m(t) = k_p \left(b_{sp}\,\omega_d(t) - \omega_l(t)\right) - k_i \int \left(\omega_d(t) - \omega_l(t)\right) dt$$

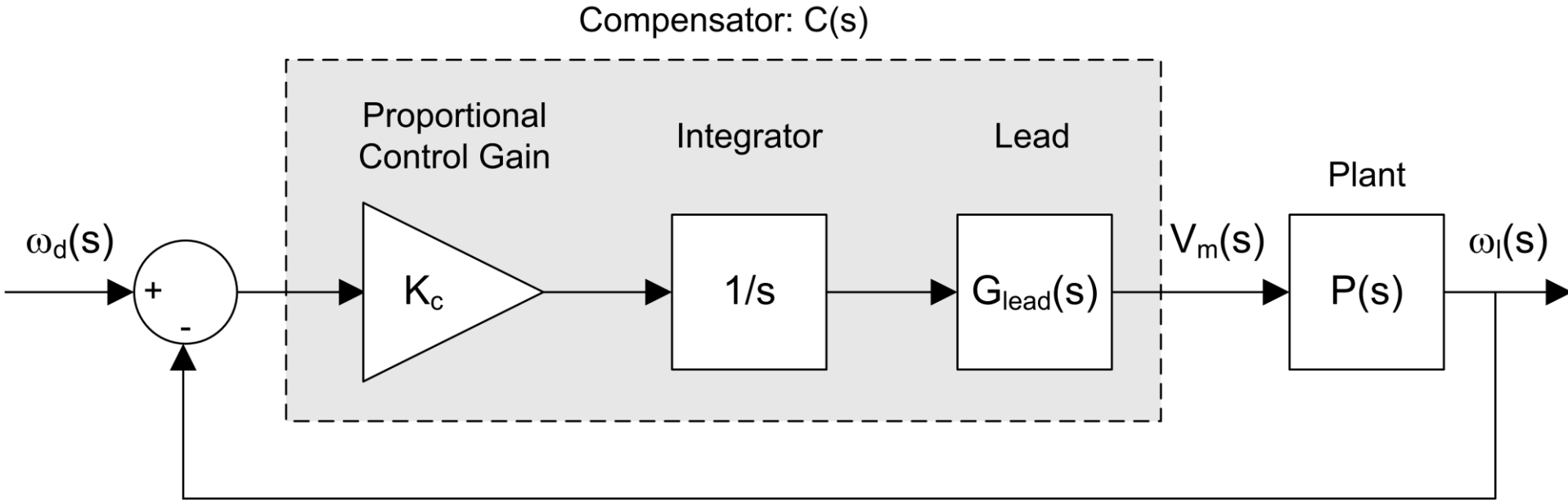
Lab 7

Design a lead compensator with an integrator: Step Response with LEAD Control



$$P(s) = \frac{K}{\tau s + 1}$$

$$G_{lead}(s) = \frac{1 + aTs}{1 + Ts}$$



Submission of next week

1. Lab report (Lab 7)

- Finish your lab report according to the template in Section 3.5.2 and tips in Section 3.5.3.

II. RESULTS

Do not interpret or analyze the data in this section. Just provide the results.

1. Response plot from step 9 in Section 3.3.2.1, *Step response simulation with Lead Control*
2. Response plot from step 9 in Section 3.3.2.2, *Step response implementation with Lead Control*
3. Provide data collected in this laboratory (from Table 3.1).

Submit this lab report to your TA before the same time of next week

Submission of next week

Section / Question	Description	Symbol	Value	Unit
Question 2	**Pre-Lab: PI Gains**			
	Proportional Gain	k_p		
	Integral Gain	k_i		
	Open-Loop Time Constant	τ		
	Open-Loop Steady-state Gain	K		
Question 4	**Pre-Lab: DC Gain Estimate**			
√	DC Gain Estimate of $P_i(s)$	$\lvert P_i(1)\rvert$		
Question 5	**Pre-Lab: Gain Crossover Frequency**			
√	Gain crossover frequency	ω_g		
Section 3.3.1.1	**In-Lab: PI Step Response Simulation**			
	Peak time	t_p		
	Percent overshoot	PO		
	Steady-state error	e_{ss}		
Section 3.3.1.2	**In-Lab: PI Speed Control Implementation**			
	Measured peak-to-peak ripple	$e_{\omega,meas}$		
	Steady-state error	e_{ss}		
	Peak time	t_p		
	Percent overshoot	PO		
Section 3.3.2.1	**In-Lab: Step Response Simulation with Lead Control**			
√	Peak time	t_p		
	Percent overshoot	PO		
	Steady-state error	e_{ss}		
Section 3.3.2.2	**In-Lab: Lead Speed Control Implementation**			
√	Peak time	t_p		
	Percentage overshoot	PO		
	Steady-state error	e_{ss}		

Lab 7

- In ‘ENG4550 control systems’ on desktop, unzip ‘Lab MatlabSimulink Software-20181001.zip’ to a NEW DIRCTORY. All files you need in Lab 7 are in …/NEW DIRCTORY/Speed Control (Labs 6 and 7)
- When complete, DELETE/REMOVE your files and the FOLDER you created.

Simulation

1. Configuring the SRV02 according to Section 3.4.2.

- In setup_srv02_exp03_spd.m, make sure CONTROL_TYPE is set to '**MANUAL**'. Run setup_srv02_exp03_spd.m.

2. Follow the steps in 3.3.2.1 Simulation.

Experimental test

1. Configuring the SRV02 according to Section 3.4.3.

- Setup q_srv02_pos.mdl: Double-click on the QUARC HIL Initialize block. Select the data acquisition device (q2_usb or q8_usb) you are using. Click on the **Defaults** and **OK** button.
- In setup_srv02_exp03_spd.m, make sure CONTROL_TYPE is set to '**MANUAL**'. Run setup_srv02_exp03_spd.m.

3. Follow the steps in 3.3.2.2 Implementing LEAD Speed Control.

- Before building the model (Step 7), click QUARC -> Set Default Options to avoid the possible target error.