WEEK 12 PI CONTROL THEORY & MODELLING

Week 12 Report

Oral presentations and submission of report.

Objectives

To observe the operation and behavior of your system's approximate linear FOPDT model with PI control. To observe the effect of the value of the proportional feedback gain, K_C and the integral time, τ_I. To observe the limits of stable operation of the closed loop system. To observe the response of a closed loop controlled system to a set point change. To tune the controller for quarter decay response.

Reference: Smith & Corripio, pp 163-168, 318-319

The quarter decay tuning parameters for a PI controller can be derived from Smith & Corripio, table on page 212 or 225. Use these values to see how your approximate model behaves with PI control.

Run your approximate linear FOPDT model with a much larger value of K_C to see what impact that has on the response. Same for a much smaller value of K_C. Same for τ_I.

Useful things to do with MATLAB: Plot the root locus for the problem. Label with the values of Kc on the Root Locus plot where the breakaway and crossover are. Draw the line from the origin to the point where Kc gives "quarter decay."

When you include MATLAB work: In the Theory section, include material that shows what you're doing and any work you do in preparation for MATLAB calculations. In the Appendix of your report, put tables of your input, results and the raw plots.

Disk File Suggestion: For all your data files that you save this week, start their names with "W12" (meaning week #12)

WEEK 13 PI CONTROL EXPERIMENT

Objectives

To observe the operation and behavior of your PI control system design. To observe the effect of the value of the proportional feedback gain, K_C and the integral time, τ_I. To observe the limits of stable operation of the closed loop system. To observe the response to a closed loop controlled system to a set point change and a disturbance input (as appropriate). To tune the controller with approximate modelling results for quarter decay response. To observe reset windup.

Reference: Smith & Corripio, pp 226-234

PROCEDURE FOR RUNNING THE PI CONTROLLER

Prepare system for operation

Open LabVIEW program labelled "(PI)". This program emulates a proportional-integral feedback controller. You should get a panel somewhat like the one shown in Figure 21.

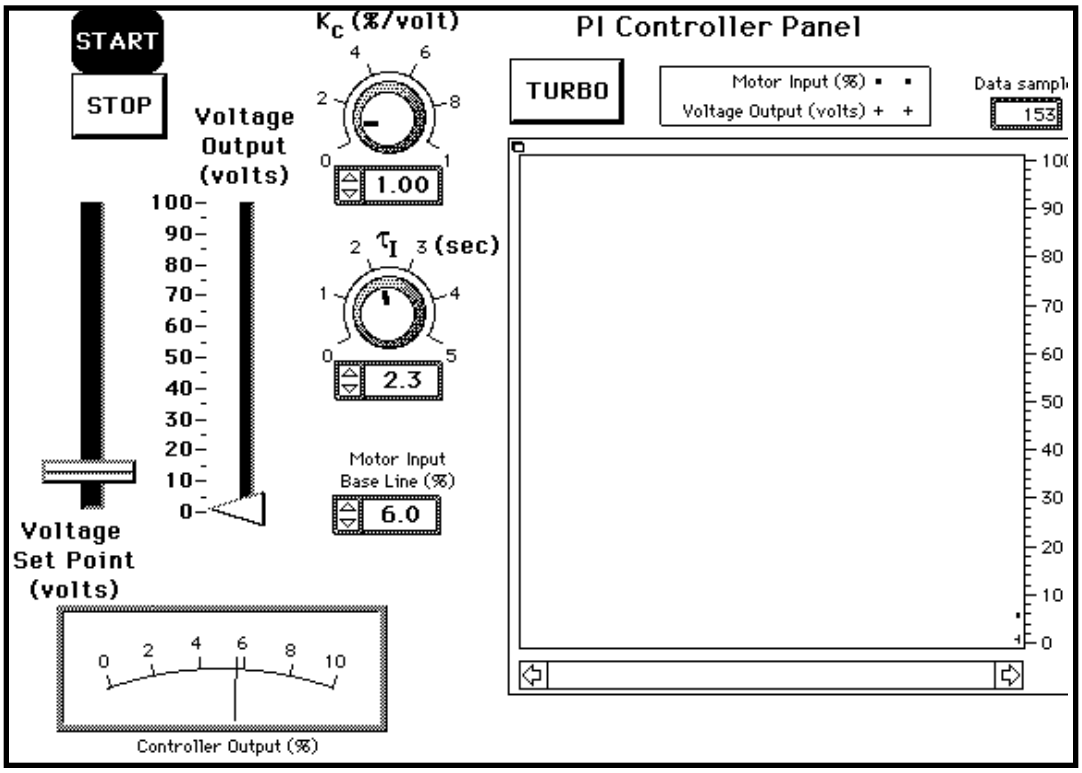

Figure 21. PI automatic controller panel

Again on this panel, you put the "set point" with the control slide on the left. The "set point" is the value you want for the output variable. Set the

values you want for K_c, the proportional controller gain, and τ_I, the integral or reset time, with the knobs or in the appropriate windows. Click on the RUN arrow.

Choose the values of K_c and τ_I that your theory and approximate modelling predict will be good for you system. You can observe the system's response to a step change in set point by changing the set point. You can observe the system's response to a disturbance by changing disturbance input.

Using the values of K_c and τ_I that your approximate modelling results gave for various system responses, observe the experimental system responses for the equivalent experiments.

Observe reset windup by choosing a set point that is about 5% to 10% below the maximum operating point & then starting the LabVIEW program.

Useful things to do with MATLAB: Plot the root locus for the problem. Label with the values of Kc on the Root Locus plot where the breakaway and crossover are. Draw the line from the origin to the point where Kc gives "quarter decay."

When you include MATLAB work: In the Theory section, include material that shows what you're doing and any work you do in preparation for MATLAB calculations. In the Appendix of your report, put tables of your input, results and the raw plots.

Disk File Suggestion: For all your data files that you save this week, start their names with "W13" (meaning week #13)

Week 14 Report

A draft of Week 14 Report is due the second school day before the next scheduled lab meeting.

WEEK 14 REPORT CONTENTS
PI CONTROLLER PERFORMANCE

Introduction	
Theory	Description & explanation of system components & connections Schematic diagram Input function(s) and output function Theory & governing equations for components, system and PI feedback controller Time domain and Laplace domain descriptions, OLTF, CLTF, characteristic equations, K_{cu}, ω_u Quarter decay tuning parameters from theory Block diagram. Root locus plots Previous system results (gain, time constant, etc.)
Modelling	Equations & methods used in modelling
Results	Performance of experimental system with PI control Modelling results for PI control
Discussion	Comparison of theory, modelling and behavior of experimental system responses with PI control
Conclusions	
Recommendation	
Appendices	Physical properties Modelling diagram, equations
Attachments	Include a sheet for each team member that describes the contribution to the work in the laboratory since last reported.

WEEK 14

Week 14 Report

Oral presentations and submission of report.

REJOICE