Worksheet: PID Control

Learning Objectives

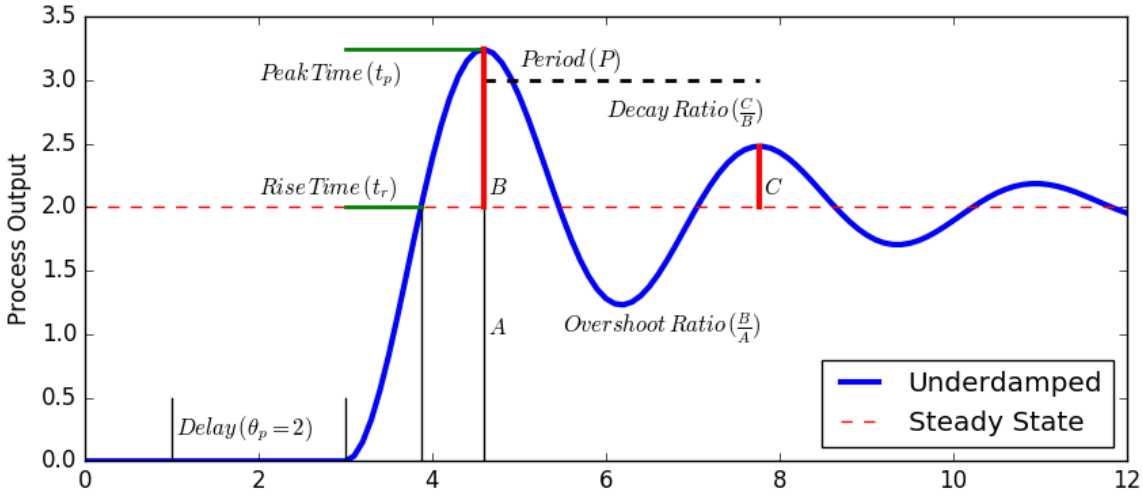
• Implement a PID control strategy on an interacting two-heater system (TCLab).
• Design and tune PID controllers for interacting processes.
• Analyze closed-loop performance.

Estimated Time Allocation (≈60 minutes)

Section	Task	Time
1	Background & Setup	10 min
2	Controller Design & Implementation	25 min
3	Closed-loop Testing	20 min
4	Reflection & Reporting	5 min

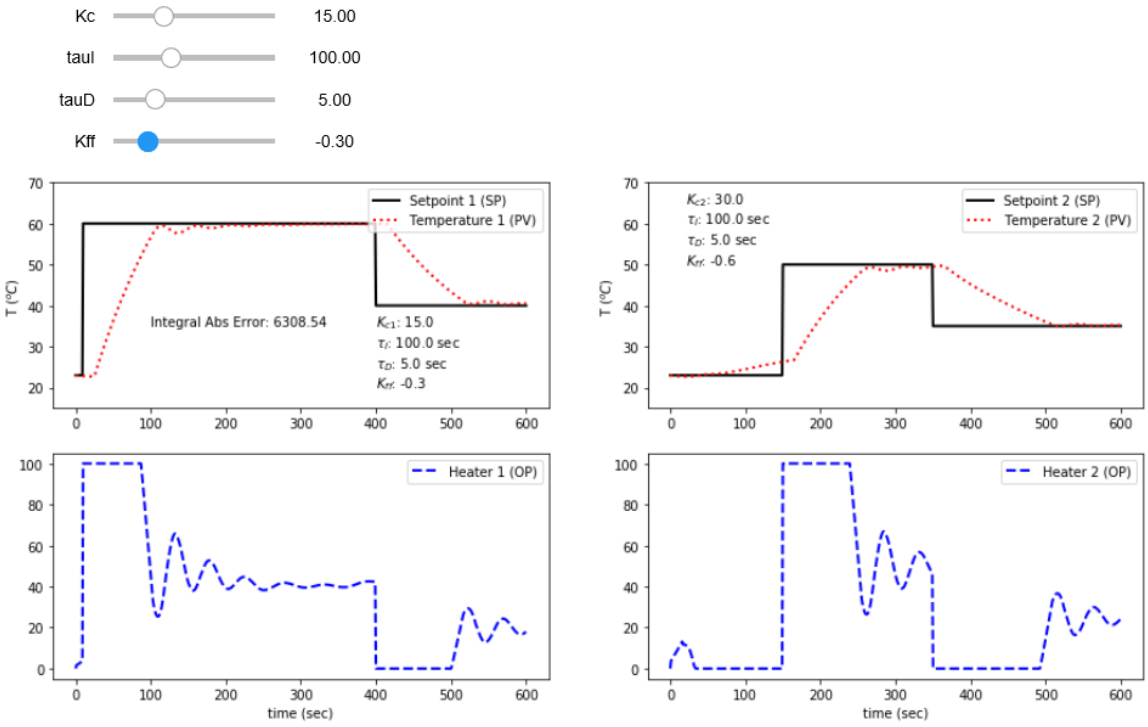
1. Background & Setup (10 min)

a. Review the interacting system with two heaters (T1 and T2). Note how heater 1 and heater 2 interact through convective and radiative heat transfer.
b. Recall the concept of PID control (Proportional, Integral, Derivative) and how each term influences response.
c. Define the control objectives
- Maintain temperature at setpoint and minimize heater (actuator) changes
- Quantify controller performance



2. Simulated Controller Design & Implementation (20 min)

a. Open the interactive simulation at:
https://apmonitor.com/pdc/index.php/Main/ArduinoControl2



b. Tune PID controllers for T1 and T2.
- Adjust K_C, τ_I, τ_d, and K_{ff}.
- Record performance (MAE for Setpoint Tracking):_____

3. Closed-loop Testing (25 min)

a. Test PID Control with TCLab Hardware.
b. Record responses of T1 and T2 with PID control.
c. Evaluate performance:
- Record performance (MAE for Setpoint Tracking):_____

4. Reflection & Reporting (5 min)

Write a short (2–3 sentences) reflection:
• What are the specific response characteristics that are desirable for this PID controller?

• Suggest one improvement to the controller design.

Quick Checklist

[ ] PID parameters recorded
[ ] Closed-Loop Step response plots included
[ ] MAE recorded for simulated and TCLab PID control
[ ] Reflection written