Merton/Sfwr Eng 4AA4

lab 5

PID Controller

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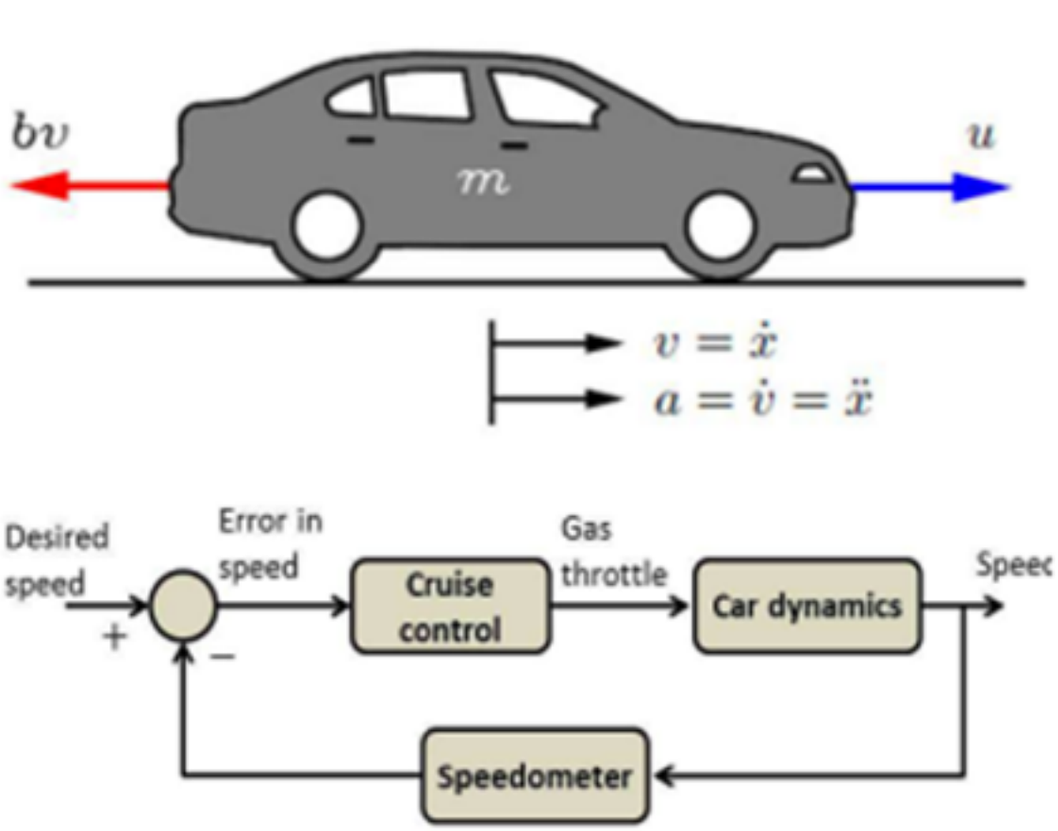
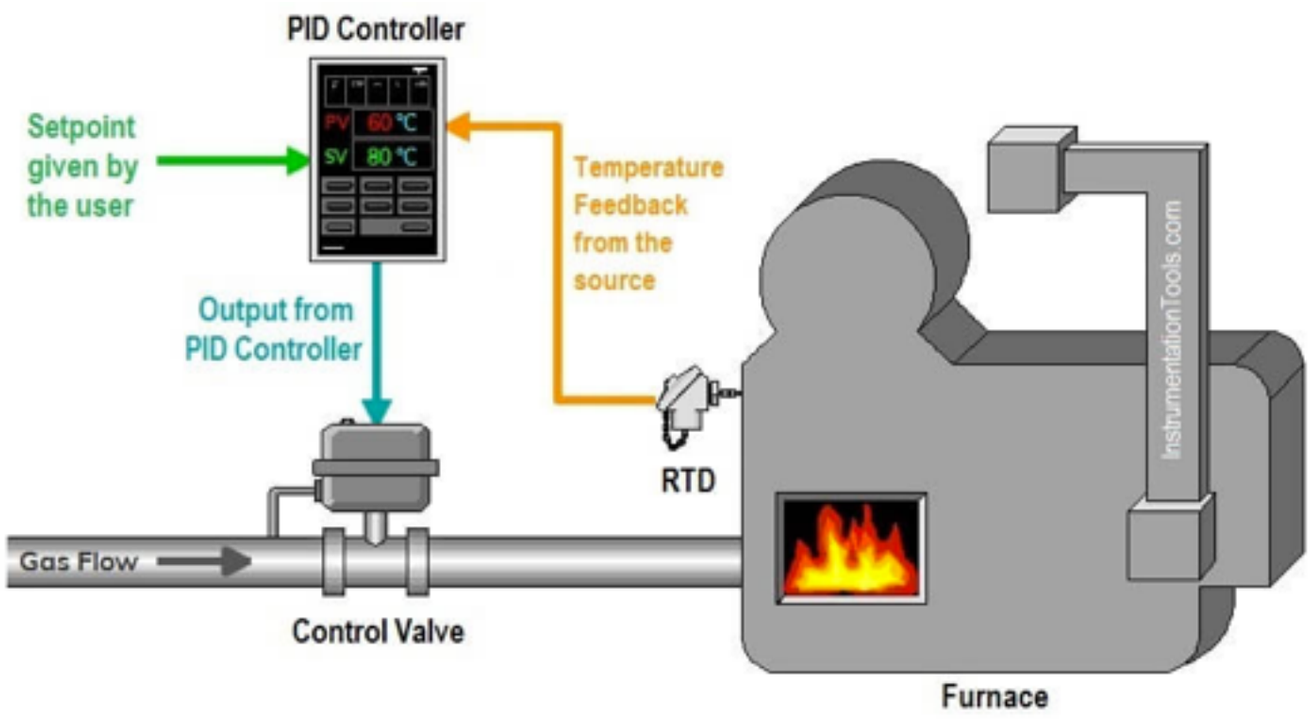
Introduction

- A PID controller is an instrument used in industrial control applications to regulate temperature, flow, pressure, speed and other process variables. PID, which stands for proportional integral derivative, controllers use a control loop feedback mechanism to control process variables and are the most accurate and stable controller.



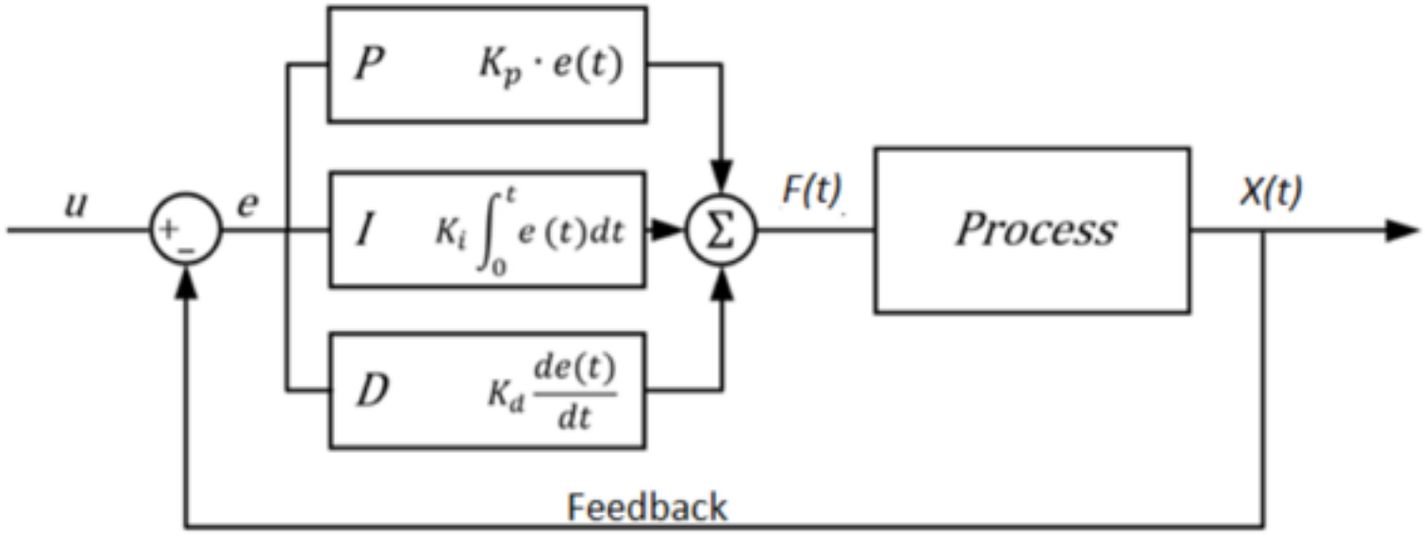
Cruise Control



Temperature Control

Introduction

DC motor:
Speed is controlled by voltage level.
Moving direction is controlled by voltage direction.
Clockwise: Positive volt
Anticlockwise: Negative volt



u: Set point, or target position degree
x(t): potentiometer reading, feedback degree
f(t): the volt value output to the DC motor

In time domain, a PID controller can be represented by the following differential equation:

$$F(t) = K_p e(t) + K_i \int_0^t e(\eta) d\eta + K_d \frac{de(t)}{dt}$$

$F(t)$ = PID control variable
K_p = proportional gain
$e(t)$ = error value
K_i = integral gain
de = change in error value
dt = change in time

After Euler's approximation

$$F(k) = K_p e(k) + K_i T \sum_{i=1}^{k} e(i) + \frac{K_d}{T}(e(k) - e(k-1))$$

Check instruction for details.

Goals and Preparations

- **Goal:** Learn how to simulate a PID controller and a DC Motor using Matlab and Simulink for determination of suitable values for Kp, Ki and Kd of the PID controller.

- **Preparations**:

  - http://en.wikipedia.org/wiki/PID_controller

  - http://igor.chudov.com/manuals/Servo-Tuning/PID-without-a-PhD.pdf

  - https://www.mathworks.com/products/simulink.html

  - https://www.mathworks.com/help/

Note:

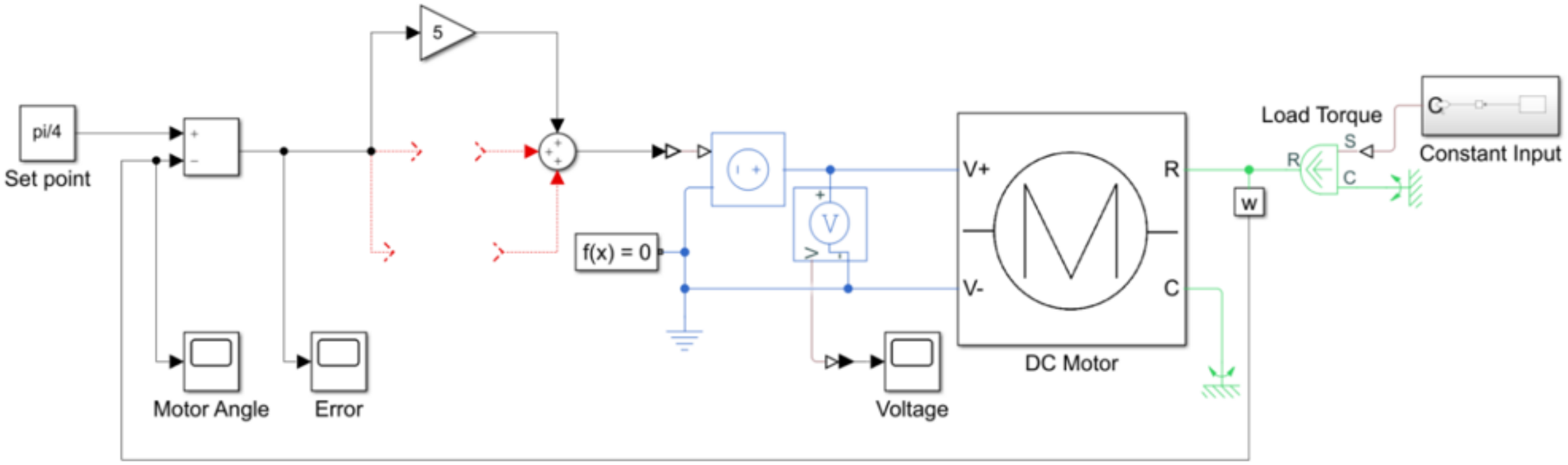
"If you are using your own personal computer, before staring the lab, **MATLAB 2020a** or 2020b and **SIMULINK** library are needed to be installed. **Lower versions of MATLAB will not work for this lab.** McMaster is providing free academic licence of MATLAB for students:

https://uts.mcmaster.ca/services/computers-printers-and-software/software-licensing/matlab/

They are already installed in the desktops of ITB235 as well."

Or use the online website https://matlab.mathworks.com

Contents: PID Controller and DC motor



- Run the simulation code.
- Fill the Integral and Derivative block.
- Modify the Kp, Ki, Kd to find the best one.

DC motor:
Speed is controlled by voltage level.
Moving direction is controlled by voltage direction.
Clockwise: Positive volt
Anticlockwise: Negative volt

Marking scheme

- Completed the PID controller. (**25%**)
- A table that shows the selected Kp, Ki and Kd values, along with the overshooting and the final value at each step. (**25%**)
- A screenshot of final Motor Angle result. Your final simulation should not be worse than the result in instruction, where the max overshooting value is 0.8168, the final value is 0.7403 and there is only 1 obvious oscillation of the angle. (**25%**)
- Explanation of your observation from the effect of changing Kp , Ki and Kd on the system response: (**25%**)

Save your report in a PDF file named "your macid.pdf"and upload it in Avenue
(Every one in group should send the report)

Thank you