Intelligent Robot Studio
From Theory to Practice

Homework 3

Motion Control

A. Theory

Question 1

The orientation θ of a robot overtime is given as follows:

Time step	orientation
$t_0 = 0$ s	$\theta_0 = 0^0$
$t_1 = 0.5$ s	$\theta_1 = 4^0$
$t_2 = 1$ s	$\theta_2 = 10^0$
$t_3 = 1.5$ s	$\theta_3 = 25^0$

Assume that the current time step is t_3 and the robot is being driven by a PID control to reach the goal having the orientation $\theta_g = 45^0$. Find

a) The sampling period of the controller
b) The control signal c_p contributed by the Proportional component: $c_p = K_p e_p$ where e_p is the proportional error and $K_p = 5$.
c) The control signal c_I contributed by the Integral component: $c_I = K_I e_I$ where e_I is the integral error and $K_I = 2$.
d) The control signal c_D contributed by the Derivative component: $c_D = K_D e_D$ where e_D is the derivative error and $K_D = 3$.
e) The total control signal being used as the control input

Question 2

Find the feedback control laws for *v* and *w* of a differential drive mobile robot to drive it from the current pose (-6, -4, 45^0) to the goal (1, 1, 0^0) given the control parameters (γ, λ, h)=(3, 6, 1).

Question 3

A car-like robot is at the location (1,3) with its direction following the x axis. Calculate its steering angle to reach the goal location (10,8) using the pure pursuit method.

B. Practice

Write a program to control the robot from its start position (0,0,0) to the goal position (1,1,0) using two different methods:

- Feedback control laws
- PID

Comments on the accuracy of the result and explain possible cause of errors.