TI-RSLK MAX

Texas Instruments Robotics System Learning Kit

Texas Instruments

Module 17

Quiz: Control Systems

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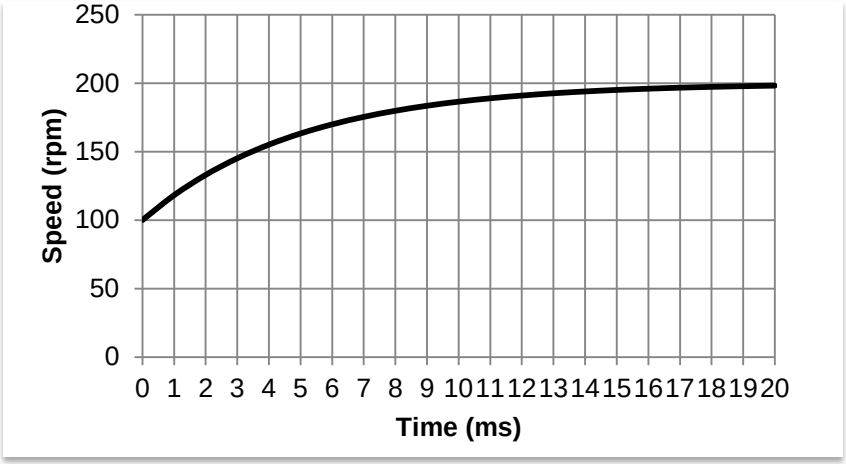
Q1 Controller

The following shows the speed response of a motor given a step change in duty cycle. The speed changes from 100 to 200 rpm.



Part a) What is the time constant of the motor? Explain how you determine this value

Part b) What time between executions of the digital software is needed to control this motor?

Q2 Fixed point

Let r be the radius of a circle, defined as a fixed point number with constant Δ=0.01 cm. Let R be the integer part of the fixed point number. In other words, if r =1.23cm, then the integer R is 123. Let a be the area of a circle, defined as a fixed point number with constant Δ=0.001 cm^2. Let A be the integer part of the fixed point number. In other words, if A = 4.752916 cm^2, then the integer A is 4753. Write C code that calculates the area of the circle, given R. In other words, let R be the input and A be the output of this C code.

Q3 Definitions

In 32 words or less, define each of these terms

Part a) Controller accuracy.

Part b) Controller stability.

Part c) Overdamped. Draw a picture to explain

Part d) Underdamped. Draw a picture to explain

Q4 Integral controller

Assume the desired speed is **Sstar** and the estimated speed can be obtained by calling the function with the following prototype

uint16_t Speed(void);

Both estimated and desired speed have units in RPM, with a range of 0 to 500 RPM. The actuator is a PWM circuit with a duty cycle range of 0 (0%) to 1000 (100%). Software sets the duty cycle by calling the function with the following prototype

void PWM_Duty(uint16_t duty);

You will run the digital controller every 1 ms. Show the C code to implement this integral controller

e(t) = Sstar-Speed()
U(t) = U(t) + 13.48*e(t)*Δt
0 ≤ U(t) ≤ 1000

The units of U are duty cycle (0 to 1000). The units of e **Speed()** and **S*** are RPM. The units of **Δt** are seconds (0.001 sec). The units of 13.52 are duty-cycle/RPM/sec.

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