TI-RSLK MAX

Texas Instruments Robotics System Learning Kit

TEXAS INSTRUMENTS

Module 17

Activity: Control Systems

Activity: Control Systems

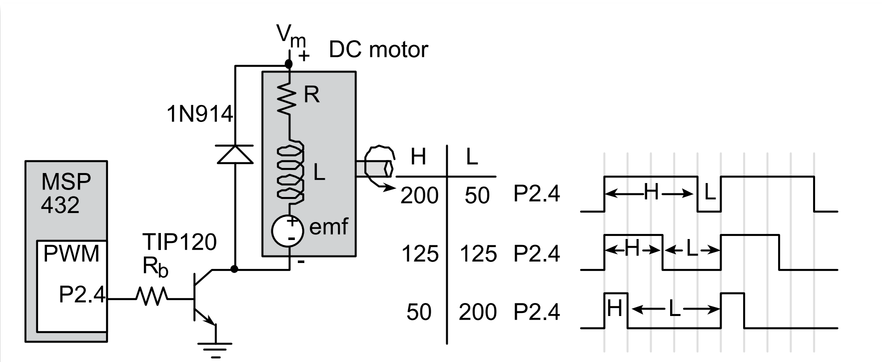
Question 1

In this activity you will design multiple digital controllers. Assume the desired speed is **S*** and the estimated speed can be obtained by calling the function with the following prototype

```
uint16_t Speed(void);
```

Both estimated and desired speed are unsigned 16-bit integers in RPM. The time constant of the motor is 10ms. The actuator is a PWM circuit with a duty cycle range of 0 (0%) to 250 (100%). Software sets the duty cycle by calling the function with the following prototype

```
void PWM_Duty(uint16_t duty);
```



At what rate should the controller run? Let **Δt** be the time between executions of the controller.

Question 2

Using the hardware, **Speed()**, and **PWM_Duty()** functions described in Q1 Show the C code that implements an incremental controller. Make sure to limit the actuator output to between 0 and 250.

Question 3

Using the hardware, **Speed()**, and **PWM_Duty()** functions described in Q1 implement a proportional controller.

$$U(t) = 0.1256 \cdot e(t)$$
$$0 \le U(t) \le 250$$

Question 4

Using the hardware, **Speed()**, and **PWM_Duty()** functions described in Q1 implement an integral controller.

$$U(t) = U(t) + 12.52 \cdot e(t) \cdot \Delta t$$
$$0 \le U(t) \le 250$$

where **Δt** was determined in Q1.

Question 5

Using the hardware, **Speed()**, and **PWM_Duty()** functions described in Q1 implement a proportional-integral controller.

$$U_p(t) = 0.3451 \cdot e(t)$$
$$U_i(t) = U_i(t) + 125.1 \cdot e(t) \cdot \Delta t$$
$$0 \le U_i(t) \le 250$$
$$U(t) = U_i(t) + U_p(t)$$
$$0 \le U(t) \le 250$$

where **Δt** was determined in Q1.

Question 6

Using the hardware, **Speed()**, and **PWM_Duty()** functions described in Q1 implement a proportional-integral-derivative controller.

$$U_p(t) = 0.024 \cdot e(t)$$
$$U_d(t) = 0.000012 \cdot e(t)/\Delta t$$
$$U_i(t) = U_i(t) + 256.7 \cdot e(t) \cdot \Delta t$$
$$0 \le U_i(t) \le 250$$
$$U(t) = U_i(t) + U_p(t) + U_d(t)$$
$$0 \le U(t) \le 250$$

where **Δt** was determined in Q1

ti.com/rslk

Texas Instruments

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265