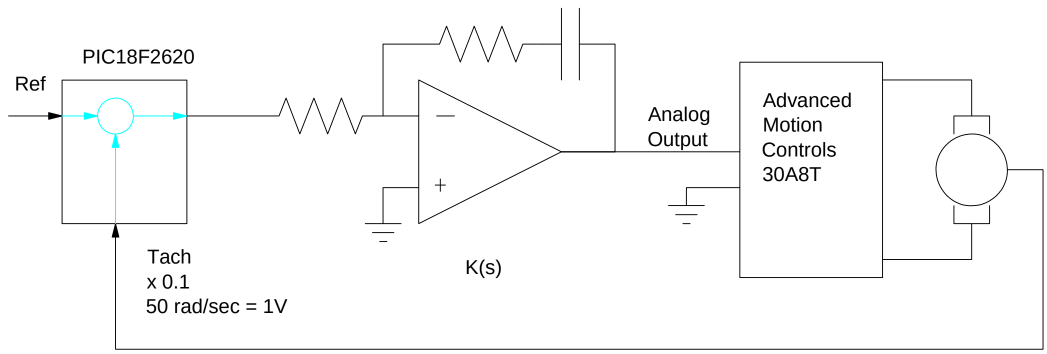
Homework #12: ECE 461

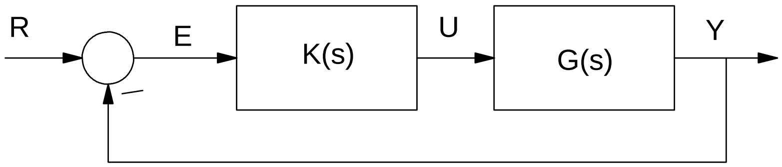
Part 1: Analog PI Control of a DC Motor - Monday November 20th



A DC Servo motor is set up in room 237 with a PIC controller. The PIC serves as a tachometer:

- It measures the speed of the motor using the optical encoder, and
- Outputs a voltage proportional to the error (x 0.1)
- The push-button (Step input) lets you change the set point from -50 rad/sec to +50 rad/sec

If you lump the x0.1 gain for the tachometer along with the power amplifier and motor, the block diagram for this system is then



$$G(s) = \left(\frac{3.2}{s+6}\right)$$

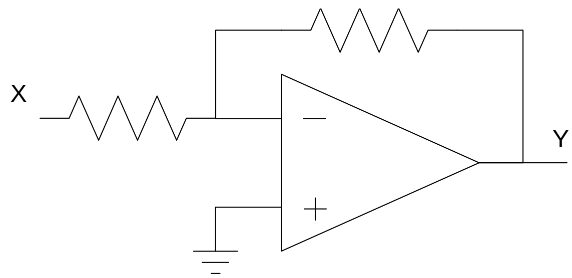
The speed of the motor is output on the serial port at

- 9600 baud
- No flow control
- 20ms / sample (50 samples / second)

If you capture the resulting data and import it into Matlab, you can plot the resulting step responses:

```
DATA = [  <paste data here ];
t = [1 : length(DATA)]'  * 0.02;
plot(t,DATA)
```

Proportional Feedback: K(s) = k



1) Let K(s) = 1

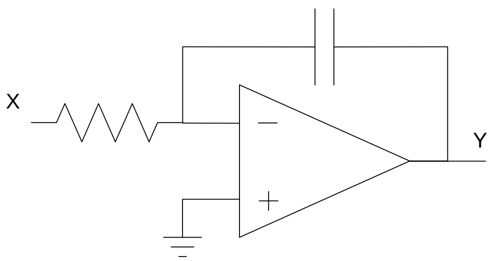
- Determine the resulting closed-loop pole and steady-state error
- Take the step response and verify your calculations

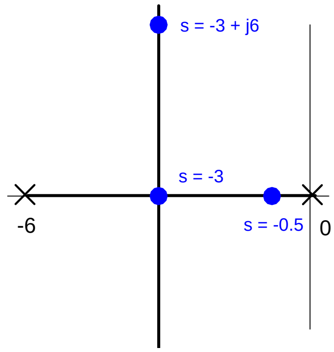
k = 1	Expected (calculated)	Actual (measured)
2% Settling Time		
Steady-State Error		

2) Determine k to place the closed-loop dominant pole at s = -30. Calculate and experimentally determine the following:

k =	Expected (calculated)	Actual (measured)
2% Settling Time		
Steady-State Error		

Integral Feedback: K(s) = k/s





Determine the integral feedback gain to place the closed-loop dominant pole at

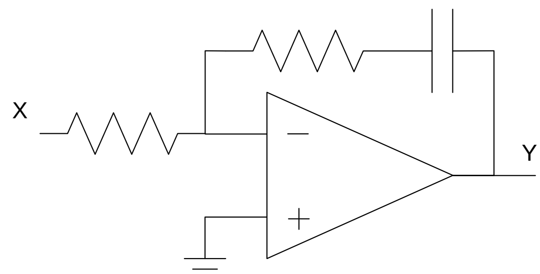
- s = -0.5
- s = -3
- s = -3 + j6

s = -0.5: K(s) =	Expected (calculated)	Actual (measured)
2% Settling Time		
Steady-State Error		
% Overshoot		

s = -3: K(s) =	Expected (calculated)	Actual (measured)
2% Settling Time		
Steady-State Error		
% Overshoot		

s = 3 + j6: K(s) =	Expected (calculated)	Actual (measured)
2% Settling Time		
Steady-State Error		
% Overshoot		

Proportional - Integral Feedback: $K(s) = k(\frac{s+a}{s})$



Determine a PI feedback compensator which places the closed-loop dominant pole at s = -10

s = -10: K(s) =	Expected (calculated)	Actual (measured)
2% Settling Time		
Steady-State Error		
% Overshoot		