Faculty of Engineering
Department of Electrical & Computer Engineering (ECE)

Control Systems (ECE 331)

Experiment No: 08

"Speed Control with Proportional plus Integral (PI) Controller"

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Control Systems ECE 331

Experiment 08
Speed Control with Proportional plus Integral Controller

Contents

1 Modeling:

The open loop transfer function for the dc motor is given by,

$$s(Js+b)\Theta(s) = KI(s)$$
$$(Ls+R)I(s) = V(s) - Ks\Theta(s)$$
$$P(s) = \frac{\dot{\Theta(s)}}{V(s)} = \frac{K}{(Js+b)(Ls+R)+K^2} \qquad \frac{rad/sec}{V}$$

J = 3.2284E-6;
b = 3.5077E-6;
K = 0.0274;
R = 4;
L = 2.75E-6;
s = tf('s');
$Pmotor = K/(s*((J*s+b)*(L*s+R)+K^2));$

Let's first try a PI controller to get rid of the steady-state error due to the disturbance. We will set Kp = 21 and test integral gains Ki ranging from 100 to 500.

Now examine the output graph for the given proportional plus integral controller.
The final script programme as under::

```
clc
clear all


J = 3.2284E-6;
b = 3.5077E-6;
K = 0.0274;
R = 4;
L = 2.75E-6;
s = tf('s');
Pmotor = K/(s*((J*s+b)*(L*s+R)+K^2));

Kp = 21;
Ki = 100;
for i = 1:5
    C(:,:,i) = pid(Kp,Ki);
    Ki = Ki + 200;
end

syscl = feedback(C*Pmotor,1);
t = 0:0.001:0.4;
step(syscl(:,:,1),syscl(:,:,2),,syscl(:,:,3), t)
```

```
ylabel('Position, \theta (radians)')
title('Response to a Step Reference with K_p = 21 and Different Values of K_i')
legend('K_i = 100','K_i = 300','K_i = 500')
```

The graph for the proportional controller as under:

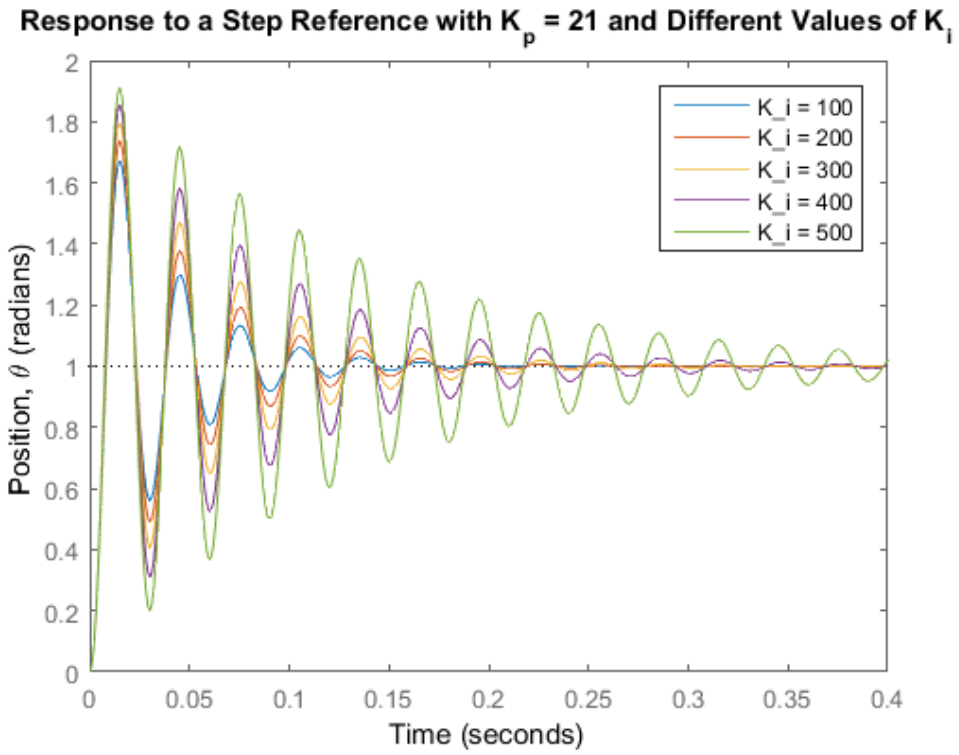

Figure 1: Step input for Proportional plus Integral Controller

Now let's see what happened to the step disturbance response.

```
distcl = feedback(Pmotor,C);
step(distcl(:,:,1), distcl(:,:,2), distcl(:,:,3), t)
ylabel('Position, \theta (radians)')
title('Response to a Step Disturbance with K_p = 21 and Different Values of K_i')
legend('K_i = 100',  'K_i = 300',  'K_i = 500')
```

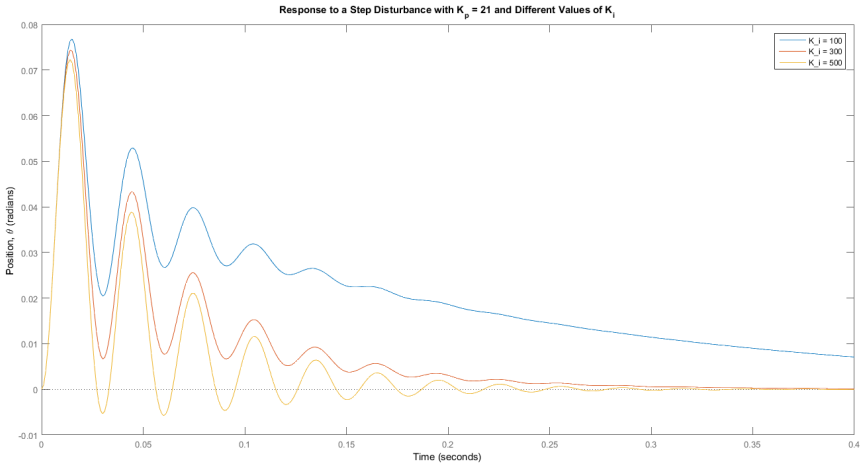

Figure 2: Step input for PI Controller with Disturbance