

# ECE 761: Homework 12: Position Control of a 2-Link Robotic Arm

## Take 1: 300:1 Gear Reduction

Assume a DC servo motor drives a 2-link robotic arm with 300:1 gear reduction. Each link is 1m long with a point mass of 1kg at the tip.

1) Determine the joint angles so that the robot traces out a square with coordinates

- $P0 = (0.1, -0.5)$        $t = 0$
- $P1 = (1.1, -0.5)$        $t = 1$
- $P2 = (1.1, +0.5)$        $t = 2$
- $P3 = (0.1, +0.5)$        $t = 3$
- $P4 = P0 = (0.1, -0.5)$        $t = 4$

PD Control

2) Determine the joint angles if the relationship between the desired angle ( $R$ ) and actual angle is

$$\theta = \left( \frac{2500}{s^2 + 70s + 2500} \right) R$$

3) Plot the actual and desired angle as the robot traces out the square.

PD Control with Feedforward Term ( $sR$ )

4) Determine the joint angles if the relationship between the desired angle ( $R$ ) and actual angle is

$$\theta = \left( \frac{70s + 2500}{s^2 + 70s + 2500} \right) R$$

5) Plot the actual and desired angle as the robot traces out the square.

PD Control with Feedforward Term ( $sR$  and  $s^2R$ )

6) Determine the joint angles if the relationship between the desired angle ( $R$ ) and actual angle is

$$\theta = \left( \frac{s^2 + 70s + 2500}{s^2 + 70s + 2500} \right) R$$

7) Plot the actual and desired angle as the robot traces out the square.