Course outline

Assignment 8

The due date for submitting this assignment has passed.

Due on 2021-03-17, 23:59 IST.

As per our records you have not submitted this assignment.

Problem 1: Pole Placement Control Design

Consider the system from the previous assignment:

$$x(k+1) = \begin{bmatrix} 0.3 & -0.4 \\ 0.4 & 0.25 \end{bmatrix} x(k) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(k)$$

Please answer the following questions.

1) Compute the pole-placement design that gives dead-beat controller. Please report the controller gain matrix `L_db` .

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

0.55	*-0.244*

0.5 points

2) Compute the pole-placement design that gives a controller with one closed-loop pole at `0.25` and another at `0.4` .

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

-0.1	*-0.4*

0.5 points

Problem 2: Steady-State LQR Design

For the system given above, we will design an LQR using the algebraic Ricatti equation in MATLAB, for output and input weights of `Q=I` and `R=1` .

You may use the MATLAB command `idare` (in earlier versions, use `idare`) to solve Ricatti equation or directly obtain LQR solutions in this problem.

3) Compute the LQR gain matrix `L` with $Q = I$ and $R = 1$.

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

0.1745	*-0.216*

0.5 points

4) Now compute the closed-loop poles of the system with LQR controller. The closed-loop poles are complex conjugates, in this case. Please report the real and complex parts below as
______ + ______*i*_.

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

0.1877	*0.264*

0.5 points

Problem 3: Effect of tuning parameters

In the previous problem, we took one set of LQR tuning parameters. We now investigate the effect of tuning parameters. In order to make the controller more aggressive, the Q-weight is increased (with respect to R-value); conversely, increasing the R-weight makes the LQR more sluggish.

Please answer the following questions.

5) Aggressive Control: Please repeat Problem-2 with $Q = 100I$ and $R = 1$. Please report the LQR gain matrix.

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

0.333	*-0.3745*

0.25 points

6) Please repeat Problem-2 with $Q = I$ and $R = 0.01$. Please report the LQR gain matrix.

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

0.333	*-0.3745*

0.25 points

7) Sluggish/Conservative Control: Please repeat Problem-2 with $Q = I$ and $R = 100$. Please report the LQR gain matrix.

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

0.0038	*-0.0053*

0.25 points

8) Sluggish Control: Please repeat the above with $Q = I$ and $R = 10^4$. Based on these results, which of the following statements is/are true?

0.25 points

- [ ] The magnitude of LQR gain decreases as R is increased
- [ ] The magnitude of LQR gain increases as R is increased
- [ ] The magnitude of LQR gain is independent of R
- [ ] The LQR poles do not vary when R is changed
- [ ] The LQR poles go closer to open loop poles when R increases
- [ ] The LQR poles go closer to origin when R increases

No, the answer is incorrect.
Score: 0

Accepted Answers:
The magnitude of LQR gain decreases as R is increased
The LQR poles go closer to open loop poles when R increases

Problem 4: Closed Loop Simulations of LQR

In this problem, we will consider closed-loop simulations of an LQR, starting from initial state of $x(0) = [1 \quad 2]^T$

For one set of weights, the LQR gain is obtained as: $L_\infty = [0.3 \quad -0.35]$. With this L_∞, perform ten steps of closed-loop simuations and report the following results.

9) Please report the value of $x(1)$.

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

-0.1
0.9

0.25 points

10) Please report the value of $x(2)$.

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

-0.045
0.185

0.25 points

11) Please report the value of $x(3)$.

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

-0.00925
0.02825

0.25 points

12) Please report the value of $x(4)$.

No, the answer is incorrect.
Score: 0

Accepted Answers: (Type: Numeric Array)

-0.0014125
0.0033625

0.25 points