MATLAB Assignment DP11.7

Table of Contents

Setup state space

```
A = [0 1 0;
     0 0 1;
    -2 -5 -10];

B = [0;
     0;
     1];

C = [1 0 0];

D = 0;
sys = ss(A, B, C, D);
```

Select K and L

```
K = [4318 715 39.2];
L = [120;
    4795;
    51448];
```

Calculate new state space

```
Nbar = rscale(sys, K);

At = [A-B*K, B*K;
      zeros(size(A)), A-L*C];
Bt = [ B*Nbar;
       zeros(size(B))];

Ct = [C, zeros(size(C))];
Dt = 0;

sys = ss(At, Bt, Ct, 0);
```

Calculate performance

```
t = 0:0.01:2;
y = step(sys, t);
Ess = abs(1 - y(end));
wb = bandwidth(sys);
[Gm Pm Wg Wp] = margin(sys);
disp(sprintf('This system has step Ess: %f. wb: %f. Gm: %f', Ess, wb,
 Gm));
```

```
This system has step Ess: 0.000000. wb: 9.747077. Gm: 7.200003
```

Plot for step response

```
fig = figure;
step(sys, t);
title('DP11.7 Step response');
xlabel('Time (sec)');
ylabel('Output');
uiwait(fig);
```

Plot for different initial conditions

```
x0 = [0.01, 0.5, -5];
x0_est = [0.02, 1.0, -10];
disp(sprintf('Initial conditions x0 = [%f, %f, %f], x0_est = [%f, %f,
 %f]', x0(1), x0(2), x0(3), x0_est(1), x0_est(2), x0_est(3)));

fig = figure;
lsim(sys, zeros(size(t)) + 1, t, [x0, x0_est]);
[y,t,x] = lsim(sys, zeros(size(t)) + 1, t, [x0, x0_est]);
title('DP11.7 Response to different initial condition and step
 input');
xlabel('Time (sec)');
ylabel('Output');
Ess = abs(1 - y(end));
disp(sprintf('With differing initial conditions Ess: %f', Ess));
uiwait(fig);
```

```
Initial conditions x0 = [0.010000, 0.500000, -5.000000], x0_est =
 [0.020000, 1.000000, -10.000000]
With differing initial conditions Ess: 0.000000
```

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