Prelab 6b report

3 Pre-Lab

3.1 Controllability and Observability

$\dot{x}$=Ax+B y=Cx

$x\ \theta\ \dot{\theta}]^T$

A=[0 1 0 0; 0 -6.81 -1.50 0; 0 0 0 1;0 15.47 25.66 0]

B=[0 ; 1.52 ; 0 ; -3.46]

C=[1 0 0 0 ; 0 0 1 0]

Use MATLAB, I got the controllability matrix of this system,

1.0e+03 *

0	0.0015	-0.0104	0.0758
0.0015	-0.0104	0.0758	-0.5518
0	-0.0035	0.0236	-0.2492
-0.0035	0.0236	-0.2492	1.7778

Its rank is 4, so it's controllable.

The observability matrix is

1.0000	0	0	0
0	0	1.0000	0
0	1.0000	0	0
0	0	0	1.0000
0	-6.8123	-1.4957	0
0	15.4731	25.6566	0
0	46.4072	10.1894	-1.4957
0	-105.4069	-23.1437	25.6566

Its rank is 4, it's full rank. so it's observable.

3.2 Observer Design

1.A is a 4x4 matrix and C is a 2x4 matrix, to make A-LC has the same size as A, L should be a 4x2 matrix, we assume L is [l11 l12; l21 l22 ; l31 l 32 ;l41 l42]

2.A-LC is

[-1.0*l11, 1.0, -1.0*l12, 0]

[-1.0*l21, -6.8123, - 1.0*l22 - 1.4957, 0]

[-1.0*l31, 0, -1.0*l32, 1.0]

[-1.0*l41, 15.473, 25.657 - 1.0*l42, 0]

we can just use the place command in MATLAB, the eigenvalues of(A-LC) is the same as (A^T-C^T*L^T),

```
AT=A';
CT=C'
LT=L';
P=[-10+15i; -10-15i; -12+17i; -12-17i];
```

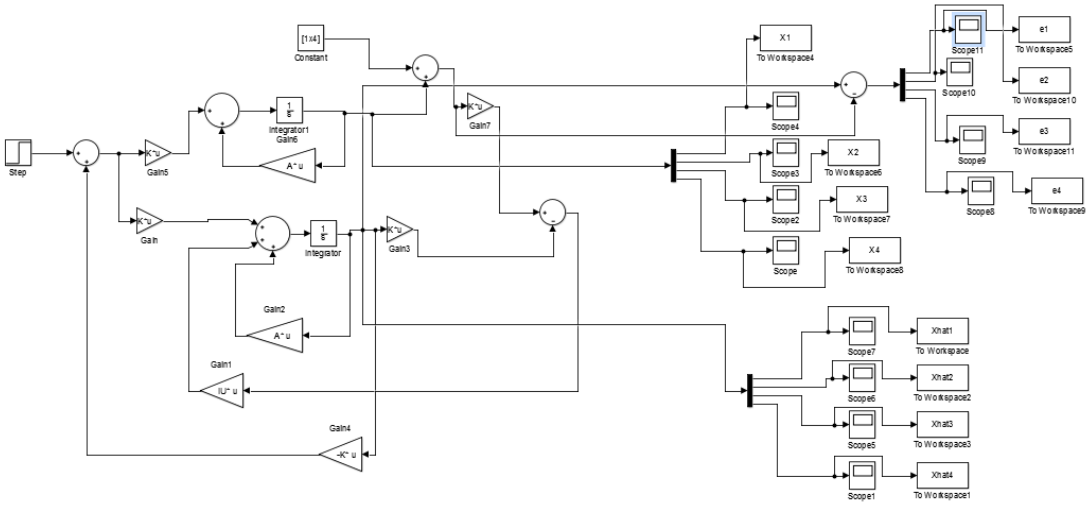
```
LT=place(AT,CT,P)
```

Get L=

16.1595	-2.3767
254.9780	-5.4818
15.7136	21.0282
180.7734	378.1934

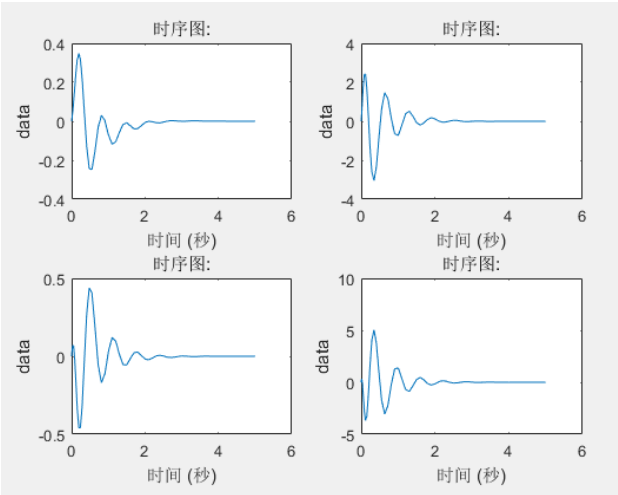
3.3 Simulation

1.The Simulation block

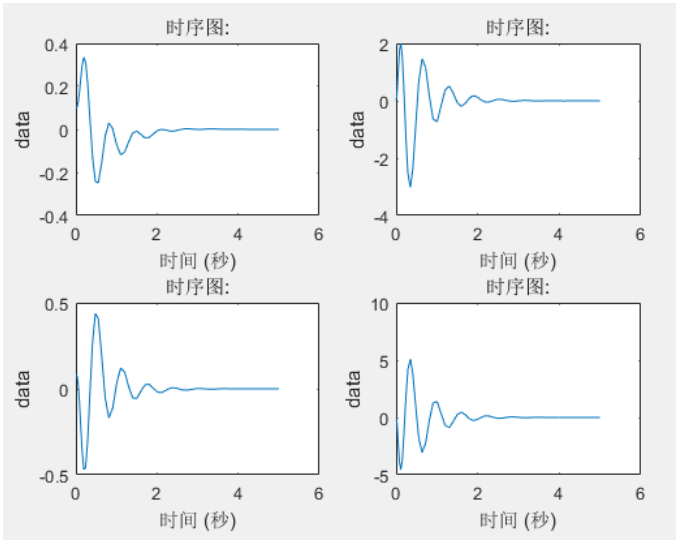


2.4 plots of x^ and 4 plots of x

4 plots for X^:



4 plots for X



3.

4 plots for error