自控原理实验

1，传递函数的模型表示

```
>> num = [1 5];
>> den = [1 2 3 4 5];
>> G = tf(num,den)
G =
              s + 5
  ----------------------------
  s^4 + 2 s^3 + 3 s^2 + 4 s + 5
Continuous-time transfer function.
```

2，零极点模型表示

MATLAB使用zpk命令完成！语法： G=zpk(z,p,k) z表示零点列向量 p为极点列向量 k为增益

```
>> num = [1 5];
>> z = roots(num);
>> den = [1 2 3 4 5];
>> p = roots(den)
p =
   0.2878 + 1.4161i
   0.2878 - 1.4161i
  -1.2878 + 0.8579i
  -1.2878 - 0.8579i
>> zpk(z,p,1)
ans =
                      (s+5)
  ------------------------------------------------
  (s^2 + 2.576s + 2.394) (s^2 - 0.5756s + 2.088)

Continuous-time zero/pole/gain model.
```

附：

控制系统的传递函数也可以用部分分式法来表示，采用的是将传递函数表示为部分分式或者留数的形式、

MATLAB中可以用residue命令来实现由传递函数得出的极点和系数；

```
>> num = [1 5];
>> den = [1 2 3 4 5];
>> [r p k] = residue(num,den)
r =
   0.3612 - 0.3164i
   0.3612 + 0.3164i
  -0.3612 - 0.2103i
  -0.3612 + 0.2103i
```

```
p =
  -1.2878 + 0.8579i
  -1.2878 - 0.8579i
   0.2878 + 1.4161i
   0.2878 - 1.4161i
k =
     []
```

3，连续系统系统模型之间的转换

函数：tf2zp

调用格式Wie： [z, p ,k] = tf2zp(num,den)

功能：传递函数转化为零极点描述

```
>> num = [1 5];
>> den = [1 2 3 4 5];
>> G = tf(num, den)
G =
              s + 5
  ----------------------------
  s^4 + 2 s^3 + 3 s^2 + 4 s + 5
Continuous-time transfer function.
>> num = [1 -0.5 2];
>> den = [1 0.4 1];
>> [z,p,k]=tf2zp(num,den)
z =
   0.2500 + 1.3919i
   0.2500 - 1.3919i
p =
  -0.2000 + 0.9798i
  -0.2000 - 0.9798i
k =
     1
```

4，传递函数的特征根以及零极点图

MATLAB提供了多项式求根函数roots（），调用格式为roots（p） p为多项式

```
>> p = [1 3 0 4];
>> r = roots(p)
r =
  -3.3553
   0.1777 + 1.0773i
   0.1777 - 1.0773i
```

反过来，如果知道了特征多项式的特征根，可调用MATLAB中的poly（）函数求得多项式降幂排列时候的各项系数

```
>> poly(r)
ans =
    1.0000    3.0000   -0.0000    4.0000
```

5，结构框图的模型表示

（1）串联结构，siso的串联结构是两个模块串联在一起

G = G1*G2

G = series(G1,G2)

（2）并联结构，siso的并联结构是两个模块并联在一起

G = G1+G2

```
G = parallel(G1,G2)
```
（3）反馈结构是前向通道和反馈通道构成的正反馈和负反馈
```
G = feedback(G1, G2, sign)
```
说明：sign= -1或者省略时表示负反馈，否则表示正反馈
```
>> G1 = tf(1,[1 2 1])
G1 =
        1
  -------------
  s^2 + 2 s + 1
Continuous-time transfer function.
>> G2 = tf(1,[1 1]);
>> G3 = tf(1,[2,1]);
>> G4 = tf(1,[1 0]);
>> G12 = G1+G2
G12 =
      s^2 + 3 s + 2
  ---------------------
  s^3 + 3 s^2 + 3 s + 1
Continuous-time transfer function.
>> G34 = G3-G4
G34 =
   -s - 1
  ---------
  2 s^2 + s
Continuous-time transfer function.
>> G = feedback(G12,G34,-1)
G =
       2 s^4 + 7 s^3 + 7 s^2 + 2 s
  -------------------------------------
  2 s^5 + 7 s^4 + 8 s^3 + s^2 - 4 s - 2

Continuous-time transfer function.
```


练习

1 ，题目1

```
>> num = [4 8];
>> z = roots(num)
z =
    -2
>> den = [1 6 5 0];
>> p = roots(den)
p =
     0
    -5
```

```
    -1

>> zpk(z,p,4)
ans =
     4 (s+2)
  -------------
  s (s+5) (s+1)
Continuous-time zero/pole/gain model.
```

部分分式法表示

```
>> num = [4 8];
>> den = [1 6 5 0];
>> [r p k] = residue(num,den)
r =
   -0.6000
   -1.0000
    1.6000
p =
    -5
    -1
     0
k =
     []
```

问题是为什么增益k不能计算出来呢/

2，题目2

```
>> num = [6 11 6 10];
>> z = roots(num)
z =
  -1.7938
  -0.0198 + 0.9637i
  -0.0198 - 0.9637i
>> den = [1 2 3 1 1];
>> p = roots(den)
p =
  -0.9567 + 1.2272i
  -0.9567 - 1.2272i
  -0.0433 + 0.6412i
  -0.0433 - 0.6412i
>> zpk(z,p,6)
ans =
       6 (s+1.794) (s^2 + 0.03952s + 0.9291)
  ---------------------------------------------
  (s^2 + 0.08663s + 0.413) (s^2 + 1.913s + 2.421)

Continuous-time zero/pole/gain model.
>> num = [6 11 6 10];
>> den = [1 2 3 1 1];
>> [r,p,k] = residue(num, den)
```

```
r =
   3.5017 - 1.2899i
   3.5017 + 1.2899i
  -0.5017 - 1.9422i
  -0.5017 + 1.9422i
p =
  -0.9567 + 1.2272i
  -0.9567 - 1.2272i
  -0.0433 + 0.6412i
  -0.0433 - 0.6412i
k =
     []
```

3，题目3

第一题特征根

```
>> p = [1 6 5 0];
>> r = roots(p)
r =
     0
    -5
    -1
```

第二题特征根

```
>> p =[1 2 3 1 1];
>> r = roots(p)
r =
  -0.9567 + 1.2272i
  -0.9567 - 1.2272i
  -0.0433 + 0.6412i
  -0.0433 - 0.6412i
```

4，题目4

```
>> G1 = tf(1,[6 5]);
>> G2 = tf(3,[5 1]);
```

注释：串联形式

```
>> G12 = G1*G2
G12 =
          3
  -----------------
  30 s^2 + 31 s + 5

Continuous-time transfer function.
```

注释：并联情况

```
>> G21c = G1+G2
G21c =
      23 s + 16
  -----------------
  30 s^2 + 31 s + 5
```

```
Continuous-time transfer function.
注释：反馈函数
>> G = feedback(G1,G2,-1)
G =
       5 s + 1
  -----------------
  30 s^2 + 31 s + 8
Continuous-time transfer function.
```