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clc; clear; num=[1]; den=[1 1]; % 一阶系统 den=[1 0.6 1]; num=[0.04798 0.0464]; den=[1 -1.81 0.9048]; noiseAmp=0.1; sys = tf(num,den);

```
sys=linsys1;
```

时域分析

```
tmp = stepinfo(sys);
Ts=tmp.SettlingTime
```

```
Ts = 78.2415
```

取-3dB

```
[mag,ph,w]=bode(sys);   %依次返回幅频、相频、角频率
mag = 20*log10(squeeze(mag));    % dB
% plot(mag,w)
w0=spline(mag,w,mag(1)-3)    % rad/s
```

```
w0 = 0.0499
```

计算M/IM序列参数

```
fM=w0/2/pi      % Hz
```

```
fM = 0.0079
```

```
delta=0.3/fM
```

```
delta = 37.7736
```

```
delta = 30;      %根据上面的值，手动取值
Np=[1/(fM*delta),1.2*Ts/delta,1.5*Ts/delta]     %确定M序列的长度
```

```
Np = 1×3
    4.1971    3.1297    3.9121
```

```
M_Np=max(round(max(Np)),7);
M_T=M_Np*delta;
M_Np=M_Np*2;
M_T=M_T*2;
M_d=delta;
if M_T>Ts
    disp('M序列周期大于原始系统')
end
```

```
M序列周期大于原始系统
```

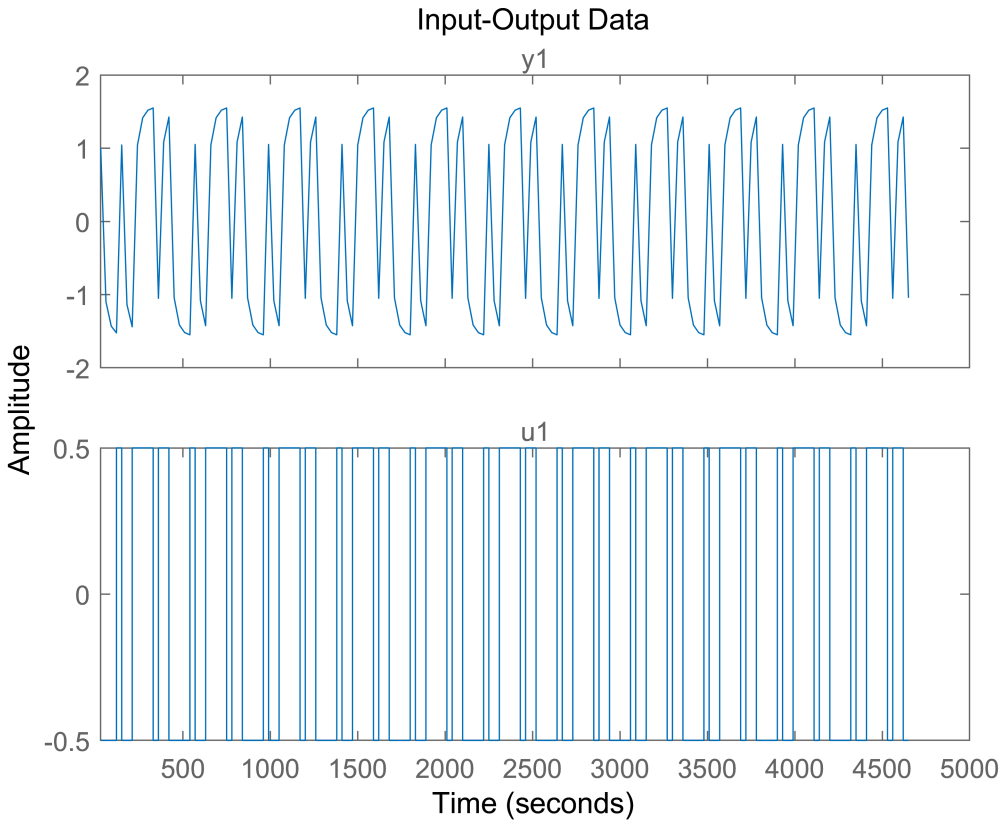
```
simTime=11*M_T
```

```
simTime = 4620
```

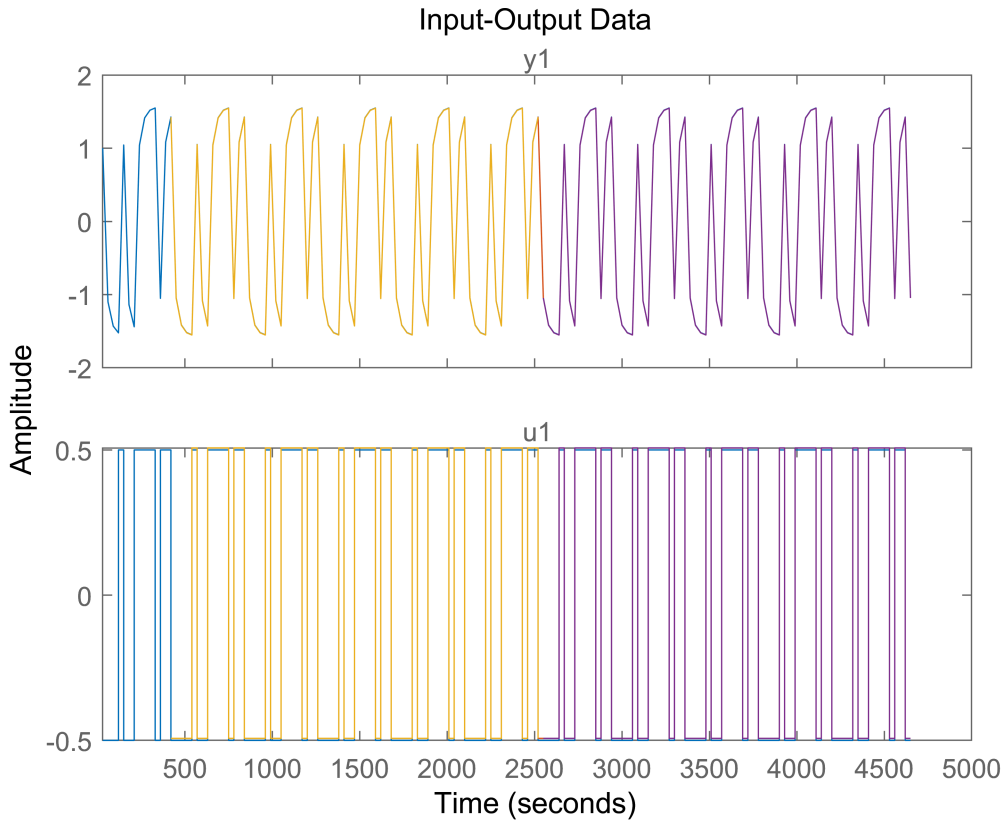
```
sim('mysysIM.slx');
```

```
警告: Square root of a negative number in 'mysysIM/Water-Tank System/Sqrt'. Consider setting the 'Output
 signal type' to complex.
```

```
Q=iddata(myout,myin,M_d);
figure(2)
plot(Q);%画出封装的输入输出数据
```




```
dataStart = M_T/M_d;
Qe = Q([dataStart:end]);%        去第一个周期
Qd=detrend(Qe);      %去趋势项
% plot(Qe,Qd);
Qde=Qd([1:end/2]);  %前一半数据用来测试
Qdv=Qd([end/2+1:end]);  %后一半数据用来验证
figure(3)
plot(Q,Qd,Qde,Qdv);
```

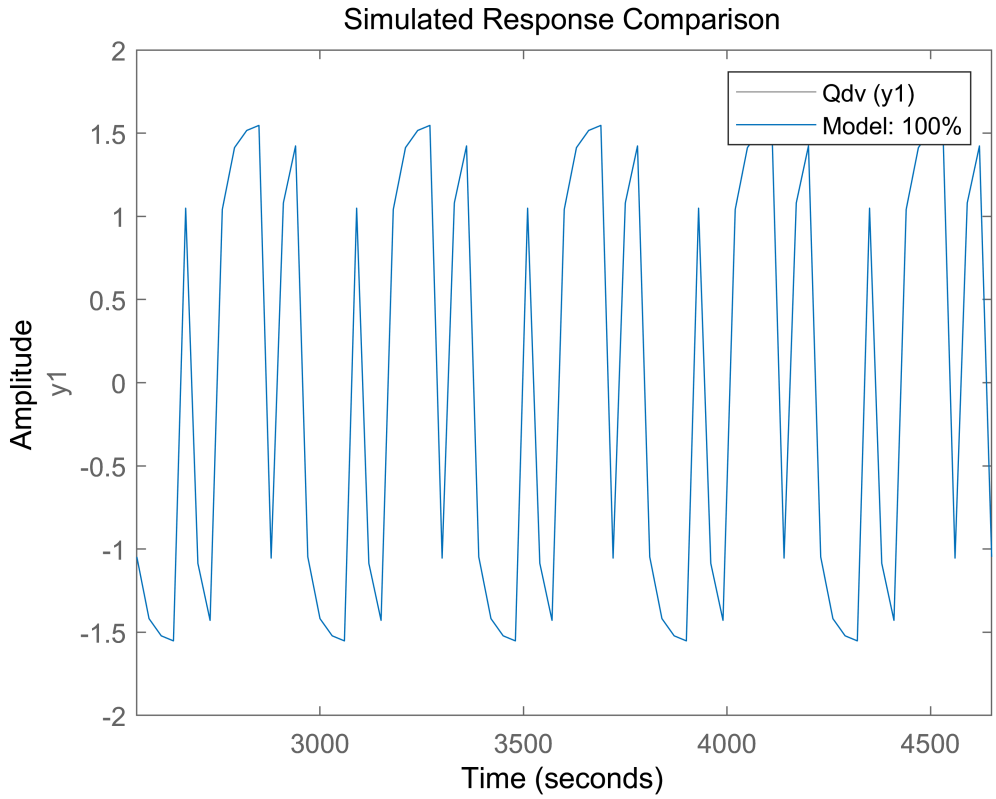


ident

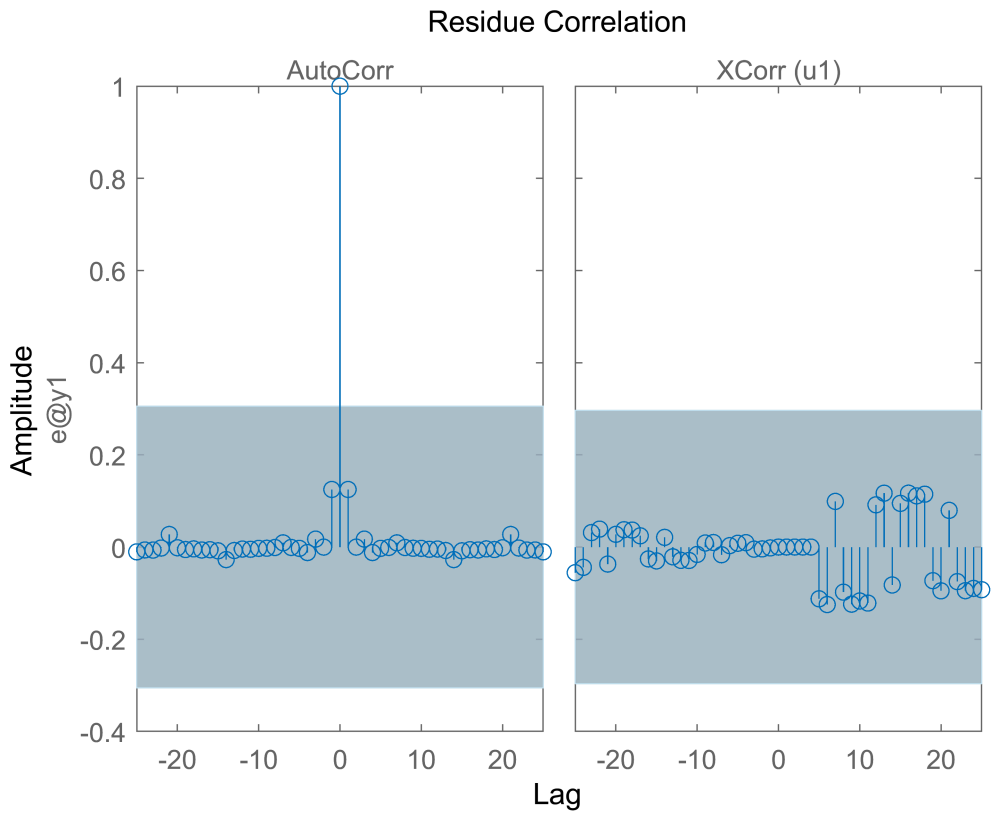
```
NN=struc(1:10,1:10,1:10);
Loss_fun= arxstruc(Qde,Qdv,NN);
order =[4 4 1];

Model=arx(Qde,order)
```

```
Model =
Discrete-time ARX model: A(z)y(t) = B(z)u(t) + e(t)

  A(z) = 1 - 1.305 z^-1 + 1.379 z^-2
                - 1.232 z^-3 + 0.1649 z^-4


  B(z) = 2.549 z^-1 - 2.955 z^-2 + 3.095 z^-3
                              - 2.692 z^-4

Sample time: 30 seconds

Parameterization:
   Polynomial orders:   na=4   nb=4
   nk=1
   Number of free coefficients: 8
   Use "polydata", "getpvec", "getcov" for parameters and their uncertainties.

Status:
Estimated using ARX on time domain data "Qde".
Fit to estimation data: 100% (prediction focus)
FPE: 2.524e-14, MSE: 1.794e-14
```

```
figure(4)
compare(Qdv,Model);%预测输出与实际输比较
```




```
figure(5)
resid(Model,Qde); %模型预测误差及相关分析
```




```
Model_tf_d=tf(Model) %离散模型
```

```
Model_tf_d =

  From input "u1" to output "y1":

  2.549 z^-1 - 2.955 z^-2 + 3.095 z^-3

                              - 2.692 z^-4

  ---------------------------------------

  1 - 1.305 z^-1 + 1.379 z^-2 - 1.232 z^-3

                             + 0.1649 z^-4


Sample time: 30 seconds
Discrete-time transfer function.
```

```
Model_tf_c=d2c(Model_tf_d) %连续模型
```

```
Model_tf_c =

  From input "u1" to output "y1":

  0.188 s^3 - 0.0003357 s^2 + 0.0004652 s

                              - 8.799e-09
```

```
  ----------------------------------------

  s^4 + 0.06009 s^3 + 0.002404 s^2

                  + 0.0001535 s + 2.306e-08

Continuous-time transfer function.
```

```
% Model_tf_c=d2c(Model_tf_d,'tustin')

num=cell2mat(Model_tf_d.num)
```

```
num = 1×5
         0    2.5493   -2.9555    3.0951   -2.6917
```

```
den=cell2mat(Model_tf_d.den)
```

```
den = 1×5
    1.0000   -1.3046    1.3791   -1.2321    0.1649
```

```
num1=cell2mat(Model_tf_c.num)
```

```
num1 = 1×5
         0    0.1880   -0.0003    0.0005   -0.0000
```

```
den1=cell2mat(Model_tf_c.den)
```

```
den1 = 1×5
    1.0000    0.0601    0.0024    0.0002    0.0000
```

```
sim('myverify2.slx')
```

```
警告: Output port 1 of 'myverify2/Idmodel1' is not connected.
ans =
  Simulink.SimulationOutput:

                   tout: [56x1 double]

     SimulationMetadata: [1x1 Simulink.SimulationMetadata]
           ErrorMessage: [0x0 char]
```

```
% plot(simVerifyOut.time,simVerifyOut.signals.values(:,1),simVerifyOut.time,simVerifyOut.signal
```