题目、 程序 、 运算结果 、 出现的错误

[shiephuangwei@126.com](mailto:shiephuangwei@126.com)

一、应用matlab实现数学模型的转换

例题1.22

解法1：

num =

0 0 25.0000 113.0000

den =

1.0000 5.0000 25.0000 5.0000

解法2：

sys\_ss = ss(A , B ,C ,D);

sys\_tf = tf(sys\_ss)

sys\_tf =

25 s + 113

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s^3 + 5 s^2 + 25 s + 5

Continuous-time transfer function.

例题1.23

解法1：

A = [0 1 ; -25 -4];

B = [1 1 ; 0 1];

C = [1 0 ; 0 1];

D = [0 0 ; 0 0 ];

[num , den ] = ss2tf(A, B ,C ,D,1)

num =

0 1 4

0 0 -25

den =

1.0000 4.0000 25.0000

[num , den ] = ss2tf(A, B ,C ,D,2)

num =

0 1.0000 5.0000

0 1.0000 -25.0000

den =

1.0000 4.0000 25.0000

解法2：

A = [0 1 ; -25 -4];

B = [1 1 ; 0 1];

C = [1 0 ; 0 1];

D = [0 0 ; 0 0 ];

sys\_ss = ss(A ,B , C,D);

sys\_tf = tf(sys\_ss)

sys\_tf =

From input 1 to output...

s + 4

1: --------------

s^2 + 4 s + 25

-25

2: --------------

s^2 + 4 s + 25

From input 2 to output...

s + 5

1: --------------

s^2 + 4 s + 25

s - 25

2: --------------

s^2 + 4 s + 25

Continuous-time transfer function

习题1.1

错误：一开始使用开环函数计算结果错误

（1）

[A , B , C ,D] = tf2ss([10] , [0.05 0.6 11])

A =

-12.0000 -220.0000

1.0000 0

B =

1

0

C =

0 200

D =

0

（2）

[A , B , C ,D] = tf2ss([7 21] , [1 6 10 15 21])

A =

-6 -10 -15 -21

1 0 0 0

0 1 0 0

0 0 1 0

B =

1

0

0

0

C =

0 0 7 21

D =

0

（3）

[A , B , C ,D] = tf2ss([4 8] , [0.2 1 4 8 ])

A =

-5 -20 -40

1 0 0

0 1 0

B =

1

0

0

C =

0 20 40

D =

0

二、应用matlab求解状态方程

1、线性定常连续系统状态方程的求解

（1）例题2.16

解法1：

A = [0 ,1 , 0;0 , 0 ,1 ; 0 -2 ,-3];

B = [0 ; 0 ; 1];

u = 1;

[Phit , PhitBu] = vsolve1(A , B ,u)

Phit =

[ 1, exp(-2\*t)/2 - 2\*exp(-t) + 3/2, exp(-2\*t)/2 - exp(-t) + 1/2]

[ 0, 2\*exp(-t) - exp(-2\*t), exp(-t) - exp(-2\*t)]

[ 0, 2\*exp(-2\*t) - 2\*exp(-t), 2\*exp(-2\*t) - exp(-t)]

PhitBu =

t/2 + exp(-t) - exp(-2\*t)/4 - 3/4

(exp(-2\*t)\*(exp(t) - 1)^2)/2

exp(-2\*t)\*(exp(t) - 1)

解法2：

A = [0 ,1 , 0;0 , 0 ,1 ; 0 -2 ,-3];

B = [0 ; 0 ; 1];

u = '1/s';

[sI\_A , sI\_ABu] = vsolve2(A , B ,u)

[ 1, exp(-2\*t)/2 - 2\*exp(-t) + 3/2, (exp(-2\*t)\*(exp(t) - 1)^2)/2]

[ 0, 2\*exp(-t) - exp(-2\*t), exp(-t) - exp(-2\*t)]

[ 0, -2\*exp(-2\*t)\*(exp(t) - 1), -exp(-2\*t)\*(exp(t) - 2)]

sI\_ABu =

t/2 + exp(-t) - exp(-2\*t)/4 - 3/4

(exp(-2\*t)\*(exp(t) - 1)^2)/2

exp(-t) - exp(-2\*t)

（2）习题2.6

解法1：

A = [-1 -0.5; 1 0];

B = [0.5 ; 0];

u = 1;

[Phit , PhitBu] = vsolve1(A , B ,u);

X0 = [0 ; 0];

X = Phit \* X0 + PhitBu

y = [1 0 ] \* X

输出结果：

X =

sin(t/2)\*exp(-t/2)

1 - sin(t/2)\*exp(-t/2) - cos(t/2)\*exp(-t/2)

y =

sin(t/2)\*exp(-t/2)

解法2：

A = [-1 -0.5; 1 0];

B = [0.5 ; 0];

u = '1/s';

[sI\_A , sI\_ABu] = vsolve2(A , B ,u);

X0 = [0 ; 0];

X = sI\_A \* X0 + sI\_ABu

y = [1 0 ] \* X

输出结果：

X =

sin(t/2)\*exp(-t/2)

1 - 2^(1/2)\*sin(t/2 + pi/4)\*exp(-t/2)

y =

sin(t/2)\*exp(-t/2)

例题2.24

A = sym('[0 , sin(w \* t) ; 0 , 0]' );

B = [1 : 1];

u = 1;

[Phi , PhiBu] = tsolve(A , B , u , 't' , 't0' , 2)

运行结果：

Phi =

[ 1, -(cos(t\*w) - cos(t0\*w))/w]

[ 0, 1]

PhiBu =

[ t - t0, (cos(t0\*w)\*(t - t0))/w - (sin(t\*w) - sin(t0\*w))/w^2]

[ 0, t - t0]

习题2.8

A = sym('[0 , 1/(t + 1)^2 ; 0 , 0]' );

Phi = transmtx(A , 't' , 't0' , 2)

运行结果：

Phi =

[ 1, piecewise([-1 <= t & t0 <= -1, Inf], [-1 < t0 | t < -1, 1/(t0 + 1) - 1/(t + 1)])]

[ 0, 1]

例题2.28

A = [0 , 1;-0.21 , -1];

B = [1 ; 1];

u = 'z/(z - 1)';

[Ak ,AkBu] = disolve(A ,B ,u);

X0 = [1 ; -1];

xk = Ak \* X0 + AkBu

运行结果：

xk =

(249\*(-7/10)^n)/68 - (209\*(-3/10)^n)/52 + 300/221

(627\*(-3/10)^n)/520 - (1743\*(-7/10)^n)/680 + 79/221

习题2.10

递推法：

A = [0 , 1 ; -0.16 , -1];

B = [1 ; 1];

X0 = [1 ; -1];

u = 1;

X1 = A \* X0 + B \* u

X2 = A \* X1 + B \* u

X3 = A \* X2 + B \* u

X1 =

0

1.8400

X2 =

2.8400

-0.8400

X3 =

0.1600

1.3856

Z变换法：

A = [0 , 1 ; -0.16 , -1];

B = [1 ; 1];

u = 'z/(z - 1)';

[Ak ,AkBu] = disolve(A ,B ,u);

X0 = [1 ; -1];

xk = Ak \* X0 + AkBu

运行结果：

xk =

(22\*(-4/5)^n)/9 - (17\*(-1/5)^n)/6 + 25/18

(17\*(-1/5)^n)/30 - (88\*(-4/5)^n)/45 + 7/18

例题2.30

A = sym('[1 , exp(-2 \* k) ;0 ,exp(-k)]');

B = sym('[exp(-k) ; 1]');

x0 = [0 ; 0]; u =1;

xk = tdsolve(A , B , u ,x0 , 0 , 4)

运行结果：

xk =

[ 1, exp(-1) + exp(-2) + 1, exp(-1) + 2\*exp(-2) + exp(-4) + exp(-5) + 1, exp(-1) + 2\*exp(-2) + exp(-3) + exp(-4) + exp(-6) + exp(-8) + exp(-1)\*(exp(-4) + exp(-8)) + 1]

[ 1, exp(-1) + 1, exp(-2) + exp(-3) + 1, exp(-3) + exp(-5) + exp(-6) + 1]

>> double(xk)

ans =

1.0000 1.5032 1.6636 1.7163

1.0000 1.3679 1.1851 1.0590

习题2.15

syms T

A = sym('[0 , 1/(1 + kT)^2 ; 0 , kT]');

B = sym('[1 ; kT]');

Ak = eye(size(A)) + T \* A

Bk = T \* B

运行结果：

Ak =

[ 1, T/(kT + 1)^2]

[ 0, T\*kT + 1]

Bk =

T

T\*kT