ME 231_HW3

Problem 1

1(1)

```
p = sdpvar(2,1);
%u=sdpvar(4,1);
C1=(-3*p(1)+2*p(2)-30)<=0;
C2=(-2*p(1)+p(2)-12)<=0;
C3=-1*p(1)<=0;
C4=-1*p(2)<=0;
%KKT
%C5=-5+u(1)*(-3)+u(2)*(-2)+u(3)*(-1);
%C6=-7+u(1)*(2)+u(2)*(1)+u(4)*(-1);
%C7=-1*u<=0;
%C=[C1,C2,C3,C4,C5,C6,C7];
C=[C1,C2,C3,C4];
%obj=
-5*p(1)-7*p(2)+u(1)*(-3*p(1)+2*p(2)-30)+u(2)*(-2*p(1)+p(2)-12)+u(3)*-1*p(1)+u(4)*-1*p(
2);
obj=-5*p(1)-7*p(2);
%options = sdpsettings('verbose', 'bnb', 'bnb.solver', 'fmincon');
options = sdpsettings('verbose',1,'savesolveroutput',1);
out=optimize(C,obj,options);
out.solveroutput.LAMBDA
double(p);
double(obj)
```

```
%double(u)

% unbounded , KKT is notsatisfied
```

```
*    0: obj =  0.000000000e+000  infeas = 0.000e+000 (0)

*    4: obj = -1.200000000e+007  infeas = 0.000e+000 (0)


ans =


     0

     0

     0

     0



ans =


     1000000

     1000000



ans =


   -12000000
```

1(2)

```
p = sdpvar(2,1);

C1=(p(1)-p(2))<=1;

C2=(3*p(1)+2*p(2))<=12;
```

```
C3=(2*p(1)+3*p(2))<=3;

C4=(-2*p(1)+3*p(2))>=9;

C5=p(1)>=0;

C6=p(2)>=0;

C=[C1,C2,C3,C4,C5,C6];


obj= 3*p(1)+p(2);

options = sdpsettings('verbose',1,'savesolveroutput',1);

out=optimize(C,obj,options);

out.solveroutput.LAMBDA

double(p);

double(obj)

%KKT is not satisfied
```

```
      0: obj =  0.000000000e+000  infeas = 9.000e+000 (0)

      1: obj =  1.000000000e+000  infeas = 6.000e+000 (0)

glp_simplex: unable to recover undefined or non-optimal solution


ans =


     0

     0

     0

     0

     0

     0


ans =
```

```
     0
     0


ans =

     0
```

1(3)

```
p = sdpvar(2,1);
t1=sdpvar(1,1);
t2= sdpvar(2,1);
C1=(3*p(1)+2*p(2))<=-3;
C2=p(1)>=0;
C3=p(1)<=2;
C4=p(2)>=-2;
C5=p(2)<=3;
C6=[abs(p(1)-2)<=t1,t1>=0];
C7=abs(p(2))<=t1;
C8=[abs(p(1))<=t2(1),t2(1)>=0];
C9=[abs(p(2)+5)<=t2(2),t2(2)>=0];
C=[C1,C2,C3,C4,C5,C6,C7,C8,C9];


obj= t1+t2(1)+t2(2);
options = sdpsettings('verbose',1,'savesolveroutput',1);
out=optimize(C,obj,options);
out.solveroutput.LAMBDA
```

```
double(p);

double(obj)

%KKT is not satisfied
```

```
     0: obj = -2.000000000e+006  infeas = 1.000e+007 (0)
*    13: obj =  5.200000000e+000  infeas = 0.000e+000 (0)
*    14: obj =  5.000000000e+000  infeas = 0.000e+000 (0)


ans =


        0
        0
        0
        0
        0
   -0.0000
        0
   -1.0000
   -1.0000
        0
   -1.0000
        0
        0
   -0.0000
        0
   -1.0000
   -0.5000
   -0.5000
   -1.0000
        0
```

```
ans =

     0
    -2


ans =

     5
```

1(4)

```
p = sdpvar(2,1);
t1=sdpvar(1,1);
t2= sdpvar(2,1);
C1=p(1)<=-3;
C2=p(2)<=4;
C3=(4*p(1)+3*p(2))<=0;
C=[C1,C2,C3];
obj= p(1)^2+p(2)^2;
options = sdpsettings('verbose',1,'savesolveroutput',1);
out=optimize(C,obj,options);
%out.solveroutput.LAMBDA
double(p);
double(obj)
%KKT is satisfied
```

```
feasible solution found by trysol heuristic after 0.0 seconds, objective value 2.000000e+10
presolving:
(round 1, fast)      0 del vars, 3 del conss, 0 add conss, 3 chg bounds, 0 chg sides, 0
chg coeffs, 0 upgd conss, 0 impls, 0 clqs
(round 2, fast)      0 del vars, 3 del conss, 0 add conss, 6 chg bounds, 0 chg sides, 0
chg coeffs, 0 upgd conss, 0 impls, 0 clqs
presolving (3 rounds: 3 fast, 1 medium, 1 exhaustive):
 0 deleted vars, 3 deleted constraints, 0 added constraints, 6 tightened bounds, 0 added
holes, 0 changed sides, 0 changed coefficients
 0 implications, 0 cliques
presolved problem has 3 variables (0 bin, 0 int, 0 impl, 3 cont) and 1 constraints
     1 constraints of type <quadratic>
Presolving Time: 0.02
transformed 1/1 original solutions to the transformed problem space

 time | node  | left  |LP iter|LP it/n| mem |mdpt |frac |vars |cons |cols |rows |cuts
|confs|strbr|  dualbound   | primalbound  |  gap
  0.0s|     1 |     0 |     0 |     - | 199k|   0 |   0 |   3 |   1 |   3 |   6 |   0 |   0 |   0
| 9.000000e+00 | 2.000000e+10 |  Large
q 0.1s|     1 |     0 |     0 |     - | 199k|   0 |   - |   3 |   1 |   3 |   6 |   0 |   0 |   0
| 9.000000e+00 | 9.000000e+00 |   0.00
  0.1s|     1 |     0 |     0 |     - | 199k|   0 |   - |   3 |   1 |   3 |   6 |   0 |   0 |   0
| 9.000000e+00 | 9.000000e+00 |   0.00

SCIP Status       : problem is solved [optimal solution found]
Solving Time (sec) : 0.05
Solving Nodes     : 1
Primal Bound      : +8.99999999900000e+00 (2 solutions)
Dual Bound        : +8.99999999900000e+00
Gap               : 0.00
```

```
ans =

   -3.0000
   -0.0000


ans =

    9.0000
```

Problem 2

HW2

```
A1=[1,0;0,1];
b1=[0;-5];
Ainf=[1,0;0,1];
binf=[2;0];
Ac=[3,2;1,0;-1,0;0,1;0,-1];
bc=[-3;2;0;3;2];
[xOpt, J] = reg1Inf(A1, b1, Ainf, binf, Ac, bc);
double(xOpt)
double(J)
% HW3
p = sdpvar(2,1);
t1=sdpvar(1,1);
t2= sdpvar(2,1);
C1=(3*p(1)+2*p(2))<=-3;
C2=p(1)>=0;
```

```
C3=p(1)<=2;

C4=p(2)>=-2;

C5=p(2)<=3;

C6=[abs(p(1)-2)<=t1,t1>=0];

C7=abs(p(2))<=t1;

C8=[abs(p(1))<=t2(1),t2(1)>=0];

C9=[abs(p(2)+5)<=t2(2),t2(2)>=0];

C=[C1,C2,C3,C4,C5,C6,C7,C8,C9];

obj= t1+t2(1)+t2(2);

options = sdpsettings('verbose',1,'savesolveroutput',1);

out=optimize(C,obj,options);

out.solveroutput.LAMBDA

double(p);

double(obj)
```

```
Optimization terminated.


ans =


    0.0000
   -2.0000



ans =


    5.0000


     0: obj = -2.000000000e+006  infeas = 1.000e+007 (0)
*    13: obj =  5.200000000e+000  infeas = 0.000e+000 (0)
*    14: obj =  5.000000000e+000  infeas = 0.000e+000 (0)
```

```
ans =

         0
         0
         0
         0
         0
   -0.0000
         0
   -1.0000
   -1.0000
         0
   -1.0000
         0
         0
   -0.0000
         0
   -1.0000
   -0.5000
   -0.5000
   -1.0000
         0


ans =

     0
    -2
```

```
ans =

    5
```

%% Problem 3

%% 3(a)

```
p = sdpvar(2,1);

C1=abs(p(1))-1<=0;

C2=abs(p(2))-1<=0;

C=[C1,C2];

obj=3*sin(-2*pi*p(1))+2*p(1)+4+cos(2*pi*p(2))+p(2);

options = sdpsettings('verbose',1,'savesolveroutput',1);

out=optimize(C,obj,options);

out.solveroutput.lambda

d=double(p);

double(obj)

% ans [0.2331;-0.5254]

%KKT is satisfied
```

%% 3(b)

```
%3D plot

[X,Y] = meshgrid(-1:.02:1, -1:.02:1);

Z =3*sin(-2*pi*X) + 2*X + 4 + cos(2*pi*Y) + Y;

mesh(X,Y,Z)

figure

hold on;

contour(X,Y,Z,10,'ShowText','on')

plot(0.5,-1,'dr');

plot(d(1),d(2),'dr');
```

```
hold off;
```

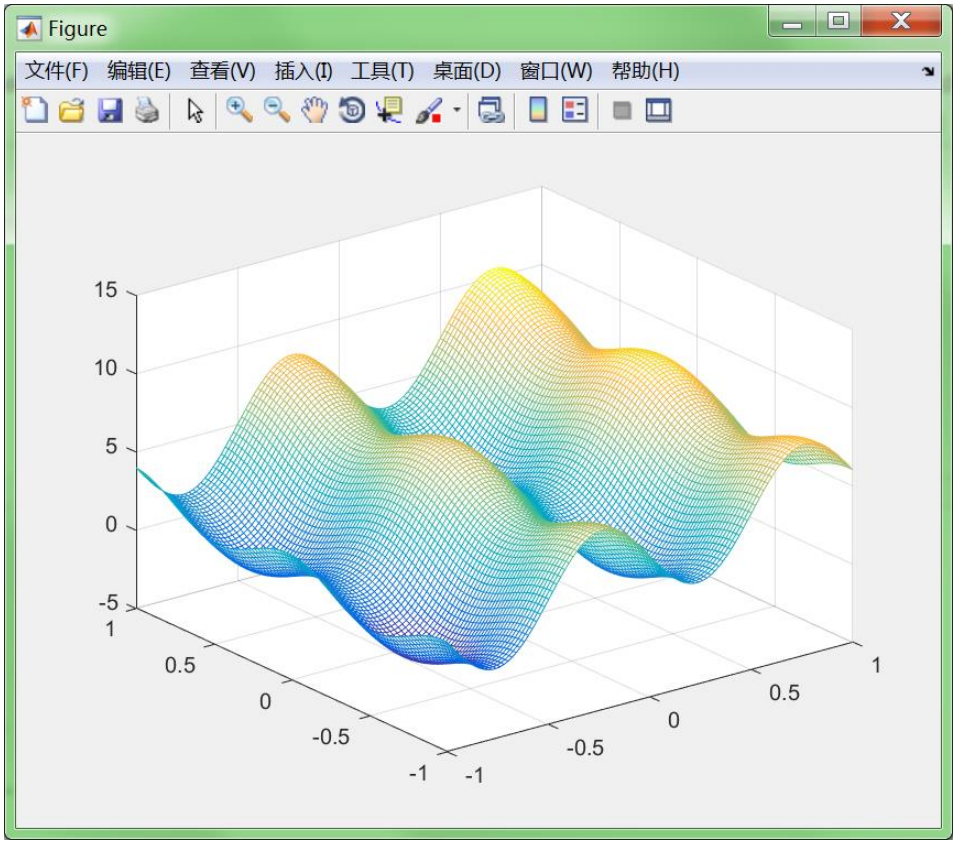


Figure
文件(F) 编辑(E) 查看(V) 插入(I) 工具(T) 桌面(D) 窗口(W) 帮助(H)
15
10
5
0
-5
1
0.5
0
-0.5
-1
-1
-0.5
0
0.5
1

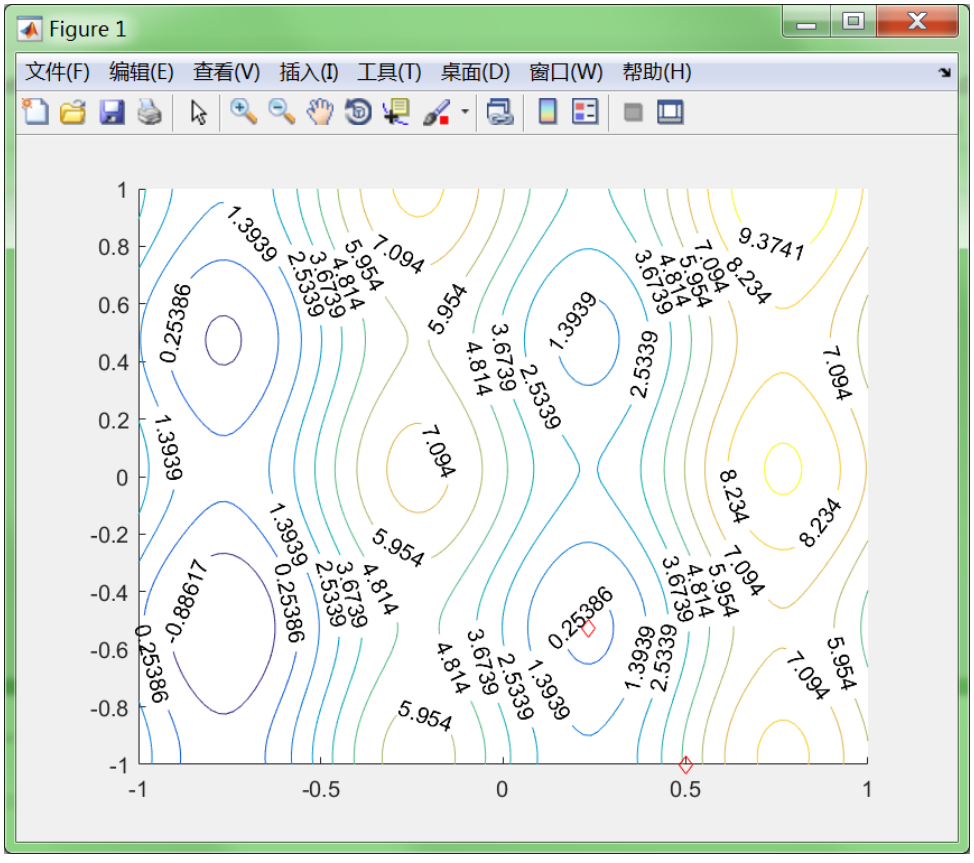
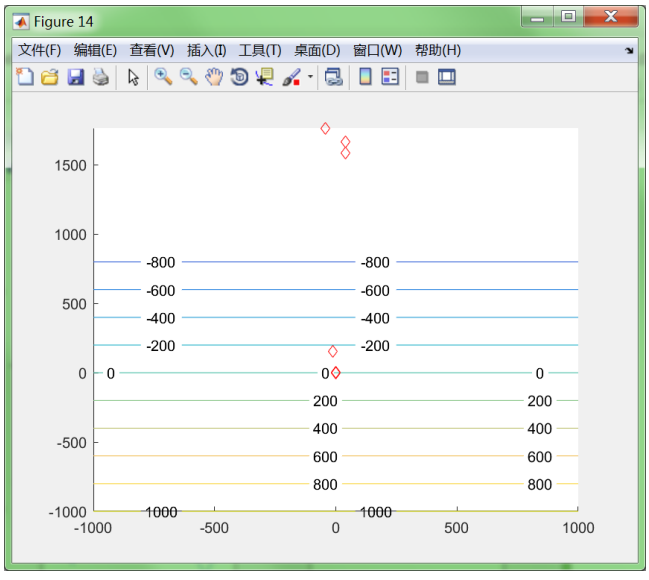


Figure 1
文件(F) 编辑(E) 查看(V) 插入(I) 工具(T) 桌面(D) 窗口(W) 帮助(H)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.5
0
0.5
1
1.3939
7.094
5.954
3.6739
4.814
2.5339
0.25386
9.3741
8.234

```
%% 3(c)
for i=1:20
p = sdpvar(2,1);
pint = 2*rand(2,1)-1;
assign(p, pint);
C =-(1+p(1)^2)^2+p(2)^2==4;
obj=log(1+p(1)^2)-p(2);
options = sdpsettings('usex0',1);
optimize(C,obj,options);
P(:,i)=double(p);
end
[X,Y] = meshgrid(-1000:1:1000, -1000:1:1000);
Z =log(1+X^2)-Y;
figure
hold on;
contour(X,Y,Z,'ShowText','on')
for i=1:20
plot(P(1,i),P(2,i),'dr');
end
hold off;
```



%% Problem 4

%% 4(a)

```
p = intvar(2,1);

C1=(p(1)+4*p(2)-16)<=0;

C2=(6*p(1)+4*p(2)-28)<=0;

C3=(2*p(1)-5*p(2)-6)<=6;

C4=p(1)<=10;

C5=p(2)<=10;

C=[C1,C2,C3,C4,C5,p(1)>=0,p(2)>=0];

obj=-6*p(1)-5*p(2);

options = sdpsettings('verbose', 'bnb', 'bnb.solver', 'fmincon');

optimize(C,obj,options);

double(p)

double(obj)

ans =


    4

    1




ans =


  -29


%% 4(b)

p=sdpvar(2,1);

b=binvar(1,1);

obj=-1*p(1)-2*p(2);

C1=(1-b)*(3*p(1)+4*p(2)-12)<=0;
```

```
C2=b*(4*p(1)+3*p(2)-12)<=0;

C=[C1,C2,p(1)>=0,p(2)>=0];

options = sdpsettings('verbose', 'bnb', 'bnb.solver', 'fmincon');

optimize(C,obj,options);

double(p)

double(obj)

ans =


    4

    1



ans =


  -29



ans =


    0.0000

    3.0000



ans =


  -6.0000
```

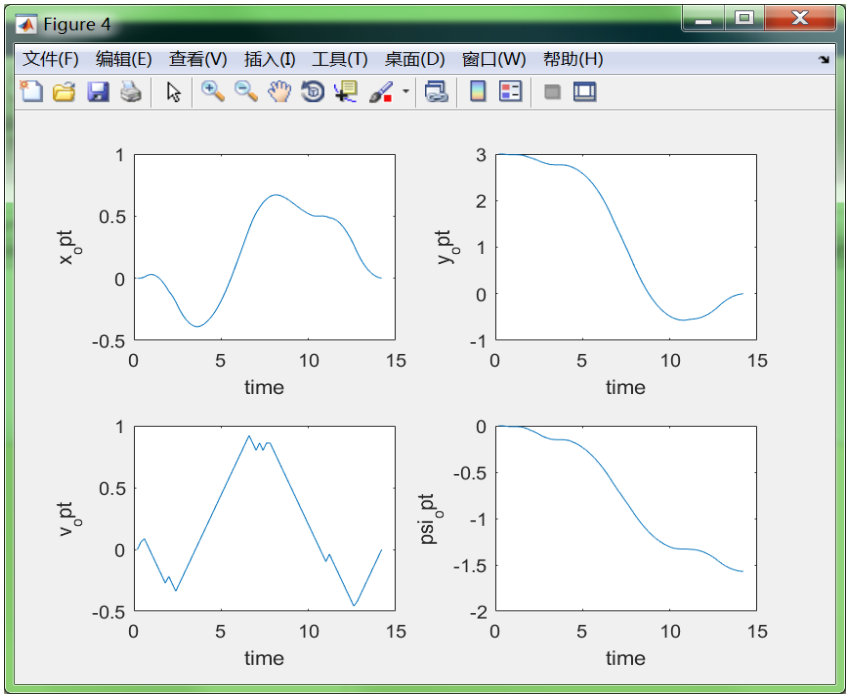
%% Problem 5

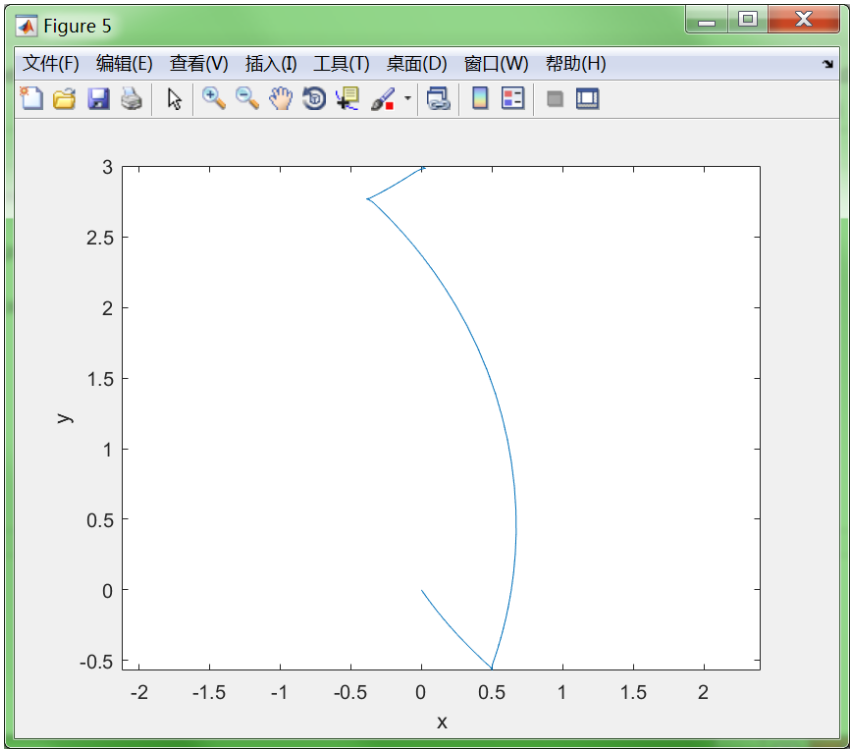
```
%% 5(a)

TS = 0.2;
```

```
N = 70;
TFinal = TS*N;
lr=1.738;
lf=lr;
x=sdpvar(N+1,1);
y=sdpvar(N+1,1);
v=sdpvar(N+1,1);
psi=sdpvar(N+1,1);
a=sdpvar(N+1,1);
beta=sdpvar(N+1,1);
z = [x,y,v,psi];
zref=[0, 0, 0,-1*pi/2];
Cinit=z(1,:)==[0,3,0,0];
Cfinal=z(N+1,:)==[0,0,0,-1*pi/2];
CIE=[abs(a(N+1))<=1.5*TS,abs(beta(N+1))<=0.6];
CE=[Cinit,Cfinal];
for i=1:N
   CIE=[CIE;
       [-20,-5,-10,-2*pi] <= z(i,:)<=[20,10,10,2*pi];
       abs(a(i))<=1.5*TS;
       abs(beta(i))<=0.6;
       abs(beta(i+1)-beta(i))<=0.2
       ];
   CE=[CE;
       x(i+1) == x(i) + TS*v(i)*cos(psi(i) + beta(i));
       y(i+1) == y(i) + TS*v(i)*sin(psi(i) + beta(i));
       v(i+1) == v(i) + TS*a(i);
       psi(i+1) == psi(i) + TS*v(i)/1.738*sin(beta(i));
       ];
end
```

```
C=[CIE,CE];

obj=norm(z(N+1,:)-zref)^2+norm(z(N-1,:)-zref)^2+norm(z(N,:)-zref)^2;

options = sdpsettings('verbose','IPOPT','savesolveroutput',1);

optimize(C,obj,options);


xopt=double(x);

yopt=double(y);

vopt=double(v);

psiopt=double(psi);

aopt=double(a);

betaopt=double(beta);


T=(1:(N+1)).*TS;

figure

subplot(2,2,1)

plot(T,xopt)

xlabel('time')

ylabel('x_opt')

subplot(2,2,2)

plot(T,yopt)

xlabel('time')

ylabel('y_opt')

subplot(2,2,3)

plot(T,vopt)

xlabel('time')

ylabel('v_opt')

subplot(2,2,4)

plot(T,psiopt)

xlabel('time')

ylabel('psi_opt')
```

```
figure

plot(xopt,yopt)

xlabel('x')

ylabel('y')

axis equal
```



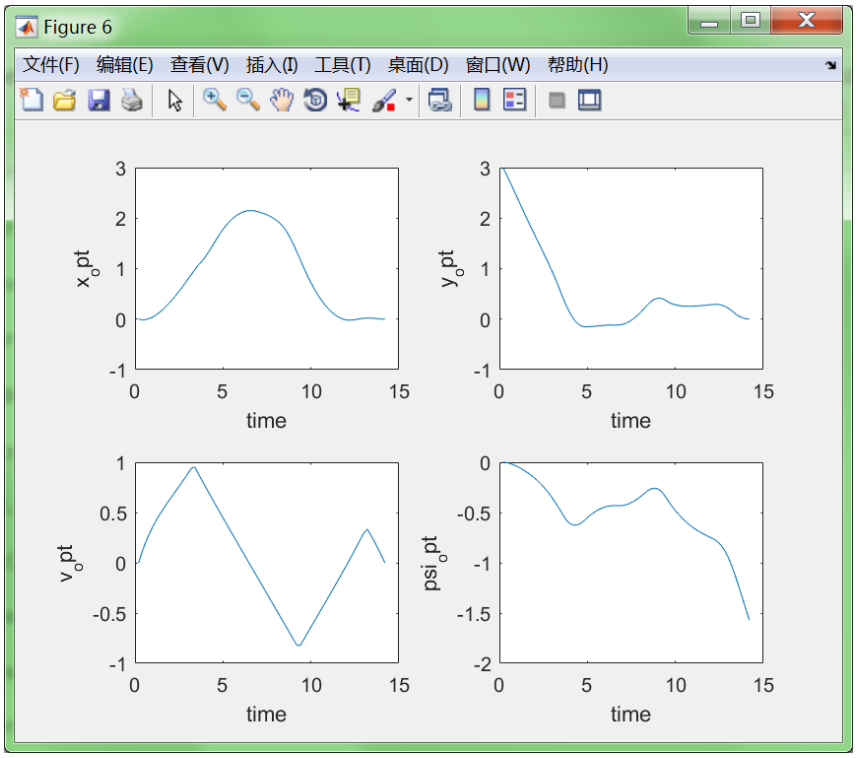


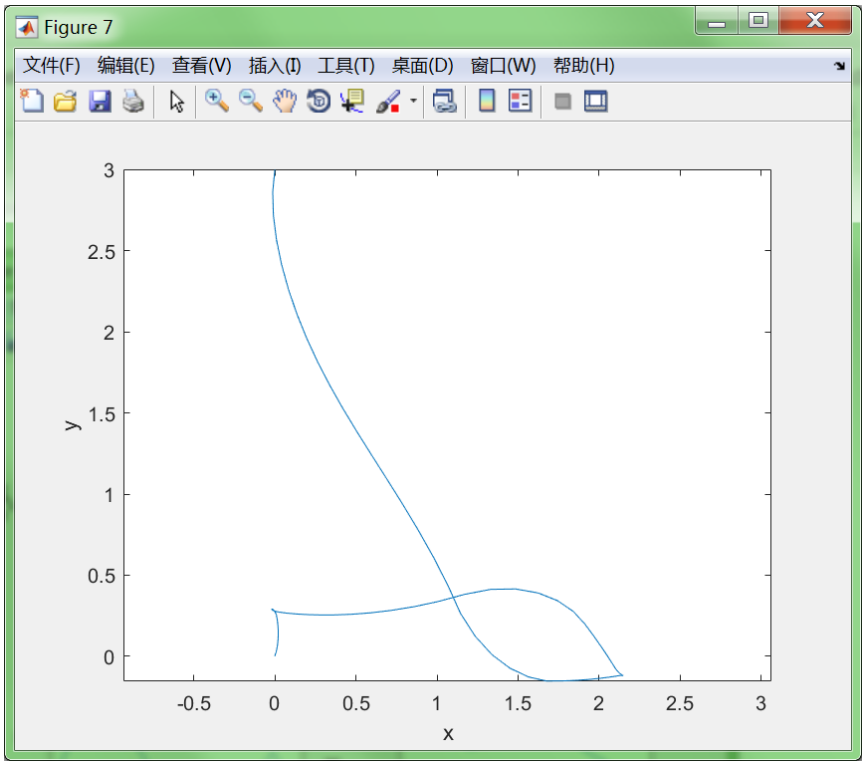

```
%% 5(b)
```

```
TS = 0.2;

N = 70;

TFinal = TS*N;

lr=1.738;

lf=lr;

x=sdpvar(N+1,1);

y=sdpvar(N+1,1);

v=sdpvar(N+1,1);

psi=sdpvar(N+1,1);

a=sdpvar(N+1,1);

beta=sdpvar(N+1,1);

z = [x,y,v,psi];

zref=[0, 0, 0,-1*pi/2];

Cinit=z(1,:)==[0,3,0,0];

Cfinal=z(N+1,:)==[0,0,0,-1*pi/2];

CIE=[abs(a(N+1))<=1.5*TS,abs(beta(N+1))<=0.6];

CE=[Cinit,Cfinal];

for i=1:N

   CIE=[CIE;

       [-20,-0.2,-10,-2*pi] <= z(i,:)<=[20,10,10,2*pi];

       abs(a(i))<=1.5*TS;

       abs(beta(i))<=0.6;

       abs(beta(i+1)-beta(i))<=0.2

       ];

   CE=[CE;

       x(i+1) == x(i) + TS*v(i)*cos(psi(i) + beta(i));

       y(i+1) == y(i) + TS*v(i)*sin(psi(i) + beta(i));

       v(i+1) == v(i) + TS*a(i);

       psi(i+1) == psi(i) + TS*v(i)/1.738*sin(beta(i));

       ];
```

```
end

C=[CIE,CE];

obj=norm(z(N+1,:)-zref)^2+norm(z(N-1,:)-zref)^2+norm(z(N,:)-zref)^2;

options = sdpsettings('verbose','IPOPT','savesolveroutput',1);

optimize(C,obj,options);

xopt=double(x);

yopt=double(y);

vopt=double(v);

psiopt=double(psi);

aopt=double(a);

betaopt=double(beta);


T=(1:(N+1)).*TS;

figure

subplot(2,2,1)

plot(T,xopt)

xlabel('time')

ylabel('x_opt')

subplot(2,2,2)

plot(T,yopt)

xlabel('time')

ylabel('y_opt')

subplot(2,2,3)

plot(T,vopt)

xlabel('time')

ylabel('v_opt')

subplot(2,2,4)

plot(T,psiopt)

xlabel('time')

ylabel('psi_opt')
```

```
figure

plot(xopt,yopt)

xlabel('x')

ylabel('y')

axis equal
```

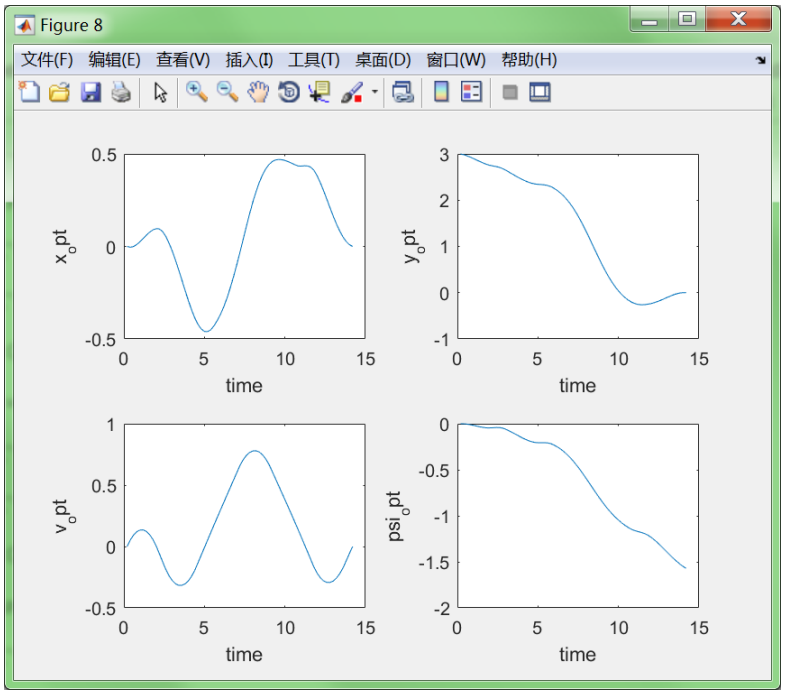


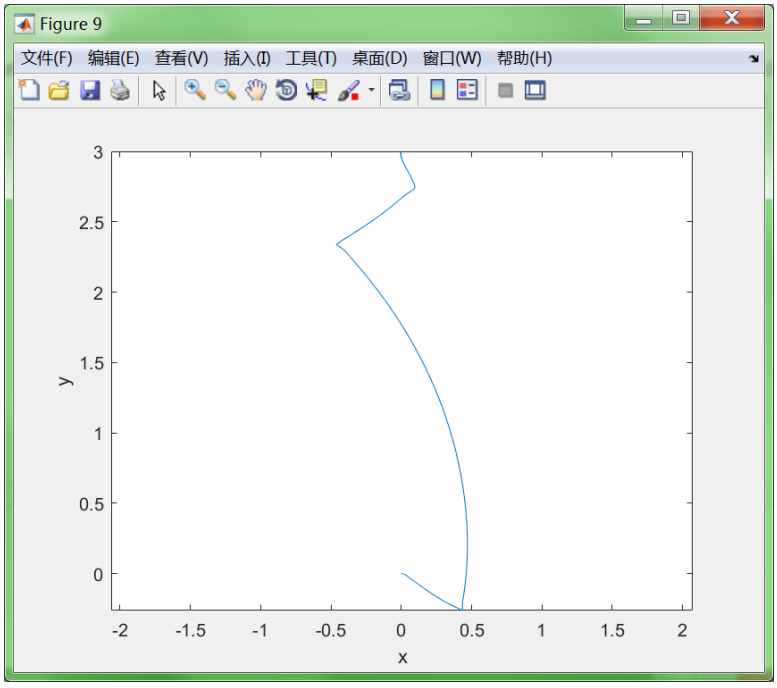


```
%% 5(c)
TS = 0.2;
N = 70;
TFinal = TS*N;
lr=1.738;
lf=lr;
x=sdpvar(N+1,1);
y=sdpvar(N+1,1);
v=sdpvar(N+1,1);
psi=sdpvar(N+1,1);
a=sdpvar(N+1,1);
beta=sdpvar(N+1,1);
z = [x,y,v,psi];
zref=[0, 0, 0,-1*pi/2];
Cinit=z(1,:)==[0,3,0,0];
Cfinal=z(N+1,:)==[0,0,0,-1*pi/2];
CIE=[abs(a(N+1))<=1.5*TS,abs(beta(N+1))<=0.6];
CE=[Cinit,Cfinal];
for i=1:N
   CIE=[CIE;
       [-20,-5,-10,-2*pi] <= z(i,:)<=[20,10,10,2*pi];
       abs(a(i))<=1.5*TS;
       abs(a(i+1)-a(i))<=0.06;
       abs(beta(i))<=0.6;
       abs(beta(i+1)-beta(i))<=0.2
       ];
   CE=[CE;
       x(i+1) == x(i) + TS*v(i)*cos(psi(i) + beta(i));
       y(i+1) == y(i) + TS*v(i)*sin(psi(i) + beta(i));
       v(i+1) == v(i) + TS*a(i);
```

```
        psi(i+1) == psi(i) + TS*v(i)/1.738*sin(beta(i));
        ];
end
C=[CIE,CE];
obj=norm(z(N+1,:)-zref)^2+norm(z(N-1,:)-zref)^2+norm(z(N,:)-zref)^2;
options = sdpsettings('verbose','IPOPT','savesolveroutput',1);
optimize(C,obj,options);
xopt=double(x);
yopt=double(y);
vopt=double(v);
psiopt=double(psi);
aopt=double(a);
betaopt=double(beta);

T=(1:(N+1)).*TS;
figure
subplot(2,2,1)
plot(T,xopt)
xlabel('time')
ylabel('x_opt')
subplot(2,2,2)
plot(T,yopt)
xlabel('time')
ylabel('y_opt')
subplot(2,2,3)
plot(T,vopt)
xlabel('time')
ylabel('v_opt')
subplot(2,2,4)
plot(T,psiopt)
```

```
xlabel('time')

ylabel('psi_opt')

figure

plot(xopt,yopt)

xlabel('x')

ylabel('y')

axis equal
```





Published with MATLAB? R2015b