Contents

Dynamics of the system

Notations: For a given variable, x, dx is its time derivative, ddx is 2nd-order derivative.

```
clc
clear all;
close all;
% the following parameters for the arm
I1=10;  I2 = 10; m1=5; r1=.5; m2=5; r2=.5; l1=1; l2=1;
g=9.8;

% we compute the parameters in the dynamic model
a = I1+I2+m1*r1^2+ m2*(l1^2+ r2^2);
b = m2*l1*r2;
d = I2+ m2*r2^2;

symx= sym('symx',[4,1]);

M = [a+2*b*cos(symx(2)), d+b*cos(symx(2));
    d+b*cos(symx(2)), d];
C = [-b*sin(symx(2))*symx(4), -b*sin(symx(2))*(symx(3)+symx(4)); b*sin(symx(2))*symx(3),0];
G = [m1*g*r1*cos(symx(1))+m2*g*(l1*cos(symx(1))+r2*cos(symx(1)+symx(2)));
    m2*g*r2*cos(symx(1)+symx(2))];


invM = inv(M);
invMC= inv(M)*C;
```

initial condition and Final condition

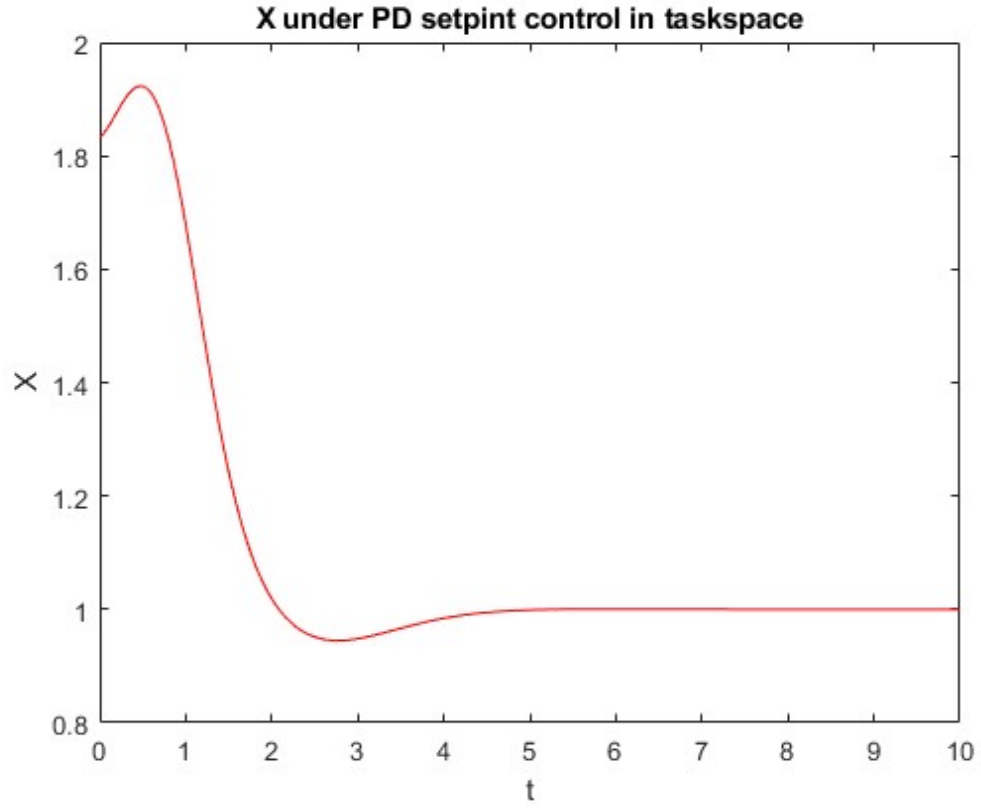
```
x0= [-0.5,0.2,0.1,0.1];

%Set point in cartesian space
Xd=[1,1];
```

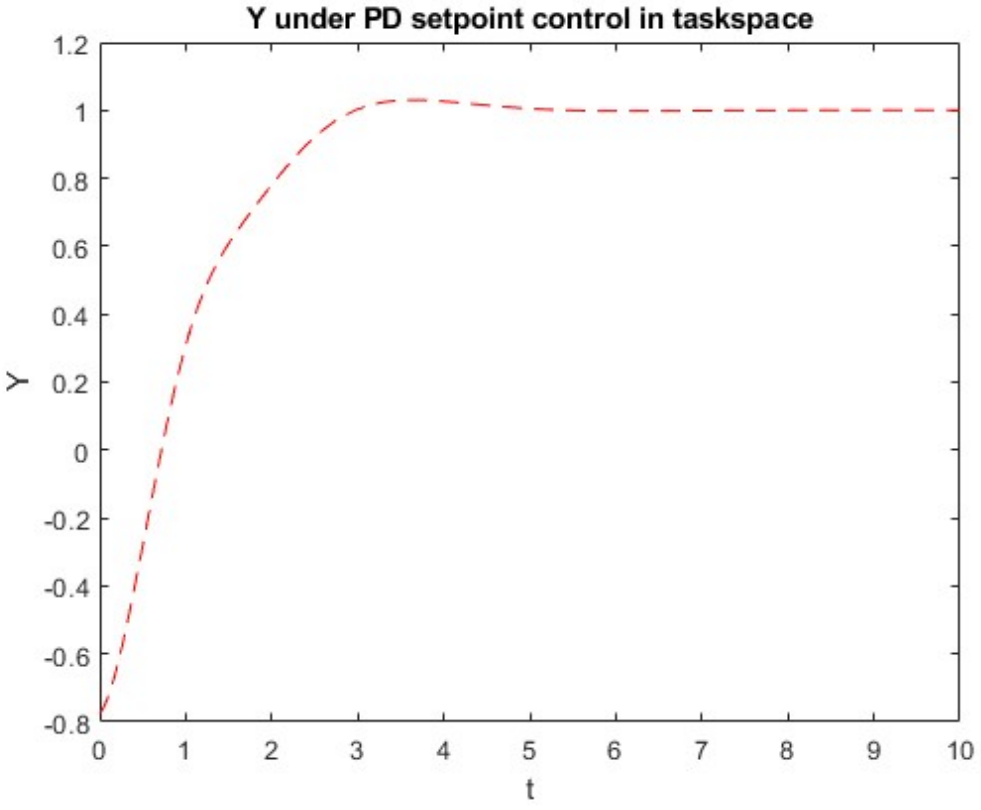
PD+ GRAVITY COMPENSATION control for set point tracking in task space

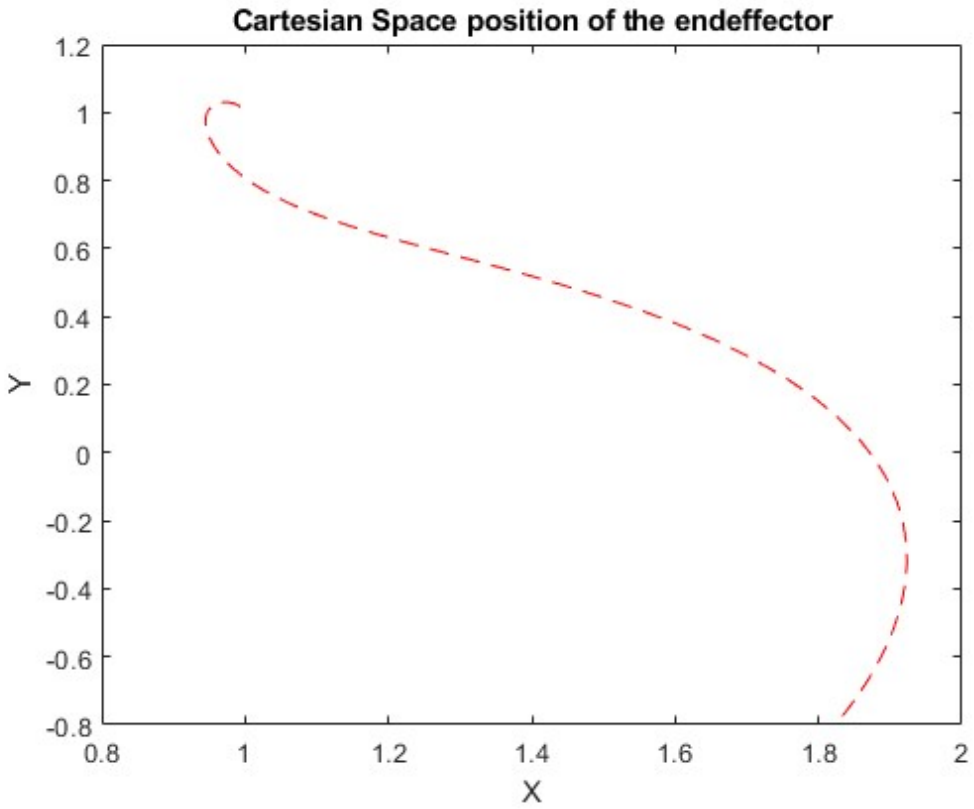
```
tf=10;
options = odeset('RelTol',1e-4,'AbsTol',[1e-4, 1e-4, 1e-4, 1e-4]);
[T,X] = ode45(@(t,x) PDControlGravity_taskspace(t,x,[I1,I2,m1,r1,m2,r2,l1,l2]),[0 tf],x0, option
s);
```

Calculate X and Y from joint angles

```
x(:,1)=l1*cos(X(:,1))+l2*cos(X(:,2)+X(:,1));
figure

plot(T, x(:,1),'r-');
xlabel('t')
ylabel('X')
title('X under PD setpint control in taskspace');
hold on

figure
y(:,1)=l1*sin(X(:,1))+l2*sin(X(:,2)+X(:,1));
plot(T, y(:,1),'r--');
title('Y under PD setpoint control in taskspace');
xlabel('t')
ylabel('Y')
hold on

figure

plot(x(:,1),y(:,1),'r--')
title('Cartesian Space position of the endeffector')
xlabel('X')
ylabel('Y')
```


X under PD setpint control in taskspace
X
t
2
1.8
1.6
1.4
1.2
1
0.8
0
1
2
3
4
5
6
7
8
9
10


Y under PD setpoint control in taskspace
Y
t
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
1
2
3
4
5
6
7
8
9
10



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