Trajectory generation

Contents

Link1

```
t0=0;
tf=20;
q1_0=0;
q1_f=15;
v1_0=5;
v1_f=0;
t = linspace(t0,tf,100);
c = ones(size(t));
M = [ 1 t0 t0^2 t0^3;
0 1 2*t0 3*t0^2;
1 tf tf^2 tf^3;
0 1 2*tf 3*tf^2];
b = [q1_0; v1_0; q1_f; v1_f];
a1 = inv(M)*b;
%a1=[0 0 0 0]
```

```
qd1 = a1(1).*c + a1(2).*t +a1(3).*t.^2 + a1(4).*t.^3;
vd1 = a1(2).*c +2*a1(3).*t +3*a1(4).*t.^2;
ad1 = 2*a1(3).*c + 6*a1(4).*t;


%Initial estimate for phi and system values
I=8;
mgd=5;
fv=2.5;
alpha=[4;1;mgd;fv;I];
```

Implement the passivity based adaptive control with ODE function

```
options = odeset('RelTol',1e-4,'AbsTol',[1e-4, 1e-4, 1e-4,1e-4,1e-4]);
[T,X] = ode45(@(t,x) ode1linkTracking_passivity_adaptive(t,x,a1'),[0 tf],alpha,options);
```

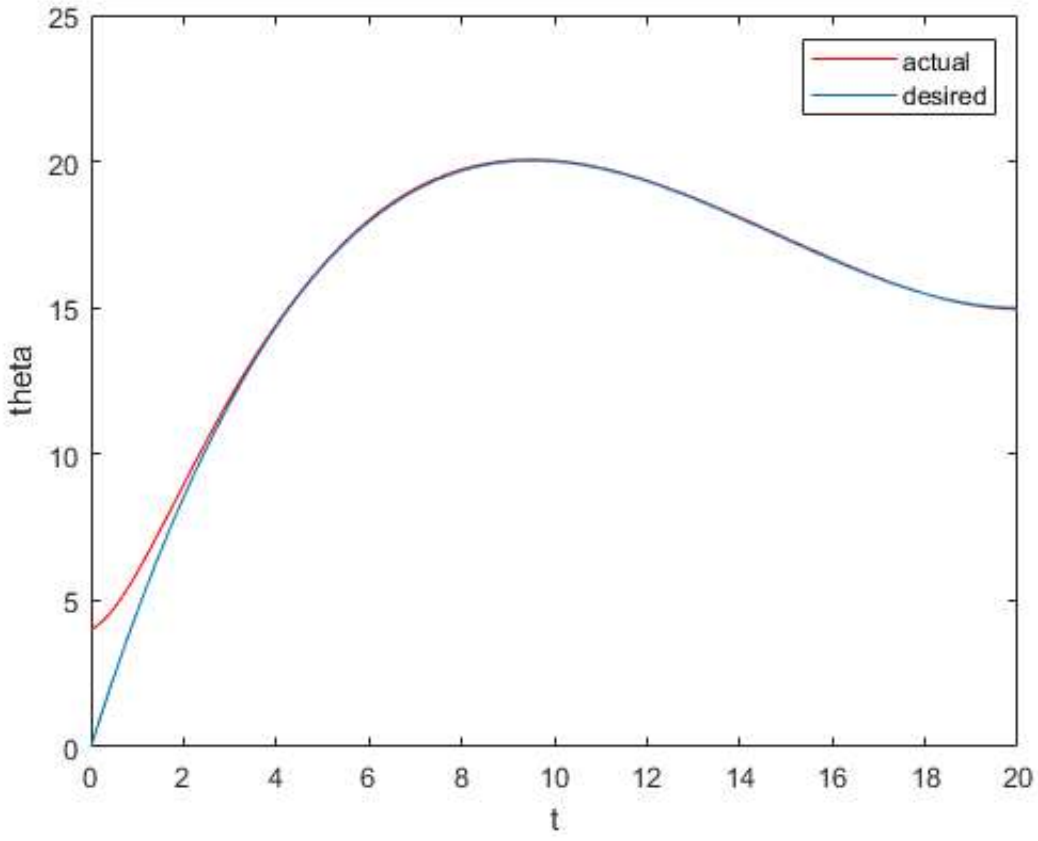
Plotting the result:

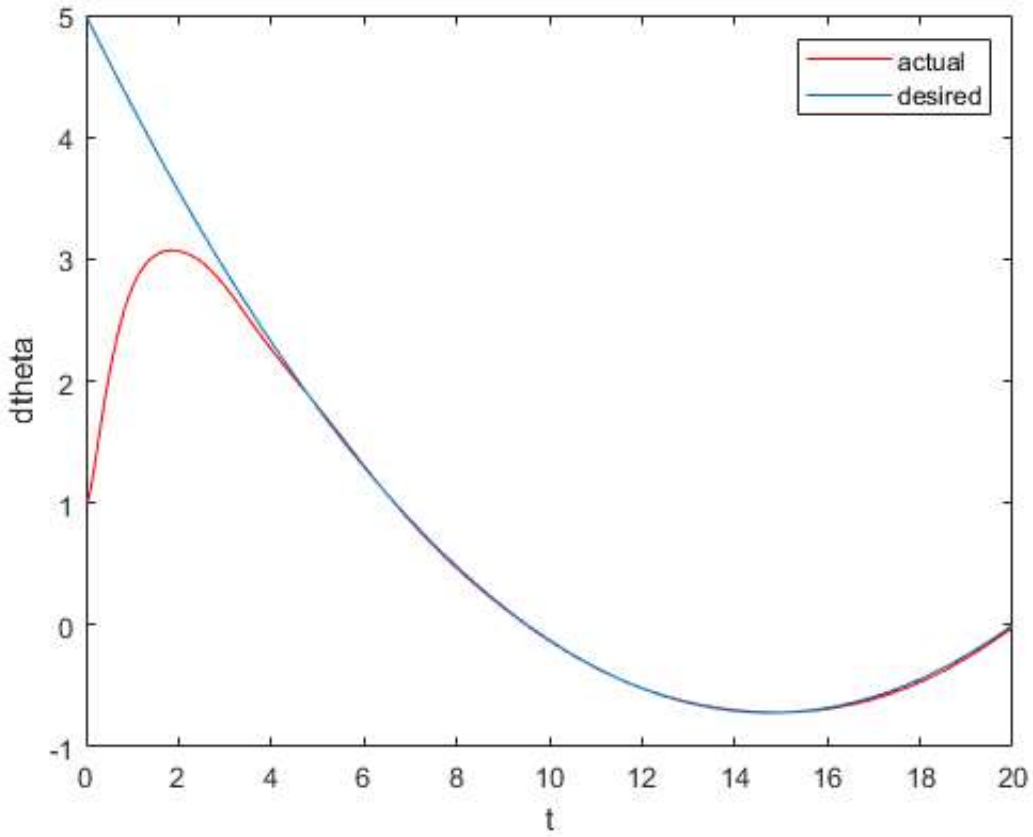
```
 figure('Name','Theta under passivity based Adaptive control');
```

```
plot(T, X(:,1),'r-');
xlabel('t')
ylabel('theta')
hold on
plot(t,qd1);
hold on;
legend('actual', 'desired')

figure('Name','dTheta under Passivity based Adaptive control');

plot(T, X(:,2),'r-');
xlabel('t')
ylabel('dtheta')
hold on
plot(t,vd1);
hold on;
legend('actual', 'desired')
```





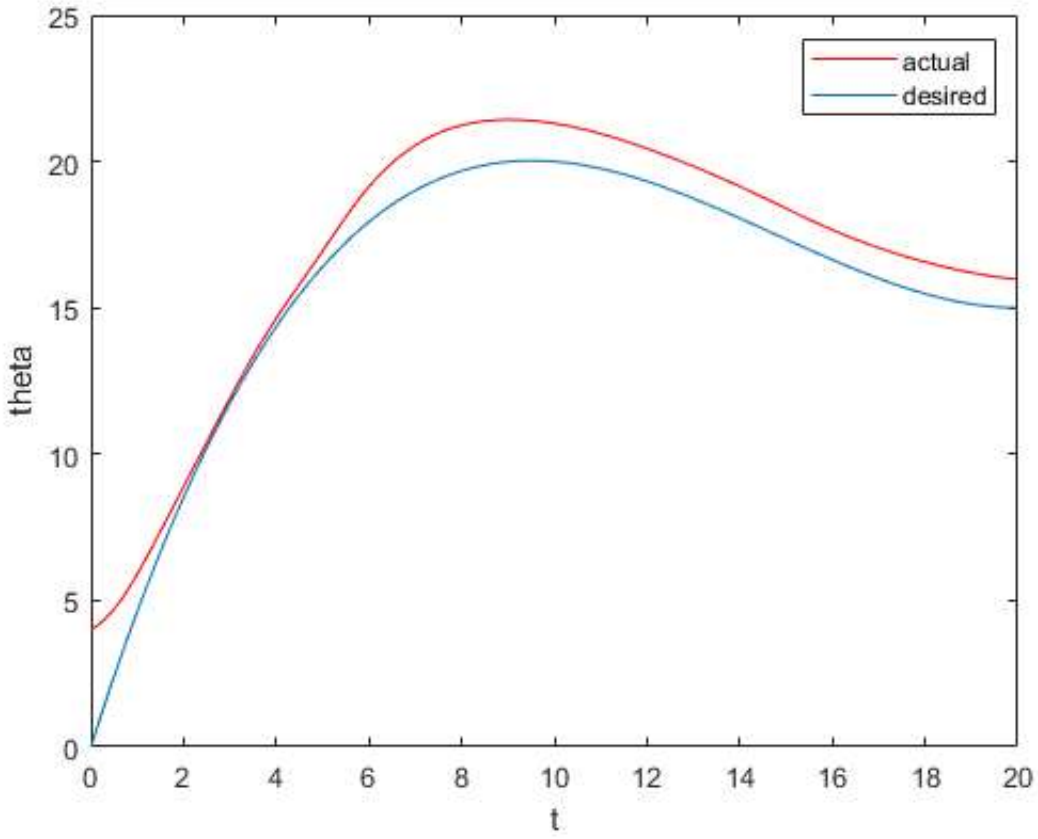
Implement the passivity based robust control with ODE function

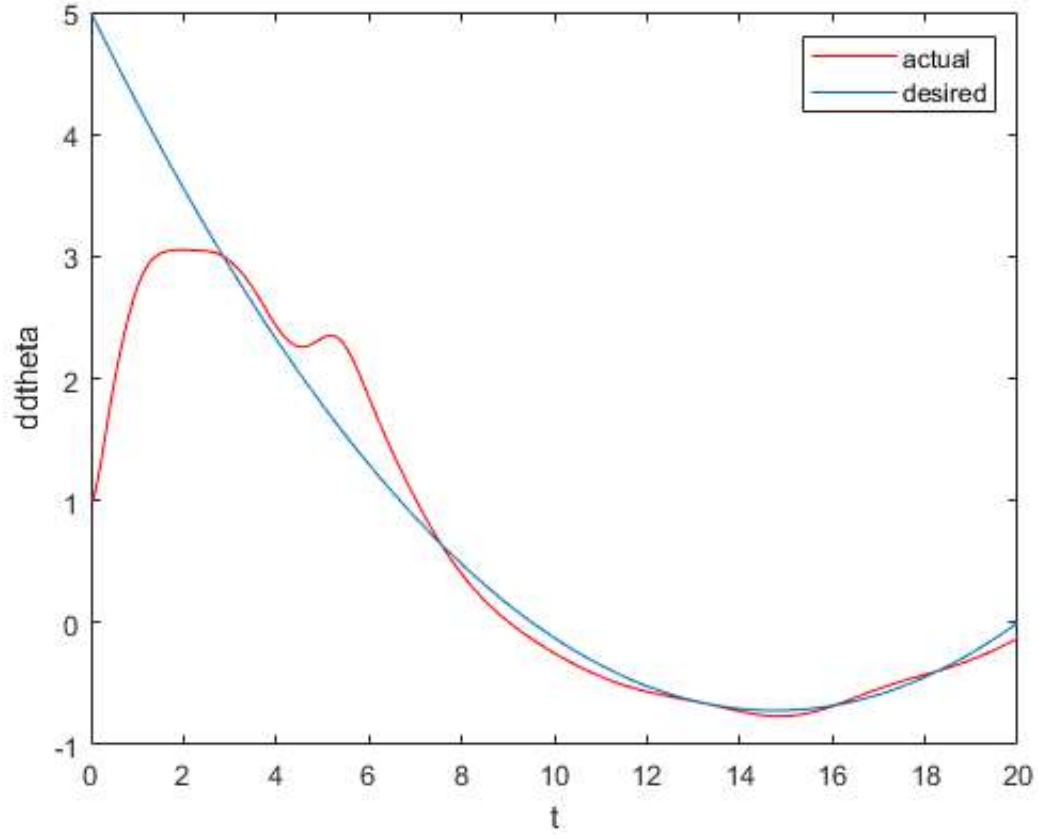
```
options = odeset('RelTol',1e-4,'AbsTol',[1e-4, 1e-4, 1e-4, 1e-4, 1e-4]);
[T,X4] = ode45(@(t,x) ode1linkTracking_passitvity_robust(t,x,a1'),[0 tf],alpha,options);
```

Plotting the result:

```
figure('Name','Theta under Passivity based robust control');
plot(T, X4(:,1),'r-');
xlabel('t')
ylabel('theta')
hold on
plot(t,qd1);
hold on;
legend('actual', 'desired')

figure('Name','dTheta under passivity based robust control');
plot(T, X4(:,2),'r-');
xlabel('t')
ylabel('ddtheta')
hold on
plot(t,vd1);
hold on;
legend('actual', 'desired')
```


actual
desired
theta
t
0
5
10
15
20
25
0
2
4
6
8
10
12
14
16
18
20


actual
desired
ddtheta
t
-1
0
1
2
3
4
5
0
2
4
6
8
10
12
14
16
18
20

Summary

1.From the plot, the passivity based adaptive controller tracking looks better than the passivity based robust controller. Eventhough the error in the starting state and dynamics are larger, still it converges quicker.

2.Whereas the robust controller is not able to exactly follow the the desired trajectory.

3.Comparing the inverse dynamic adaptive and passivity based adaptive, the latter one is able to perform better eventhough the error is large.

4. Comparing the inverse dynamic robust and passivity based robust, the velocity profile of the passivity based is not smooth and also the it's very sensitive the parameters. So, tuning is much difficult in robust.

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