## Contents



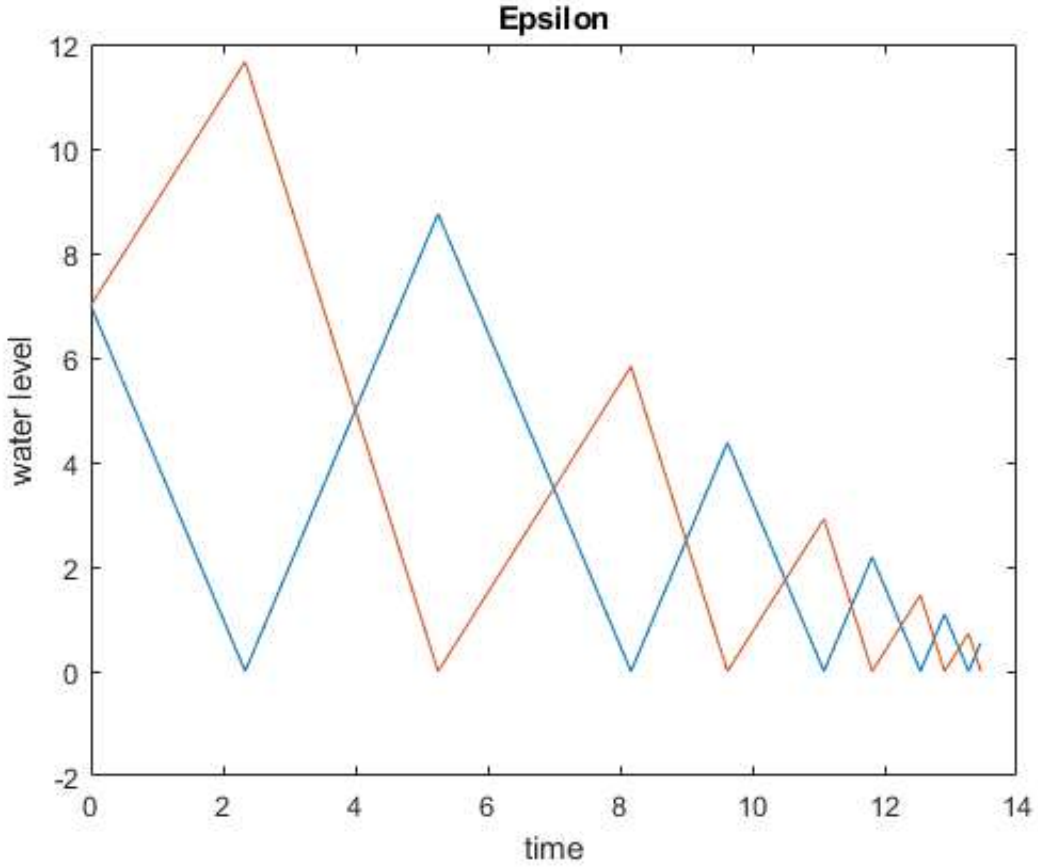
## Hybrid Control Homework #2

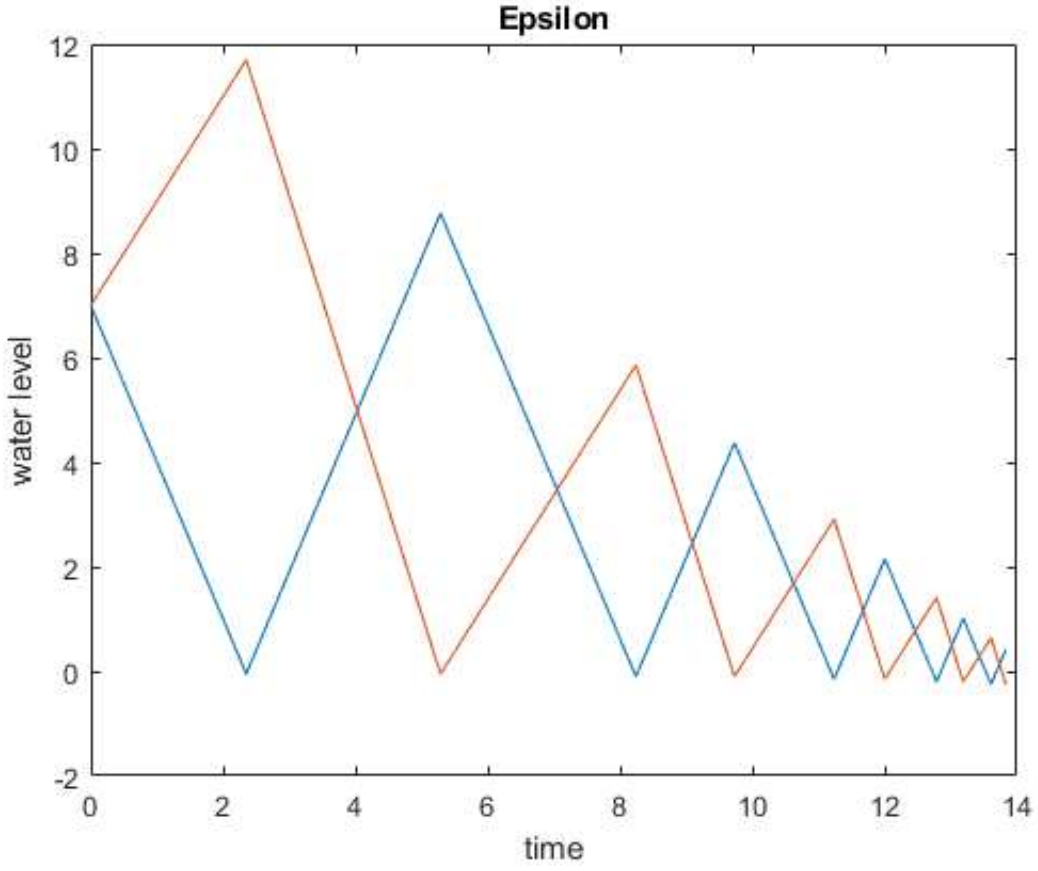
```
clc; clear; close all;
```

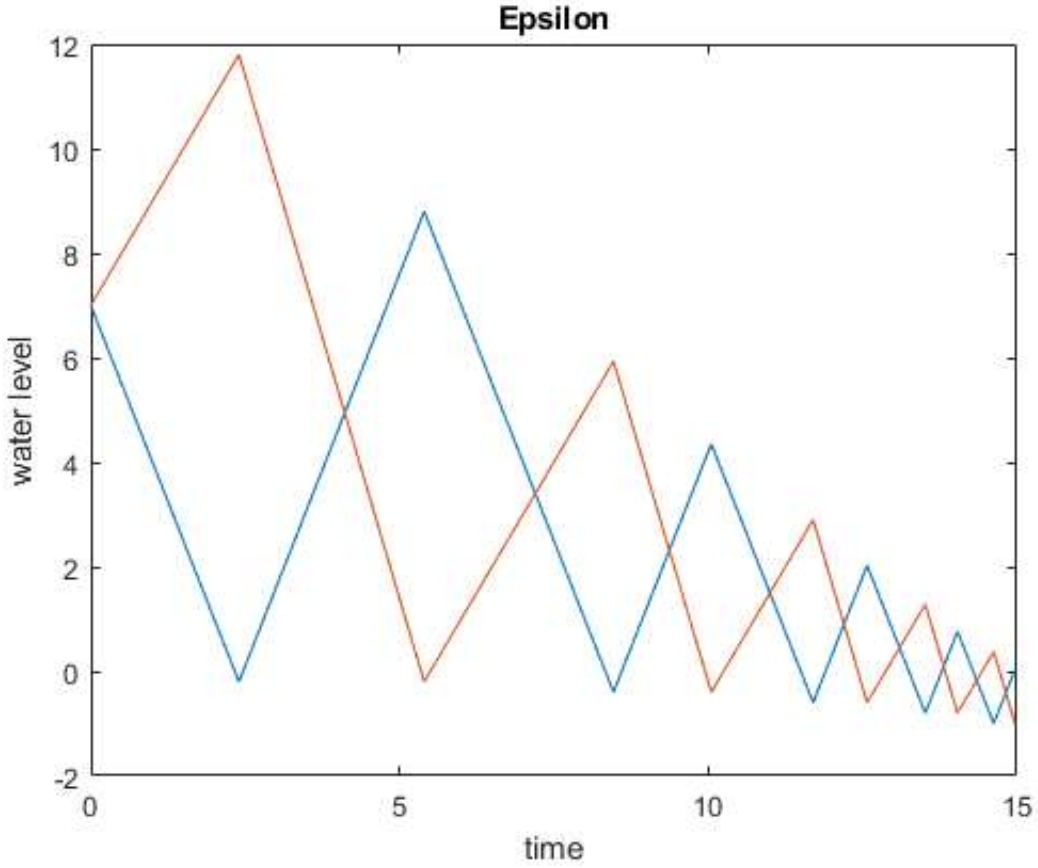
## Problem 1 Spatial

```
%%%%% Parameters
r1 = 5;
r2 = 5;
v1 = 3;
v2 = 4;
w = 6;


epsilon = [0, 0.05, 0.2, 0.5, 0.6];

for j = 1:length(epsilon)
    %%%%% Initial conditions
    x1 = 7;
    x2 = 7;
    x3 = 0;
    x4 = 0;
    x0 = [x1; x2; x3; x4];

    Tspan = [0 10] ;
    t0 = 0 ; % Initial Time
    t_vec = [] ; x = [] ;

    q0_bool = false;
    q1_bool = false;

    if x0(1) <= x0(3) - epsilon(j)
        func = @(t,x) q1(t,x,w,v1,v2,r1,r2);
        options = odeset('Events',@(t,x) event_q1(t,x,w,v1,v2,r1,r2,epsilon(j)));
        q1_bool = true;

    else
        func = @(t,x) q0(t,x,w,v1,v2,r1,r2);
        options = odeset('Events',@(t,x) event_q0(t,x,w,v1,v2,r1,r2,epsilon(j)));
        q0_bool = true;
    end

    for i = 1:10
        % Continuous Dynamics
        [t,x_vec] = ode45(func, t0+Tspan, x0, options) ;
        % Save simulation data
        t_vec = [t_vec; t] ;
        x = [x; x_vec] ;
```

```
        % Discrete Impact Dynamics
        x0 = x_vec(end,:);
        t0 = t_vec(end);

        % Simulate the system until event (water tank) occurs
        if x0(1) <= x0(3) - epsilon(j) && q0_bool
            func = @(t,x) q1(t,x,w,v1,v2,r1,r2);
            options = odeset('Events',@(t,x) event_q1(t,x,w,v1,v2,r1,r2,epsilon(j)));
            x0(3) = x0(1);
            q1_bool = true;
            q0_bool = false;

        elseif x0(2) <= x0(4) - epsilon(j) && q1_bool
            func = @(t,x) q0(t,x,w,v1,v2,r1,r2);
            options = odeset('Events',@(t,x) event_q0(t,x,w,v1,v2,r1,r2,epsilon(j)));
            x0(4) = x0(2);
            q0_bool = true;
            q1_bool = false;
        end

    end

    figure();
    plot(t_vec,x(:,1));
    hold on;
    plot(t_vec,x(:,2));
    xlabel("time");
    ylabel("water level");
    k = epsilon;
    title("Epsilon");
    hold off;
end
```


Epsilon
water level
time
12
10
8
6
4
2
0
-2
0
2
4
6
8
10
12
14


Epsilon
water level
time
12
10
8
6
4
2
0
-2
0
2
4
6
8
10
12
14


Epsilon
water level
time
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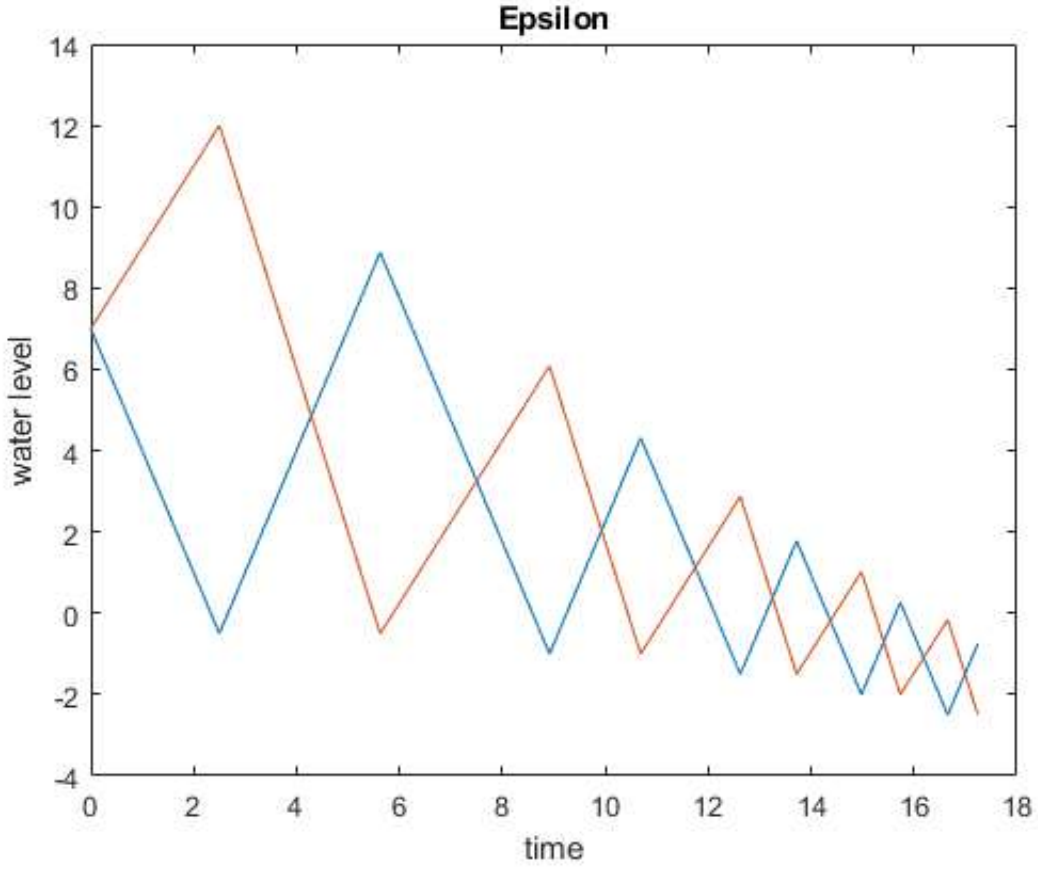
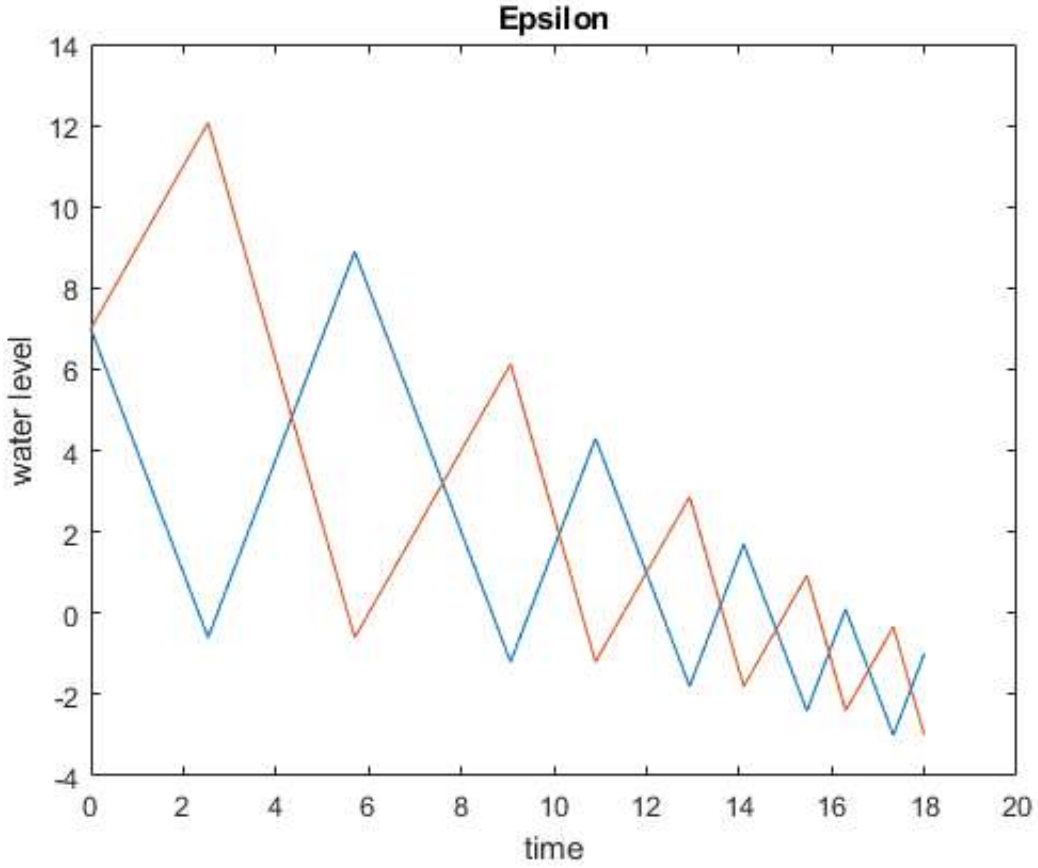
10
8
6
4
2
0
-2
0
5
10
15


Epsilon
water level
time
14
12
10
8
6
4
2
0
-2
-4
0
2
4
6
8
10
12
14
16
18

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