CMPE 246: Project Update #1

Due on Wednesday, May 18, 2015

Ricardo Sanfelice 3:00pm

Vijay Muthukumaran

Problem 1

Update on the system-

The state of the system is x.

$$x = \begin{pmatrix} x_1 \\ x_2 \\ q \end{pmatrix}$$

where x_1 and x_2 are positions of the system and q is a memory state such that $q \in [1, 2]$. This memory state is used to remember which of the two different type of flow or jump sets that need to be used.
In order to prevent a solution reaching a local minima that might be present next to an obstacle, this work is to separate the region of space around the obstacle as two wedges of equal slope, such that no flow or jumps can happen in this region (based on which flow or jump set is currently being used). Let r be the point on one axis where the obstacle is present, for simplicity I am assuming that it is only present on one of the axis. These two regions are given by O_1 and O_2. Essentially I am forming the triangle with two separate lines $x = y + r$, $x = r - y$ and any point that is smaller than the set of points that define these two lines are inside the wedge. Thus, my two regions are-

$$0_1 = \{x_1, x_2 \mid x_2 \geq 0,\ x_1 \leq x_2 + r,\ x_1 \geq r - x_2\} \tag{1}$$
$$0_2 = \{x_1, x_2 \mid x_2 \leq 0,\ x_1 \geq x_2 + r,\ x_1 \leq r - x_2\} \tag{2}$$

Now, I am going to define my flow and jump sets.
The system is in the flow set when the points are larger than the lines. And as such they are-

$$C_1 = \{x_1, x_2 \mid x_2 <= 0 \ or\ x_1 \geq x_2 + r \ or\ x_1 \leq r - x_2\} \tag{3}$$
$$C_2 = \{x_1, x_2 \mid x_2 >= 0 \ or\ x_1 \leq x_2 + r \ or\ x_1 \geq r - x_2\} \tag{4}$$

The jump sets are also defined by two similar lines with a longer slope as $x = y + r + g$, $x = r - y + g$. The jumps occur when they are inside these points.

$$D_1 = \{x_1, x_2 \mid x_2 >= 0 \ and\ x_1 \leq x_2 + r + g \ and\ x_1 \geq r - x_2\} \tag{5}$$
$$D_2 = \{x_1, x_2 \mid x_2 <= 0 \ and\ x_1 \geq x_2 + r + g \ and\ x_1 \leq r - x_2\} \tag{6}$$

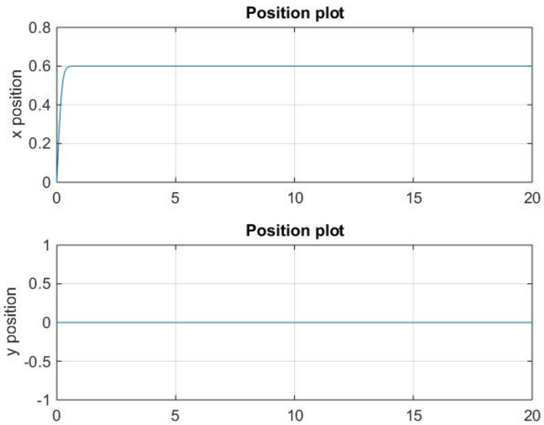
Let $C = C_1 \times \{1\} \cup C_2 \times \{2\}$ and $D = D_1 \times \{1\} \cup D_2 \times \{2\}$.

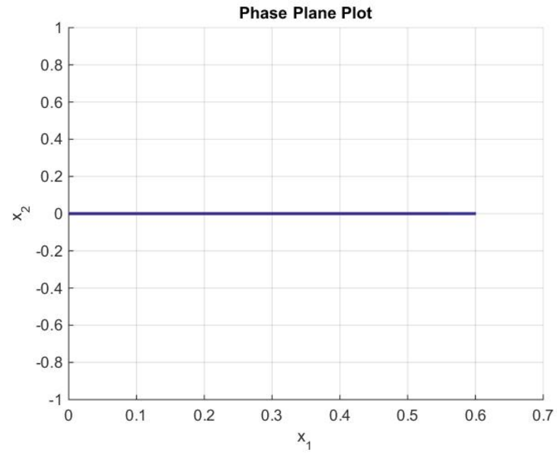
Code for flow map-

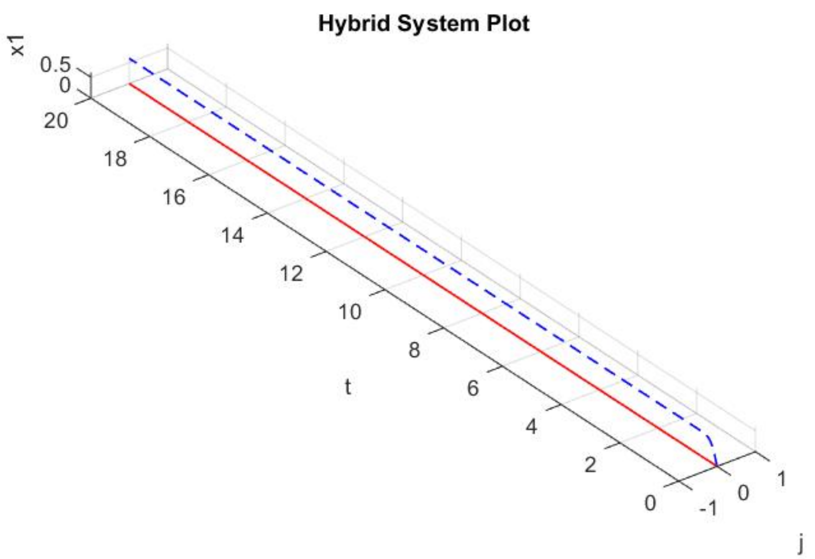
```
function xdot = f_ex1_2(x)

% state
x1 = x(1);
x2 = x(2);
x3 = x(3);

%obstacle position
r = 1;

%target position
```

```
xt1 = 3;
xt2 = 0;

%distance to obstacle (circle around obstacle)
d = sqrt((x1 - r)^2 + x2^2) - 1/(20*sqrt(2));

%piecewise function to find barrie function
if d > 1
    B = 0;
    %partial derivative with B = 0
    u1 = x1 - xt1;
    u2 = x2 - xt2;
else
    B = ((d  - 1)^2)*log(1/d);
    %partial derivative with respective B
    u1 = x1 - xt1 + (log(-1/(2^(1/2)/40 - ((r - x1)^2 + x2^2)^(1/2)))*(2*r - 2*x1)*(2^(1/2)
    u2 = x2 - xt2 + (x2*(2^(1/2)/40 - ((r - x1)^2 + x2^2)^(1/2) + 1)^2)/((2^(1/2)/40 - ((r
end

% differential equations
xdot = [-u1 ; -u2; 0];
end
```

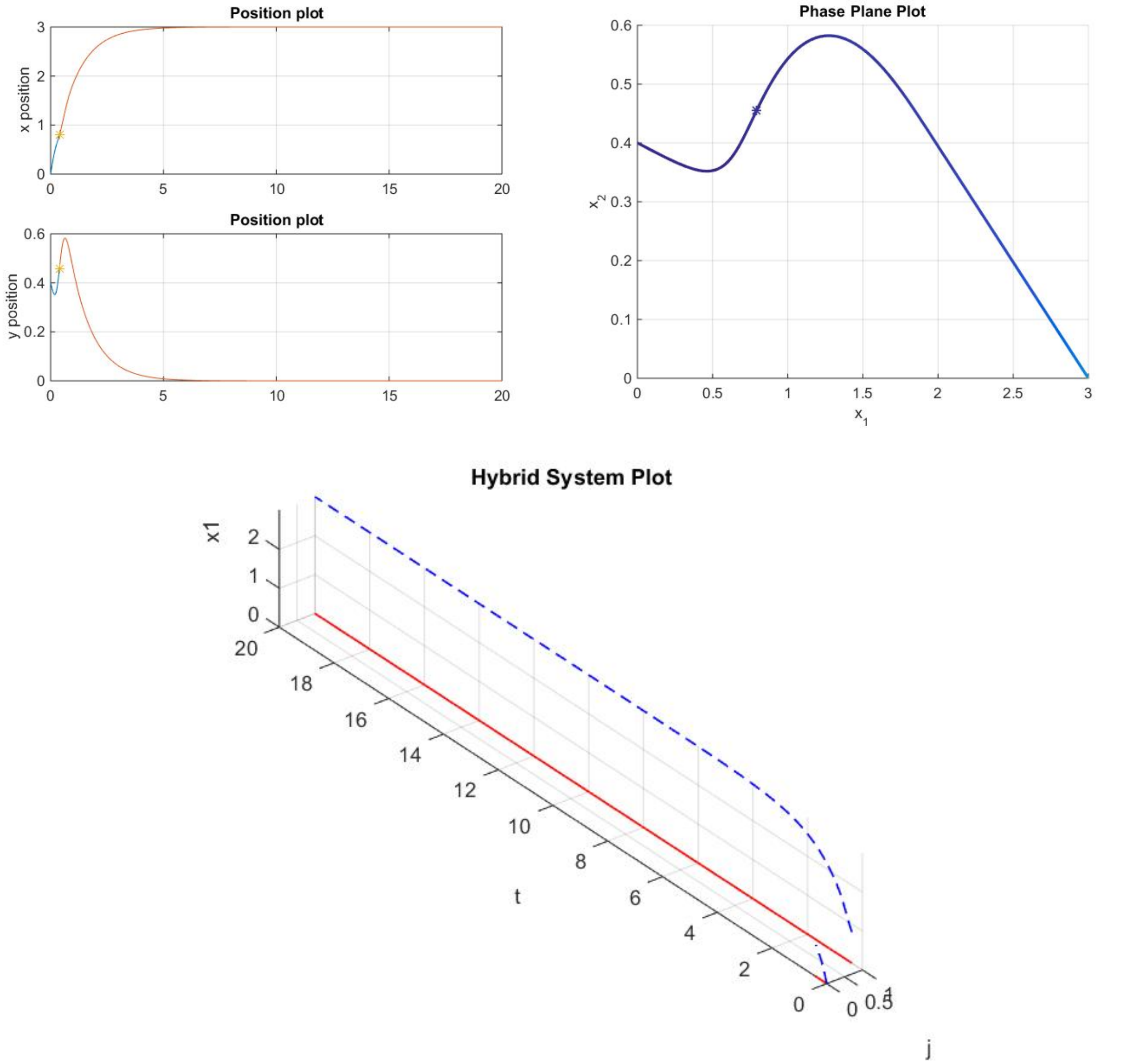
I am having a problem if the starting position for x2 = 0 and q = 1. It doesn't flow to the target, it seems to stop at 0.6 which I guess is some sort of local minima. Graph obtained-







When the initial position is x1 = 0 and x2 = 0.4. Then the system flows, hits the jump set D_1 with q= 1. Therefore, it jumps to q= 2 and flows to the target. Graph obtained-



When the initial position is x1 = 0 and x2 = -0.4. Then the system flows, hits the jump set D_2 with q= 1. Therefore, it doesn't need to jump to q= 2 and continues to flow to the target. Graph obtained-