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```
clear all, close all, clc

AX = [0,20,40,60,70,80,90,100,120,130,140,150,160,170];
AY = [0,4,0,3,3,3,10,10,15,15,15,15,15,15];
interval = length(0:0.1:100);
pathX = linspace(0,max(AX),interval);
pathY = spline(AX,AY,pathX);

clear AX AY interval;
```

Constants

```
k_hard = 15;
k_soft = 0;
linear_velocity = 1.2;
```

Test Case 1

```
pos_x = -1;

pos_y = -1;

% pi/2
veh_theta = 1.5708;

% Generate waypoint index
wpIndex = pathSearch(pathX,pathY,pos_x,pos_y);


disp(['Reference index for TC_1 is: ', num2str(wpIndex)]);

% Heading Calculation
tc_11_heading = computeHeading(pathX,pathY,wpIndex);

disp(['wp heading for TC_1 is: ', num2str(tc_11_heading)]);

% Heading Delta Calculation
heading_delta = tc_11_heading - veh_theta;

disp(['heading delta for TC_1 is: ', num2str(heading_delta)]);
```

```
% Cross Track Error calculation
target_wp = [pathX(wpIndex);pathY(wpIndex)];
veh_pos = [pos_x;pos_y];
crossTrackError = computeCTE(target_wp,veh_pos,tc_11_heading);
disp(['cross track error for TC_1 is: ', num2str(crossTrackError)]);

% Non-linear control term calculation
nonlin_ctrl_term = atan((k_hard*crossTrackError)/(k_soft
+linear_velocity));
disp(['Non Lin Ctrl Term for TC_1 is: ', num2str(nonlin_ctrl_term)]);

% raw steering angle before saturation

raw_steering_angle = heading_delta + nonlin_ctrl_term;
disp(['raw steering angle for TC_1 is: ',
 num2str(raw_steering_angle)]);
```

```
Reference index for TC_1 is: 1
index == 1
    0.7779

   -0.0762

     0

     0

    0.1322

wp heading for TC_1 is: 0.66111
heading delta for TC_1 is: -0.90969
cross track error for TC_1 is: 0.17532
Non Lin Ctrl Term for TC_1 is: 1.1427
raw steering angle for TC_1 is: 0.23302
```

Test case 2

```
pos_x = 10;

pos_y = 9;

% 30 degrees
veh_theta = 0.5236;

% Generate waypoint index
wpIndex = pathSearch(pathX,pathY,pos_x,pos_y);

disp(['Reference index for TC_2 is: ', num2str(wpIndex)]);

% Test Case 2

% Heading Calculation
tc_22_heading = computeHeading(pathX,pathY,wpIndex);
```

```
disp(['wp heading for TC_2 is: ', num2str(tc_22_heading)]);

% Heading Delta Calculation
heading_delta = tc_22_heading - veh_theta;

disp(['heading delta for TC_2 is: ', num2str(heading_delta)]);

% Cross Track Error calculation
target_wp = [pathX(wpIndex);pathY(wpIndex)];
veh_pos = [pos_x;pos_y];
crossTrackError = computeCTE(target_wp,veh_pos,tc_22_heading);
disp(['cross track error for TC_2 is: ', num2str(crossTrackError)]);

% Non-linear control term calculation
nonlin_ctrl_term = atan((k_hard*crossTrackError)/(k_soft
+linear_velocity));
disp(['Non Lin Ctrl Term for TC_2 is: ', num2str(nonlin_ctrl_term)]);

% raw steering angle before saturation

raw_steering_angle = heading_delta + nonlin_ctrl_term;
disp(['raw steering angle for TC_2 is: ',
 num2str(raw_steering_angle)]);
```

```
Reference index for TC_2 is: 63
index == normal
    0.1271

   -0.0468

    4.4927

    3.1532

    0.0216

wp heading for TC_2 is: 0.12641
heading delta for TC_2 is: -0.39719
cross track error for TC_2 is: -4.5394
Non Lin Ctrl Term for TC_2 is: -1.5532
raw steering angle for TC_2 is: -1.9504
```

Test Case 3

```
pos_x = 86;

pos_y = 10.2;

% 88 degrees
veh_theta = 1.5359;

% Generate waypoint index
```

```
wpIndex = pathSearch(pathX,pathY,pos_x,pos_y);

disp(['Reference index for TC_3 is: ', num2str(wpIndex)]);

% Test Case 3

% Heading Calculation
tc_33_heading = computeHeading(pathX,pathY,wpIndex);

disp(['wp heading for TC_3 is: ', num2str(tc_33_heading)]);

% Heading Delta Calculation
heading_delta = tc_33_heading - veh_theta;

disp(['heading delta for TC_3 is: ', num2str(heading_delta)]);

% Cross Track Error calculation
target_wp = [pathX(wpIndex);pathY(wpIndex)];
veh_pos = [pos_x;pos_y];
crossTrackError = computeCTE(target_wp,veh_pos,tc_33_heading);
disp(['cross track error for TC_3 is: ', num2str(crossTrackError)]);

% Non-linear control term calculation
nonlin_ctrl_term = atan((k_hard*crossTrackError)/(k_soft
+linear_velocity));
disp(['Non Lin Ctrl Term for TC_3 is: ', num2str(nonlin_ctrl_term)]);

% raw steering angle before saturation

raw_steering_angle = heading_delta + nonlin_ctrl_term;
disp(['raw steering angle for TC_3 is: ',
 num2str(raw_steering_angle)]);
```

```
Reference index for TC_3 is: 515
index == normal
    0.7333

   -0.0782

    8.4410

  -55.6318

    0.1247

wp heading for TC_3 is: 0.63271
heading delta for TC_3 is: -0.90319
cross track error for TC_3 is: -2.2345
Non Lin Ctrl Term for TC_3 is: -1.535
raw steering angle for TC_3 is: -2.4382
```

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