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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 = 7;  
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)]);

% Stanley output

tcl_output =
    stanleyController(pathX,pathY,pos_x,pos_y,linear_velocity,veh_theta,
    wpIndex);
tcl_steering = tcl_output(1);
disp(['Filtered steering angle for TC_1 is: ',
    num2str(tcl_steering)]);

Reference index for TC_1 is: 1
index == 1
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: 0.79662
raw steering angle for TC_1 is: -0.11307
index == 1
Filtered steering angle for TC_1 is: -0.11307

```

## Test case 2

```

pos_x = 10.2;

pos_y = 4.5;

% 7.2422 degrees
veh_theta = 0.136;

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

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

% Test Case 2

```

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---

```

% 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)]);

% Stanley output

tc2_output =
    stanleyController(pathX,pathY,pos_x,pos_y,linear_velocity,veh_theta,
        wpIndex);
tc2_steering = tc2_output(1);
disp(['Filtered steering angle for TC_2 is: ',
    num2str(tc2_steering)]);

Reference index for TC_2 is: 61
index == normal
wp heading for TC_2 is: 0.1422
heading delta for TC_2 is: 0.0061967
cross track error for TC_2 is: -0.052711
Non Lin Ctrl Term for TC_2 is: -0.2983
raw steering angle for TC_2 is: -0.29211
index == normal
Filtered steering angle for TC_2 is: -0.29211

```

## Test Case 3

```

pos_x = 87.3;

pos_y = 8.5;

% 34 degrees

```

---

```

veh_theta = 0.5934;

% 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)]);

% Stanley output

tc3_output =
    stanleyController(pathX,pathY,pos_x,pos_y,linear_velocity,veh_theta,
        wpIndex);
tc3_steering = tc3_output(1);
disp(['Filtered steering angle for TC_3 is: ',
    num2str(tc3_steering)]);

Reference index for TC_3 is: 515
index == normal
wp heading for TC_3 is: 0.63271
heading delta for TC_3 is: 0.039305
cross track error for TC_3 is: -0.094886
Non Lin Ctrl Term for TC_3 is: -0.50553
raw steering angle for TC_3 is: -0.46622
index == normal
Filtered steering angle for TC_3 is: -0.36652

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## Test Case 4

```
pos_x = 93.33;

pos_y = 10.7;

% pi/2
veh_theta = 0.01;

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

disp(['Reference index for TC_4 is: ', num2str(wpIndex)]);

% Heading Calculation
tc_44_heading = computeHeading(pathX,pathY,wpIndex);

disp(['wp heading for TC_4 is: ', num2str(tc_44_heading)]);

% Heading Delta Calculation
heading_delta = tc_44_heading - veh_theta;

disp(['heading delta for TC_4 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_44_heading);
disp(['cross track error for TC_4 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_4 is: ', num2str(nonlin_ctrl_term)]);

% raw steering angle before saturation

raw_steering_angle = heading_delta + nonlin_ctrl_term;
disp(['raw steering angle for TC_4 is: ',
    num2str(raw_steering_angle)]);

% Stanley output

tc4_output =
    stanleyController(pathX,pathY,pos_x,pos_y,linear_velocity,veh_theta,
        wpIndex);
tc4_steering = tc4_output(1);
disp(['Filtered steering angle for TC_4 is: ',
    num2str(tc4_steering)]);

Reference index for TC_4 is: 550
index == normal
wp heading for TC_4 is: 0.0135
```

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heading delta for TC\_4 is: 0.0035004  
cross track error for TC\_4 is: -0.047555  
Non Lin Ctrl Term for TC\_4 is: -0.2706  
raw steering angle for TC\_4 is: -0.2671  
index == normal  
Filtered steering angle for TC\_4 is: -0.2671

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