

# Finding Lane Lines on the Road

## Writeup Report

### Reflection

#### 1. Describe your pipeline. As part of the description, explain how you modified the `draw_lines()` function.

My pipeline consisted of 5 steps. First, I converted the images to grayscale. Second, I used the `gaussian_blur()` function to blur the image. Third, I used the Canny algorithm to detect edges. Fourth, I defined an area of interest and created a masked edges image. Fifth, I ran Hough transform on the edge detected image and drew lines on it.

In order to draw a single line on the left and right lanes, I modified the `draw_lines()` function by creating a new function called `draw_lines_improved()`. First, I fitted a straight line using `np.polyfit()` and returned slope and intercept. Second, I separated left lanes and right lanes based on slope. If the slope of a line segment is negative, it is a left lane; If the slope is positive, it is a right lane. Third, using all the points on the left I re-fitted a straight line, and using all the points on the right I also re-fitted a straight line. Therefore, I had a left lane and a right lane. Fourth, I set up the starting point and end point of each lane I want to draw. To remove lane shakiness, I adjust x points by averaging with previous frames. Lastly, I draw the 2 lanes on the image.

#### 2. Identify potential shortcomings with your current pipeline

One potential shortcoming would be curve detection. If the car is driving on a curve of short radius, the lanes might not be detected as well as the straight-line lanes.

Another shortcoming could be outlier reduction on the Hough lines.

#### 3. Suggest possible improvements to your pipeline

A possible improvement is to apply different algorithms based on road conditions (straight lanes or curves). The current pipeline works well for straight lane detection, but could have bad performance in detecting curves, especially those small-radius curves.

Another possible improvement is to add an outlier reduction algorithm when we do Hough transform.