CS 766 Midterm Report: Lane Detection and Tracking in Adverse Visibility Conditions

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1 Current Progress

As stated in our Project Proposal Timeline, our goal before the mid-term report was to gather the necessary datasets and re-implement existing approaches. The data we collected and plan to use in our future plans was obtained from Udacity's Open Source Self-Driving Car repository (`https://github.com/udacity/self-driving-car`). The data contains various lighting conditions (i.e. daytime, shadows).

We noticed that many current approaches that deal with lane detection with only RGB images follow a certain format. For example, a sequence of steps that we took first was:

1. Color selection (i.e. transform a given RGB image to a different color space such as HSV or HSL).
2. Canny Edge Detection. That is, once you convert the RGB image color space, apply a grayscale conversion, Gaussian smoothing, then implement a canny edge detector.
3. Region of Interest (ROI). An ROI is used to identify a particular area of the image(s) that is *interesting*.
4. Hough Transform. Used for line detection.

Through our investigations, implementing this sequence of methods led to good results in the daytime, where there are not many obstructions on the road. However, it failed to detect lanes in various illumination problems. In addition, we assumed the region of interest took place in the center of the image, which is a strong assumption and does not hold in the case of drastic/steep curves.

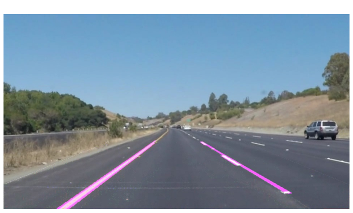

Figure 1: A simple daytime example

Figure 2: Trouble with illumination changes

We've incorporated several improvements into this pipeline based on our research in order to improve its robustness. [2] proposes using lane continuity to filter out non-lane lines, which we added to our detection algorithm. Any line that does not pass through both a near and far region is not likely to be a lane line. Furthermore, [1] uses a Modified RGB Ratio-Based Gradient-Enhancing Conversion Method to produce a grayscale image that improves contrast and more successfully shows lane lines to be extracted. This helped with illumination problems but wasn't entirely successful. We will therefore focus on more sophisticated methods in order to be more robust to illumination.

2 Future Plans

Looking forward, our focus is to re-implement a method proposed by [3]. Similar to the previous methods, the initial step was to convert an RGB image into a grayscale image by taking a weighted sum of the RGB values. To amplify the gradient, the method we plan to re-implement creates a new gray-level image using linear discriminant analysis (LDA). In addition, this new conversion vector will be dynamically updated by using the previous image (under the assumption that we use a sequence of captured images). Lastly, [3] proposes an adaptive Canny edge detector that refers to adaptive threshold being set.

Similar to [3], we will measure the detection rate of the algorithm. That is, we define a *correct detection* to be an image in which the detected lanes lie on real lane markings and that their direction curvatures are the same. A correct detection is determined by observing the image manually as [3] does.

References

[1] Z. Kim. Robust lane detection and tracking in challenging scenarios. *IEEE Transactions on Intelligent Transportation Systems*, 9(1):16–26, March 2008.

[2] Y. C. Leng and C. L. Chen. Vision-based lane departure detection system in urban traffic scenes. In *2010 11th International Conference on Control Automation Robotics Vision*, pages 1875–1880, Dec 2010.

[3] H. Yoo, U. Yang, and K. Sohn. Gradient-enhancing conversion for illumination-robust lane detection. *IEEE Transactions on Intelligent Transportation Systems*, 14(3):1083–1094, Sept 2013.