Canny And Laplacian Of Gaussian Edge Detectors

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Abstract

In the digital image processing field, detection edges of images more precisely is a big challenge. In this task we have implemented effect of varying in canny and Laplacian Of Gaussian (LOG) edge detector parameters. This task is based on Machine Vision course.

Keywords: edge detection, canny, Laplacian of Gaussian (LOG)

1 Introduction

Among numerous types of edge detectors, canny [1] is one of the most powerful and versatile ones. Canny algorithm consists of the following basic steps [2]:

- Smooth the input image with Gaussian filter
- Compute the gradient magnitude and angle images
- Apply nonmaxima suppression to gradient magnitude image.
- Use double thresholding & connectivity analysis to detect and link edges.

In the smoothing step using Gaussian filter with different standard deviation result different output, and also in the last step variation of threshold levels cause variation in detected edges.

Laplacian of Gaussian is another edge detector that detect edges using following three steps

- Smooth the input image with Gaussian filter
- Apply Laplacian
- Find zero crossings to detect edges

In the rest of this report, we have implemented canny edge detector with different standard deviation and threshold levels.

2 Implementation and results

2.1 Constant standard deviation and variation in threshold levels

We have examined operation of canny and LOG edge detector be setting standard deviation value to 1.41 (0.5 for LOG) and changing threshold levels increasing from 0 to 0.99 in 0.01 steps. Figure 1 compares detected canny edges using threshold levels 0.3 and 0.7 and Figure 2 compares detected LOG edges using threshold levels 0.3 and 0.7

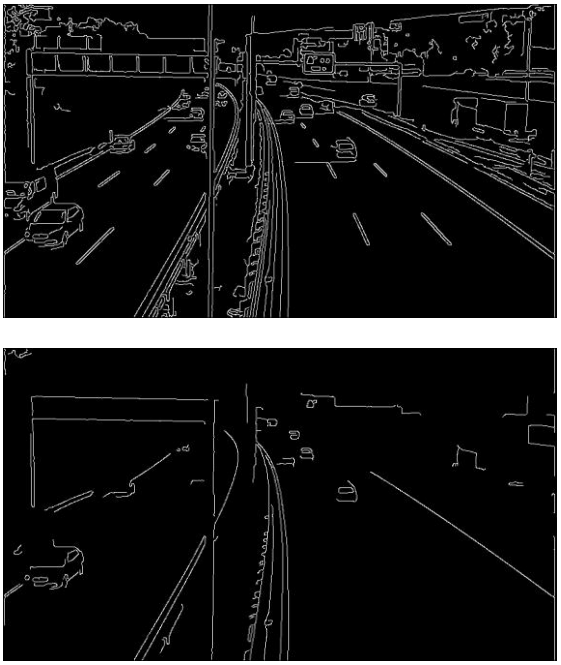

Figure 1: Canny edge detector Constant standard deviation (1.41) and variation in threshold levels. (Upper) Threshold = 0.3 (Lower) Threshold = 0.7

2.2 Constant thresholds and variation in standard deviation.

In this phase we have written a code in order to recognize behavior of canny and LOG edge detector by changing standard deviation in 0.1-4 (0.01-1 for LOG) interval

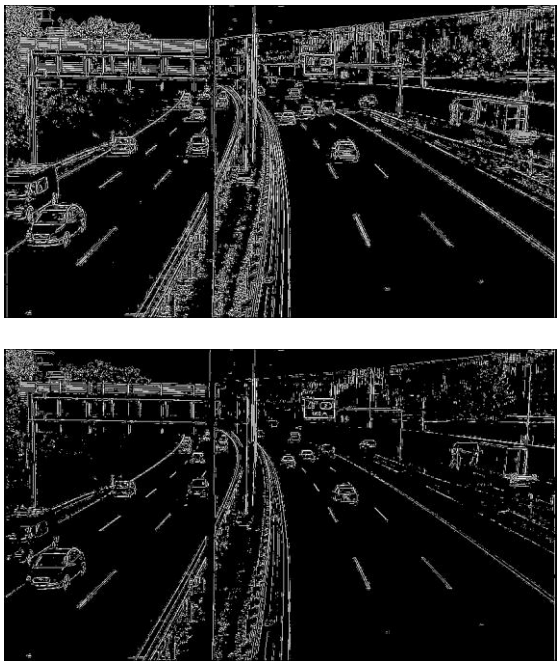

Figure 2: LOG edge detector Constant standard deviation (0.5) and variation in threshold levels. (Upper) Threshold = 0.3 (Lower) Threshold = 0.7

by increasing 0.05 (0.02 for LOG) in each iteration, and constant threshold level (0.4). In Figure 3 and 4 we can see the result of detecting edges by constant threshold levels and standard deviation values 1 and 3 for canny, and 0.3 and 0.7 for LOG.

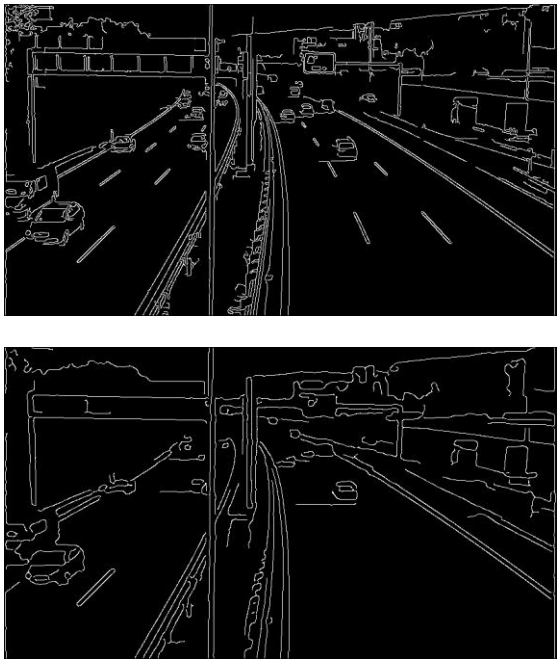

Figure 3: Canny edge detector Constant thresholds (0.4) and variation in standard deviation. (Upper) standard deviation = 1 (Lower) standard deviation = 3

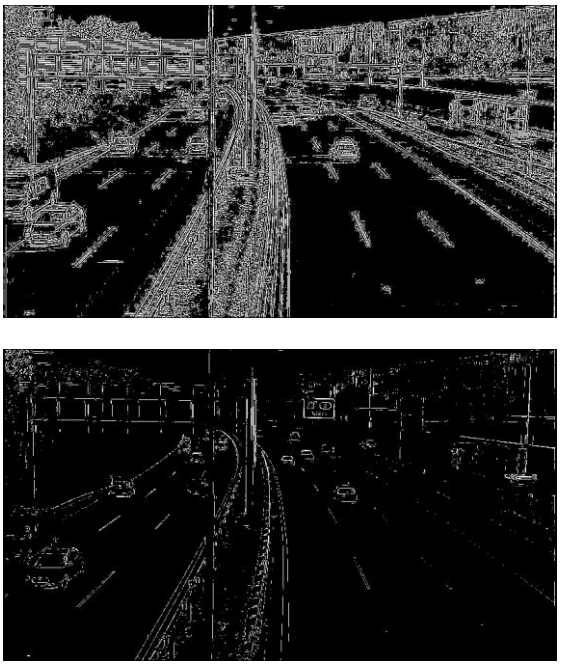

Figure 4: LOG edge detector Constant thresholds (0.4) and variation in standard deviation. (Upper) standard deviation = 0.3 (Lower) standard deviation = 0.7

3 Conclusion

3.1 Constant standard deviation and variation in threshold levels

From the recorded video frames for constant standard deviation and variation in threshold levels we can conclude that in lower threshold levels canny operator detects soft and strong edges and by higher levels it detects only strong edges of the image. Also the location of edge does not change during increasing threshold levels.

Gaussian smooth filter reduces the effect of noise in images. Second derivation increases the effect of noise and emphasize abrupt changes in image. For LOG for a constant standard deviation, increasing threshold eliminate small points and tracks that have been detected as edges.

3.2 Constant thresholds and variation in standard deviation.

As we know bigger standard deviation means more suppression of abrupt changes like edges in image. As a result of increasing this parameter we can smooth edges in the image, and this means by

bigger standard deviation we have weaker edges and this drop edges gradient magnitude even lower than threshold and finally causes eliminating edges from result. For example in recorded video for LOG by fix threshold at final frame all the edges have been vanished.

Also it seems that by increasing standard deviation of Gaussian filter in canny edge detector we have slight changes in the location of edges. If fact blurring step in edge detectors cause displacement of edges in all kind of detectors, there are a tradeoff between noise suppression and localization of edges.

References

[1] Canny, John. "A computational approach to edge detection." *IEEE Transactions on pattern analysis and machine intelligence* 6 (1986): 679-698.
[2] Gonzalez, R. S., and Paul Wintz. "Digital image processing." (1977).