Multi-ROI based lane detection in heterogeneous systems

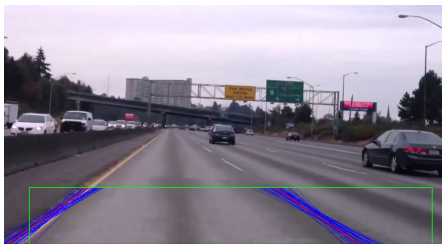
1 Introduction

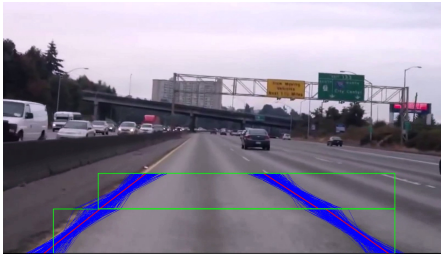
Road lane detection and tracking methods are state-of-art in present driver assistance systems. However, lane detection methods that exploit the parallel processing capabilities of heterogeneous high performance computing devices such as FPGAs (or GPUs), a technology that potentially will replace ECUs in a coming generation of cars, are a rare subject of interest.

Existing lane detection methods, however, are designed for conventional Electronic Control Units (ECUs). Though some methods may be adapted to the parallel computation structure of GPUs and FPGAs, they were not specifically developed for this purpose and hence suffer from bottlenecks and other disadvantages. And they certainly lag behind a method that is specifically designed for the use of hardware accelerators.

2 Motivation and Goals

We want to implement a fast and accurate lane detection algorithm using the popular Open Computing Language (OpenCL) programming framework. OpenCL specifies a high-level abstraction for low-level hardware instructions, and thus it enables to scale computations among different bands of CPUs, GPUs and FPGAs without changing the source code.





Much of the previous work has been done in [1]. In [1], we developed a particle-filter[2] based algorithm that can detect and track on-road lane markings. The result of one sample frame can be seen in the middle figure above. At present only a single Region Of Interest (ROI) is detected and thus the known road information is limited. Moreover, as more particles are used in the algorithm, the overall execution time become much larger.

Therefore, based on the current work, we want to implement a multi-ROI based lane detection algorithm (like the right figure above, this is just a sample). As more ROIs are used, much more information about the on-road situation can be acquired so as to better detect the lane markings. Also, this information can be made full use to greatly reduce the particle number, thus speeding up the overall executing efficiency.

3 Your tasks

- Extend the current lane detection algorithm to a multi-ROI version.
- Improve the performance of the developed algorithm, possible means include using parallel profiling, using more efficient filters, etc.

4 Requires

- Good knowledge on C++ programming skills
- Basic knowledge about OpenCV and OpenCL

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References

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