Post-doc position on Real-Time GPUs for autonomous vehicles

February 16, 2018

Post-doc position

- <u>Title</u> *Real-time Image Processing on GPUs for Autonomous Vehicles*

- <u>Supervision</u>: Prof. Giuseppe Lipari (CRIStAL, Université de Lille)
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- <u>Duration</u> : 1 year

- <u>Starting date</u> : 2018

Scientific proposal

GPUs (Graphical processing units) are specialised parallel processors used for mathematical computing and image processing. They are widely used on modern PC for accelerating graphical processing, videogame rendering, etc. Thanks to their processing power, they have recently being used in autonomous vehicles.

For example, in automotive systems GPUs have been used to perform eye tracking [2], pedestrian detection [3], navigation [1], and obstacle avoidance.

However, GPUs have not been designed with real-time processing in mind. Most of them only support sequential execution of tasks. Also, they use proprietary scheduling and allocation algorithms, so it is difficult to control how tasks are executed on them, and it is not possible to interrupt a low priority task to execute a higher priority one.

Therefore, it is very difficult to bound the response time of tasks executing on a GPU.

On the other hand, most autonomous vehicles have real-time constraints: certain important tasks must be completed within a tight time limit, otherwise something catastrophic may happen. For example, in the case of pedestrian detection [3], the algorithm must provide a (correct) result within a time limit that permits to slow down and halt the vehicle before hitting the pedestrian.

Mission

The goal of this research is to investigate methods for correctly managing the priority of the tasks executing on state-of-the art commercial GPUs, and to bound their response time.

We envision 3 stages:

[Month 1] study of the state of the art on GPU scheduling and management;

[Month 2] analysis of the characteristics of typical image processing algorithms used in autonomous vehicles;

[Month 3-9] development of OS algorithms for scheduling on GPUs to bound the execution time of the critical algorithms

[Month 10-12] experimental validation of the results on typical image processing algorithms

Expected results

The results of this research will be published in a paper in one of the following conferences/journals:

- · RTSS: Real-Time Systems Symposium ;
- · ECRTS :Euromicro Conference on Real-Time Systems;
- · RTAS: Real-Time Embedded Applications Symposium;
- · IEEE Transactions on Computers.

How to apply

Prospective applicants should send an email to Prof. Giuseppe Lipari, with their CV.

Bibliography

[1] F. Homm, N. Kaempchen, J. Ota, and D. Burschka. Efficient occupancy grid computation on the GPU with LIDAR and radar for road boundary detection. In Intelligent Vehicles Symposium, 2010.

[2] M. Lalonde, D. Byrns, L. Gagnon, N. Teasdale, and D. Laurendeau. Real-time eye blink detection with GPU-based SIFT tracking. In Canadian Conf. on Computer and Robot Vision, 2007.

[3] Y. Wang and J. Kato. Integrated pedestrian detection and localization using stereo cameras. In Digital Signal Processing for In-Vehicle Systems and Safety. 2012.