GPU Programming in Computer Vision

Preliminary Meeting

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What you will learn in the practical course

- Introduction to NVIDIA CUDA Framework
- Introduction to Parallel Computing on GPUs
- How to parallelise basic Computer Vision algorithms in CUDA/C++
- Practical project experience
- Team work, presentation skills
Important Dates

- Preliminary Meeting: **29. January 2015** (today)
- Registration for the matching system on TUMOnline: **30. January - 3. February 2015**
  - List your preferred practical courses
- Submitting Preferred Students: **4. - 9. February 2015** (by course organisers)
- Please specify if you have attended any computer vision or CUDA course before!
- Matching Results: **10. February 2015**
- Only assigned students are allowed to attend!!!
Course Organisation

- 4-5 weeks Block Course (7. Sep.- 9. Oct. 2015)
- 1 week lecture and exercise session
- 3 weeks project phase
- Our computer lab will be open for students
- Computers are equipped with very recent GPUs - GTX 750, one for each student.
- Students will work in groups: ideally 8 groups, each has 3 students.
- Every group will be assigned to one advisor.
Course Structure

• First Week
  • Theoretical lecture in the morning
  • Hands-on programming exercises in the afternoon

• Following 3-4 weeks
  • Project phase, one project to each group
    • Your own ideas,
    • Project Proposals, any related topic to Computer Vision, Image Processing, Machine Learning

• Final presentation of the projects
Evaluation Criteria

• Successful completion of the exercises
• Gained expertise in CUDA/parallel programming
• Quality of your final project
  • Successful completion of the project
  • Projects will be evaluated by the project advisors
• Your talk
Regular Attendance Is Required

- Attendance at classes/exercises is mandatory
- In case of absence: Medical attest
Motivation on GPU programming

*http://static1.evermotion.org/files/tutorials_content/lechu/octane/001.png
CPU vs GPU

Why Massively Parallel Processing?

A quiet revolution: Performance!

computations: TFLOPs vs. 100 GFLOPs

GPU in every PC – massive volume & impact
Example: Shape Analysis
Example: Depth from Focus

Reconstruct a depth map from differently focused images

Changing Focus

Variational Depth from Focus

\[ \min_{\mathbf{Z}} \mathcal{C}(d(x, y)) + |r_d(x)| \text{dx dy} \]
Example: LSD-SLAM on GPU

Porting Large-Scale Direct Monocular SLAM to GPU

Project Proposal:
Port part of LSD-SLAM to the GPU.

https://github.com/tum-vision/lsd_slam
Example: Random Forest on GPU

Implementation of Random Forest Classifier on GPU

*https://github.com/alfonsoros88/ScaRF*
Recent Works

- Dense Tracking and Mapping in Real-Time
  - https://www.youtube.com/watch?v=Df9WhgibCQA
- Kinect Fusion
  - http://msrvideo.vo.msecnd.net/rmcvideos/152815/152815.mp4
Not Assigned to the course?

Don’t Worry! Be Happy!

- Exciting IDP Projects
- Guided Research
- Master Thesis
Enjoy the practical course!