



Information Coding / Computer Graphics, ISY, LiTH

And this brought us to:

GPGPU/GPU Computing

General Purpose computation on Graphics Processing Units

Mark Harris, 2002

Perform demanding calculations on the GPU instead of the CPU!

Wild idea? No, now a serious technology! Results varied in the early years. The GPU advantage has grown.



Key components starting the GPU computing trend

High processing power in parallel

Programmability: Introduction of shader programs, much more flexible, programmable for any problem.

Floating-point buffers: Vital! Initially with poor precision. 32-bit floating-point decent... but not really impressive.



GPU computing approaches

- Using fixed pipeline graphics
 - Shader programs
 - CUDA
 - OpenCL
 - Compute shaders



Fixed pipeline GPU computing

Reformulate a problem to something that can be done by standard graphics operations.

Limited success 1999/2000. Not of any practical interest!

Example: Jörgen Ahlberg, face tracking



Fragment (pixel) shader based GPU computing

Portable! All GPUs can use shaders, no need for extra software, run using standard software/drivers.

All modern shader languages (GLSL, Cg, HLSL) are similar and easy to program in.

Requires a re-mapping of data to textures.

Very good results already in 2005: 8x speedups overall reported!



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CUDA-based GPU computing

Only works on NVidia hardware.

Requires extra software - which isn't very elegant.

Nice integration of CPU and GPU code in the same program.

Excellent results! 100x speedups are common - before optimizing! Even low-end GPUs give significant boosts.



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OpenCL-based GPU computing

Works on various hardware - not only GPUs.

Developed by Khronos Group, pushed by Apple.

Harder to get started, software looks pretty much like programming shaders.



OpenGL Compute shaders

Built into OpenGL

Similar to OpenCL

Good portability

Direct Compute Compute shaders

Built into DirectX

Similar to OpenCL

MS only



Vulkan

The "new OpenGL", arrived 2016.

"Bleeding edge".

Future main generic GPU platform for both graphics and computing?

Same compute shaders as OpenGL.

Metal

Apples "Vulkan".

Apple has deprecated everything else - including OpenCL

"Metal Performance Shaders".

Apple only.



Use the source, Luke!

Four trivial examples:

Hello World! for CUDA

Hello World! for OpenCL

Hello World for GLSL

Hello World for Compute Shaders



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In Olympen

GTX1080

Pascal GPUs!

Decent, good enough for the labs.

In Asgård

Ada Lovelace 4000

4000 series GPUs!

Very new and top performance.



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That's all, folks!

Next time: Introduction to CUDA