GPGPU in Commercial Software: Lessons From Three Cycles of the Adobe Creative Suite

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Taking advantage of the GPU for things other than rendering to the screen feels like jumping into the future of technology, like you should be wearing a lab coat to work. It totally is, but if you want to do it for real software that people pay for, there are some things to watch out for.
Overview

- Introduction
- Using GPUs for Commercial Software
- GPU Development Gotchas
- Questions
In the Core Technologies Group at Adobe

- We produce libraries that make it easier for Adobe teams to use OpenGL, OpenCL, and CUDA
- We created the Pixel Bender language
- Framework for building accelerated GPU and multi-core image processing graphs
- Some of the products which use our technologies: Photoshop, After Effects, Premiere, Flash Player, Flash Pro, Flash Builder, Encore, Audition, Soundbooth, Premiere Elements, Photoshop Elements
- First release of our technology was in Adobe Creative Suite CS3
GPU features in Adobe Products

Pre CS3
- After Effects – OpenGL drawing/effect
- Premiere – DirectX effects
- Acrobat 3D – DirectX/OpenGL

CS3 (2007)
- AIF/Pixel Bender debuts in AE CS3 - 18 GPU effects
- Acrobat GPU vector drawing/compositing

CS4 (2008)
- Photoshop GPU-accelerated canvas, 3D features, Pixel Bender plug-in
- AE 3rd party Pixel Bender support, Cartoon filter
- Premiere – GPU acceleration on mac
- Flash 10 GPU acceleration for drawing/video
- GPU-accelerated video playback for other video/audio apps

CS5 (2010)
- Premiere Mercury Engine
- Photoshop Oil Paint filter

Using GPUs in Commercial Software
Getting buy-in: Educating Management

- Performance
- Competition
- Demos
Getting going: Educating Engineering and QE

- Training
- Constraining supported cards
- Selecting Appropriate APIs
- Tooling
- Performance
- Demos

(most of what the rest of the talk is about)
Keeping it going: delivering and iterating

- Automation
- Fall-back plan
- Hot-patching
GPUs in the “real world”

- Intel has more than 50% of the GPU market (July 2010, Information Week)
- Real people don’t upgrade their hardware that often
  - Windows XP still has more than 60% of the OS market share (August 2010, Netmarketshare numbers)
  - Only 61% of Steam users have DX10-level hardware (August 2010, Steam Hardware & Software survey)
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What to do?
Strategies: Know your market!

- Professional users
  - *If I make my living using your software, I’ll upgrade my equipment if it will make my life easier (and I can afford it)*
  - Premiere CS5: 64bit only, CUDA acceleration, 3 (high-end) cards supported

- Pro-sumers
  - Maybe more willing (and more able) to switch to new hardware or upgrade because their machines aren’t their livelihood. Like the “cool” factor. Closer to gamers.

- Hobbyist/Occasional users
  - Won’t upgrade for your software
  - Angry if it doesn’t work with their machines
  - Premiere Elements: If it doesn’t run near real-time on a Core 2 Duo with IIG the users will revolt
Strategies: Scale up

- Work on a wide range of hardware, but work better on better hardware
- This is what my team advocates within Adobe

Pros
- Users with high-end machines are happy
- Users with low-end machines are (mostly) happy
- You can sell to more users

Cons
- Need to implement the same feature in multiple ways
- Much larger test matrix
- May need to support multiple APIs
- Significantly more development effort

It is a classic ROI decision.
Strategies: Be clear what hardware you work on

- Set clear minimum system configurations
- List specific cards or card families if possible
- Users want to know if their hardware will work with your software or which cards to buy
- Test for capabilities, not chipsets or drivers
- Fail gracefully
- Blacklist bad cards/drivers, don’t whitelist good ones.
- Consider allowing users to run a test program on their computer from your site to guarantee compliance
Strategies: Amdahl’s Law

The system is only as fast as it’s slowest component

- Make sure that you are using the GPU for the right things
- Rather than try to integrate GPU processing into a hostile architecture, look for new features than can be developed using the GPU
- Measure performance constantly
- Beware “premature optimizations”
- Every trip over the bus is a bottleneck
- Can you replace CPU code with CUDA/OpenCL code to keep data on the card?
- Is slow GPU code in the middle of fast GPU code faster than moving data back to the CPU and then again to the card?
Strategies: Feel your user’s pain everyday

- Make sure that someone is using the low-end of your supported hardware as their primary development / QE machine
  - If someone on the team isn’t having to live with that daily, how do you expect your users?
- Try to cycle cards through the development / QE team
  - So different members of the team notice the performance characteristics of each supported card
Strategies: Life with drivers

- Drivers change often
- Your code that worked perfectly can be busted by the time the user installs it
- You can’t expect a user will have the latest drivers installed

- Be prepared to work around driver issues
  - When you do, document them really well in the code
  - Be able to hot patch existing installs if necessary
- Work with the IHVs/OS Vendors to report bugs
  - Make sure you can send them code that reproduces the problem
- Someone on your team should always running the latest driver
- Blacklist known bad driver versions
- Test new features against old drivers periodically to make sure you aren’t turning up new driver bugs
Strategies: Choosing Your APIs

- Does your chosen API limit your supported hardware?
  - Not necessarily a bad thing
- Know when to use Proprietary vs Open APIs
  - Cross-platform development
  - Development/Support costs
  - Can always use both…
- Does an API limit mathematical precision for critical calculations?
Strategies: Automated testing

- Automation is key
- Test matrix is 3 dimensional
  - Operating System/Version
  - Graphics Card
  - Driver version
- Performance Tests need to be part of test runs
  - Getting tossed to the “slow path”
  - Need to know about it immediately
- Regression tests should include some low level HW verifications (really useful for finding driver issues)
- Good automated tests let you send them to the IHVs to be part of their driver validation suites
Strategies: Precision

- IEEE compliance is nice, but it is expensive
- Know when it is important and when it is ok to approximate
- No matter what level of compliance there is, results will vary from CPU to GPU and from GPU to GPU
- Understand how API choice and how runtime parameters affect precision
- Optionally, allow the user to specify their precision requirements
Questions?

QUESTION
THE
ANSWERS
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