NVIDIA Application Acceleration Engines
advancing interactive realism
& development speed

July 2010
NVIDIA Application Acceleration Engines

A family of highly optimized software modules, enabling software developers to supercharge applications with high performance capabilities that exploit NVIDIA GPUs.

- Easy to acquire, license and deploy (most being free)
- Valuable features and superior performance can be quickly added
- App’s stay pace with GPU advancements (via API abstraction)
NVIDIA Application Acceleration Engines

PhysX  *physics & dynamics engine*
- breathing life into real-time 3D; **Apex** enabling 3D animators

CgFX  *programmable shading engine*
- enhancing realism across platforms and hardware

SceniX  *scene management engine*
- the basis of a real-time 3D system

CompleX  scene scaling engine
- giving a broader/faster view on massive data

OptiX ray tracing engine
- making ray tracing ultra fast to execute and develop

iray physically correct, photorealistic renderer, from mental images
- making photorealism easy to add and produce

© 2010
Application Acceleration Engines

- Streamlines the adoption of latest GPU capabilities, getting cutting-edge features into applications ASAP, exploiting the full power of larger and multiple GPUs.

- Gaining adoption by key ISVs in major markets:
  - Oil & Gas: Statoil, Open Inventor
  - Design: Autodesk, Dassault Systems
  - Styling: Autodesk, Bunkspeed, RTT, ICIDO
  - Digital Content Creation: Autodesk
  - Medical Imaging: N.I.H.
Accelerating Application Development

App Example: Auto Styling

1. Establish the Scene
   = SceniX

2. Maximize interactive quality
   + CgFX + OptiX

3. Maximize production quality
   + iray

App Example: Seismic Interpretation

1. Establish the Scene
   = SceniX

2. Maximize data visualization
   + quad buffered stereo
   + volume rendering
   + ambient occlusion

3. Maximize scene size
   + CompleX
AXE – Engine Relationships: 2010

AXE Connections
- CgFX
- Tessellation
- QB Stereo
- 30-bit color
- GSync
- SDI i/o

Application Building
- CgFX
- OpenGL
- Quadro HW Features
- SceniX
- Ray Tracing, GI
- Scene Scaling, Physics

AXE Engines
- iRay
- OptiX
- PhysX
- CompleX

AXE Reach
- Non-Graphic Applications
- Custom Scene Graphs & Real-time
- Open Scene Graph
- VSG’s Open Inventor

Scene Graphs & Real-time Application
Building SceniX Non-Graphic Applications
iray® from mental images

World’s first commercial, physically correct, interactive global illumination renderer. Delivers easy to use “push button” results. The perfect choice for designers using real-world materials and lighting.

- Many times faster on GPUs than CPU
- Scalable across GPUs and nodes to achieve highly interactive speeds
- Availability:
  - w/ mental ray® 3.8 & RealityServer
  - stand-alone Integrator Edition
  - at mental ray OEM’s since October, appearing in key products this year
  - SceniX integration available later this year
Hybrid – Increasing Interactive Realism

• CgFX example – combining OptiX as a scene effect with OGL or D3D

+ Glossy Reflections
+ Soft Shadows
+ Ambient Occlusion
+ Photon Mapping, etc…

Model courtesy of Watershot® digital imaging, San Diego, CA
NVIDIA Design Garage Demo


- Highly interactive at HD on a GF100 using direct light, photoreal GI results in under a minute

- App example of SceniX with OptiX shaders – similar to other apps in development

- Demonstrates 2 renderers (direct-illumination & GI path tracing) developed in 6 weeks on OptiX/SceniX

- Source code example for application developers

- Endorsed by Electronic Arts for possible use within a future Need for Speed title

- Additional content coming for Quadro, making use of +2GB frame buffers.
Used wherever there’s a need to analyze 3D data, make decisions, and convey results in real-time:

- The interactive core of many demanding real-time commercial products
- Internal applications and in-house tools for research, visualization, simulation, broadcast, interactive training, and energy exploration

Runs on most current OpenGL HW, certified on Quadro, with NVIDIA/Quadro specific features all being optional.

- Designed around CgFX for HW flexibility and quality
- Renderer independent, for rendering flexibility in VR centers, clusters, and now ray tracing
- Relatively quick integration in applications
- Version 6 adds Tessellation support for Fermi-based GPUs, iray support coming later this year

Delta Gen image courtesy of Real Time Technologies
NVIDIA® CompleX™ scene scaling engine

Shattering the frame buffer ceiling - keeps complex scenes interactive as they exceed GPU memory, by managing the combined memory and performance of multiple GPUs

Two components, that can be used and configured independently:

- Data Distribution
  - slicing scenes across GPUs to keep them within frame buffer memory
- Compositing
  - driver level connections for the fastest possible inter-GPU compositing

Supports up to 32GB today, and 48 GB on Fermi

- SDK for any OGL app
- Ready to use for: SceniX, OpenSceneGraph, and Open Inventor 8.1 (from VSG)
CompleX – scaling results

Multi-GPU Performance with CompleX Relative to Single GPU

- 2 GPUs
- 4 GPUs
- 1 GPU

Data Size in Millions of Triangles

Performance Over Single GPU

0 2 4 6 8 10 12 14 16 18
0 10 20 30 40 50 60 70 80 90 100

[Graph showing performance comparison between single GPU and multi-GPU systems]
NVIDIA® OptiX™ ray tracing engine

A programmable ray tracing pipeline for greatly accelerating ray tracing applications – from complete renderers, to functions, to tasks (collision, acoustics, signal processing, radiation reflectance, etc.)

- Windows, Linux, and OSX on all CUDA GPUs, with GF100 being 2-4X of GT200 which is 2X of G80
- C-based shaders/functions (minimal CUDA exp. needed)
- Considerable flexibility to fit needs and workflows
- Quality/speed “dial” via hybrid OGL/D3D
- Ease of Development - you concentrate on writing ray tracing techniques, and OptiX makes them fast
- Version 2 expands GPU support, optimizes for Fermi, adds D3D and Mac OS, supports editing approaches & long renders, and greatly increases documentation and samples
OptiX – *flexibility*

OptiX generality provides maximum application flexibility:
- Not constrained to processing light/color
- Not constrained to rendering triangles
- Not tied to a rendering language
- Not fixed in shader or camera model
OptiX – *speeding development*

Making high-performance ray tracing easy to obtain:

**Benefits for anyone building a ray tracer –**

- Ray calculations are abstracted to single rays
- State-of-the-art acceleration structures (BVH and KD trees) with cutting-edge traversal algorithms
- Programmable shaders, surfaces and cameras
- Tight coupling with graphics APIs (OpenGL & D3D)

**Benefits for building a GPU ray tracer –**

- Parallelism (within the GPU and between GPUs)
- Recursion, load balancing, scheduling of shading and tracing
- Abstraction from GPU architecture for future-proof performance
With iray, you add or replace a renderer. iray is ideal when you want a ready-to-integrate, photorealistic solution, with support for co-processing and cluster rendering. e.g., BunkSpeed Shot, mental ray OEMs, etc.

With OptiX, you accelerate or build a renderer. OptiX is ideal when you want to accelerate a custom rendering solution, do hybrid rendering, or non-rendering RT tasks. e.g., Lightwork Design, Works Zebra, signal processing, etc.

With NVIDIA papers and support, experts create their own solutions: Arion, Final Render, Furry Ball, Octane, V-Ray.

**GPU Ray Tracing et. al.**

*addressing the spectrum of GPU ray tracing needs*
engines available at:
Developer Zone on NVIDIA.com

iray information available at:
www.mental.com/iray

Design Garage Demo at:
Cool Stuff on NVIDIA.com