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**

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

PhysX
physics & dynamics

CgFX
programmable shading

SceniX
scene management

CompleX
scene scaling

OptiX
ray tracing

iray
photoreal rendering

Accelerating Application Development

App Example: Auto Styling

1. Establish the Scene
   = **SceniX**

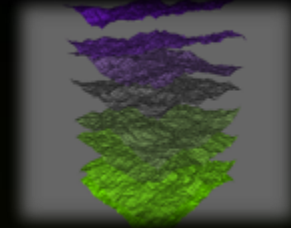2. Maximize interactive quality
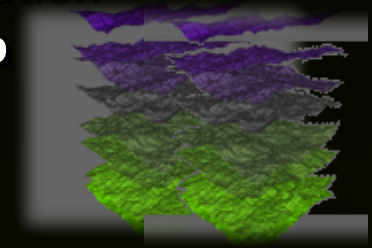   + **CgFX** + **OptiX**

3. Maximize production quality
   + **iray**

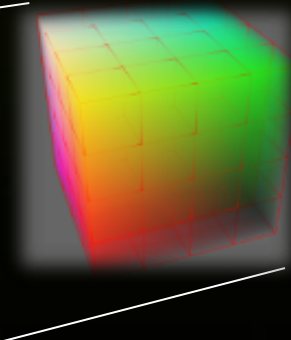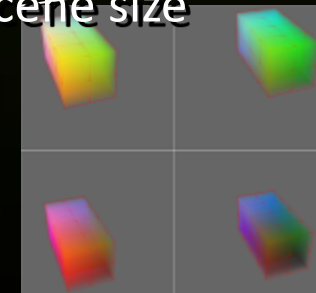**App Example: Seismic Interpretation**

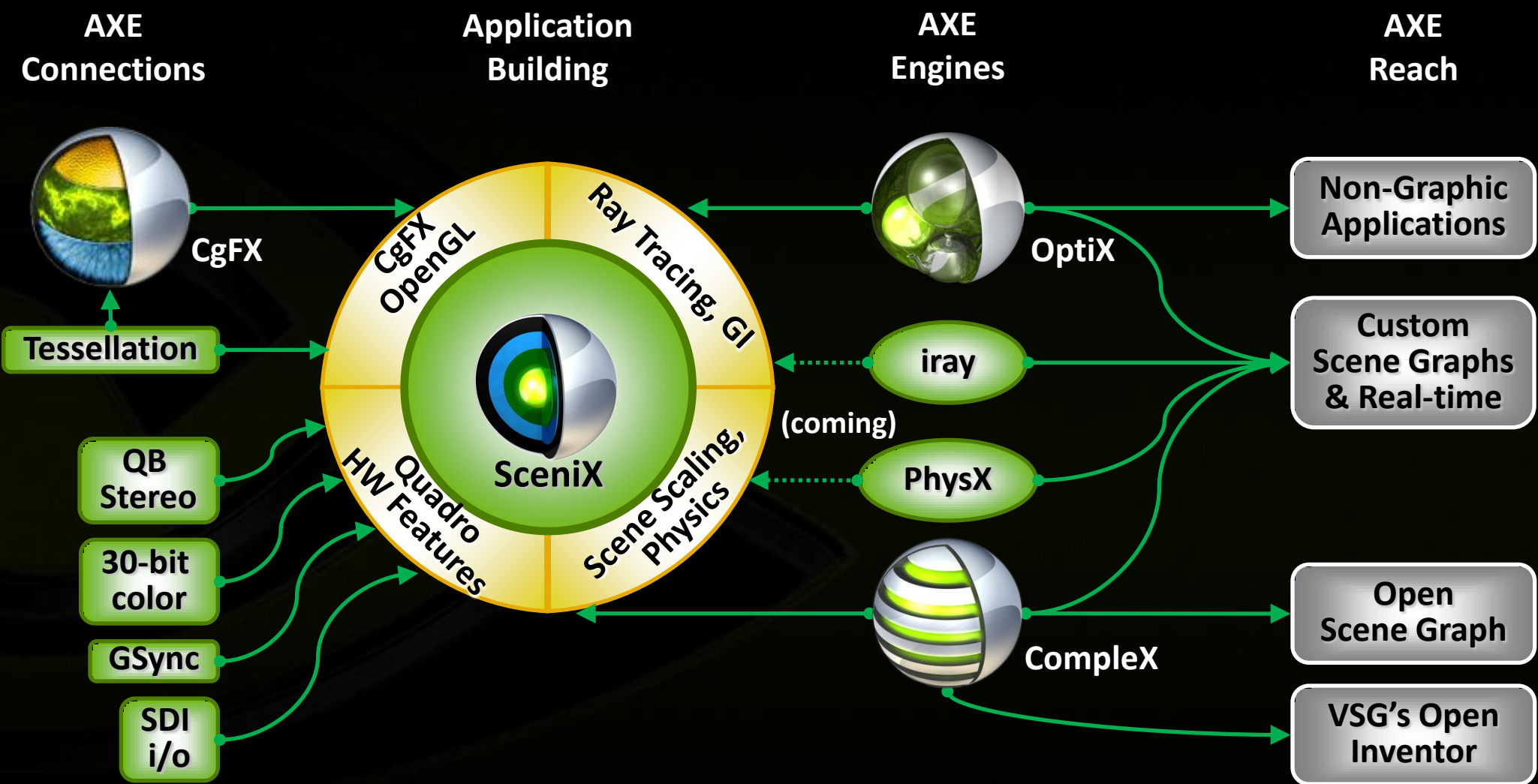1. Establish the Scene
   = **SceniX**

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

3. Maximize scene size
   + **CompleX**

AXE – Engine Relationships: 2010

AXE Connections

Application Building

AXE Engines

AXE Reach

CgFX

Tessellation

QB Stereo

30-bit color

GSync

SDI i/o

CgFX OpenGL

Ray Tracing, GI

Quadro HW Features

Scene Scaling, Physics

SceniX

OptiX

iray

PhysX

(coming)

CompleX

Non-Graphic Applications

Custom Scene Graphs & Real-time

Open Scene Graph

VSG's Open Inventor

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

evening

Interactive iray example from mental images
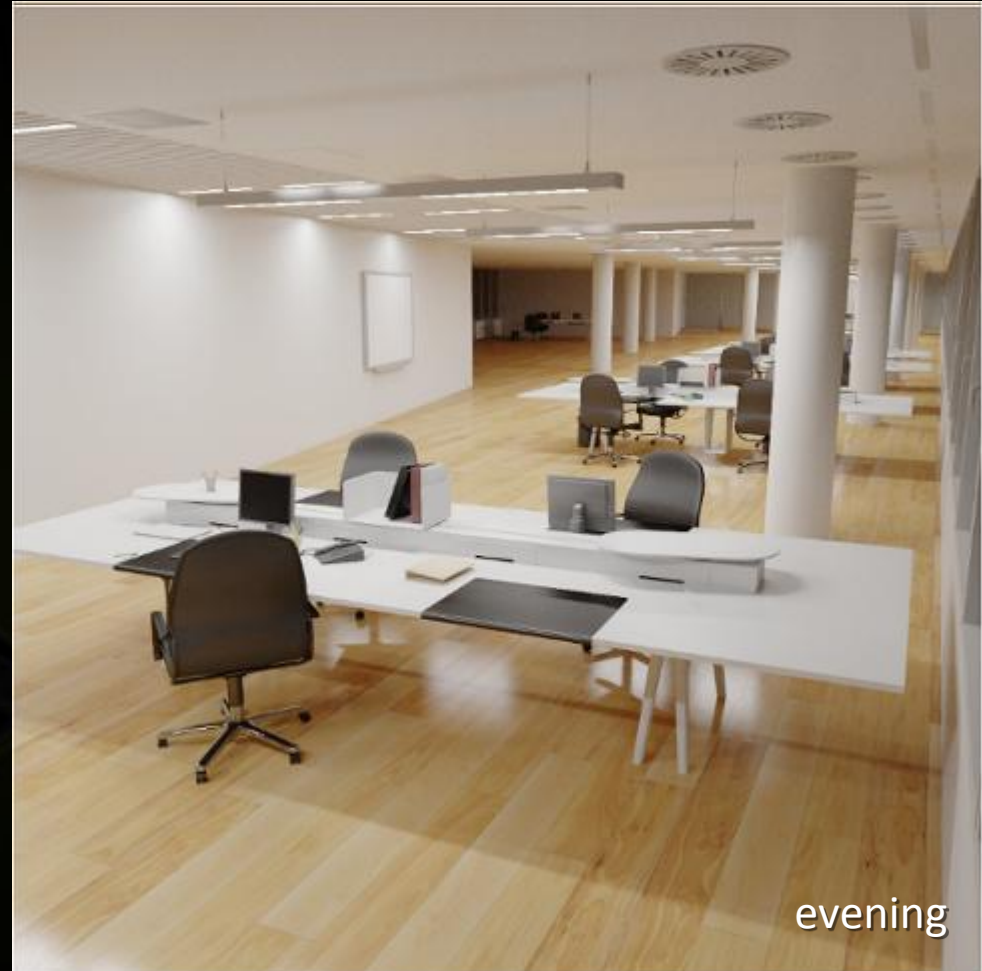
Hybrid – Increasing Interactive Realism

- **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

- Photorealistic car configurator in the hands of millions of consumers: http://www.nvidia.com/object/cool_stuff.html#/demos/2116

- 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.
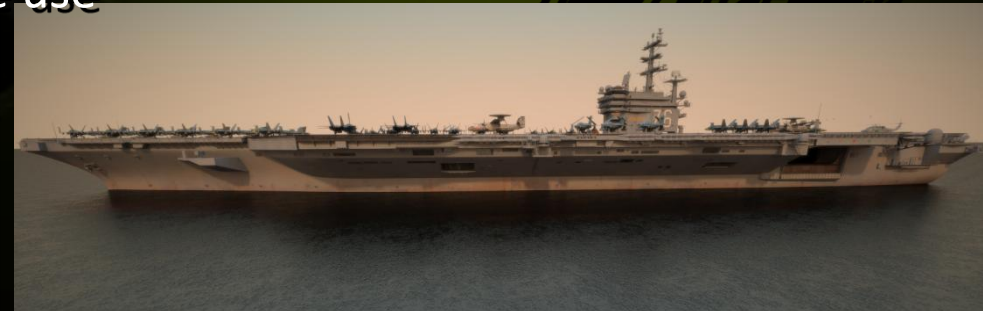
NVIDIA® SceniX™ *scene management engine*

- 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   © 2010
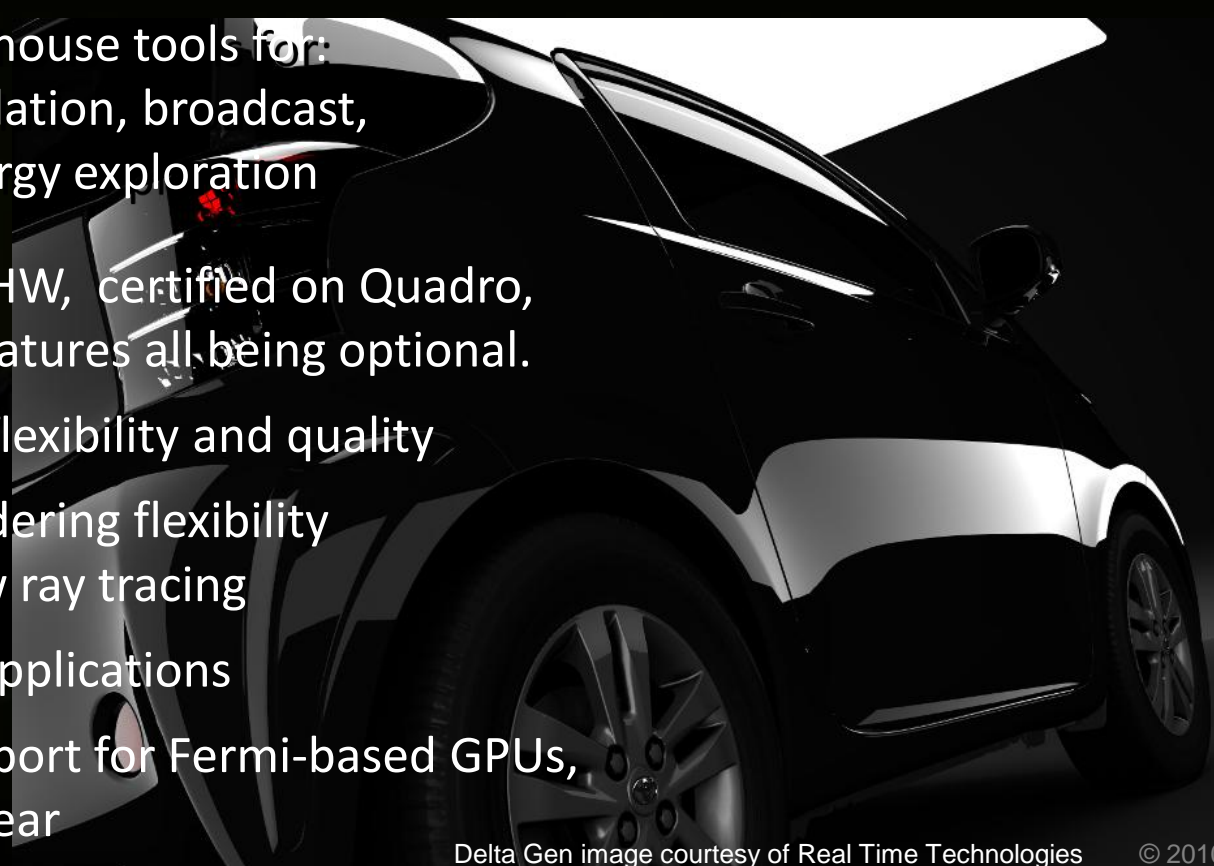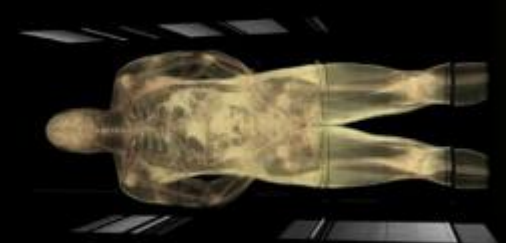
NVIDIA® CompleX™ *scene scaling engine*

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**)*
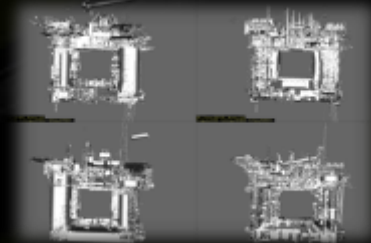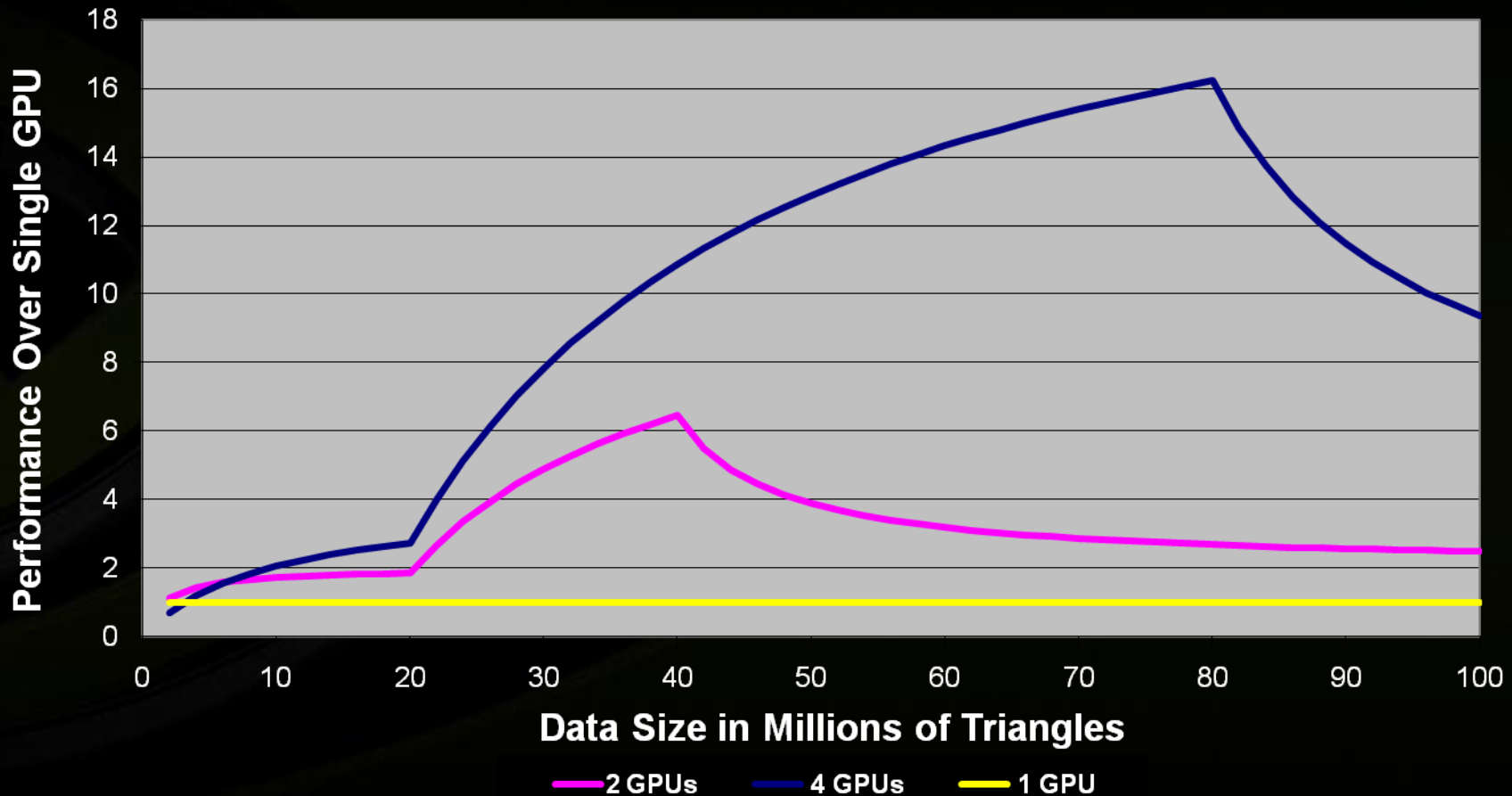
Storm Fjord

National Institute of Health

CompleX – *scaling results*

Multi-GPU Performance with CompleX Relative to Single GPU

- 2 GPUs
- 4 GPUs
- 1 GPU

x-axis: Data Size in Millions of Triangles

y-axis: Performance Over Single GPU

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
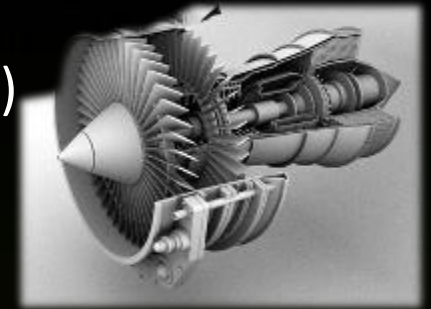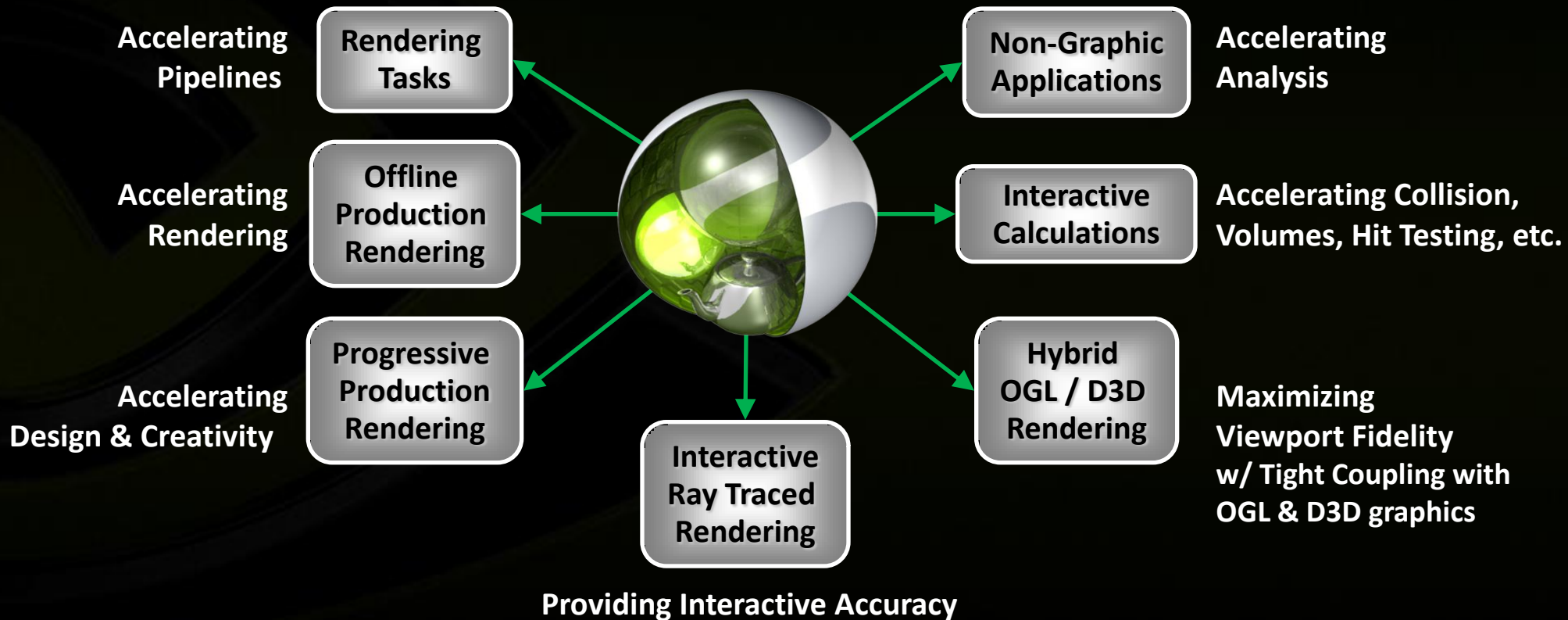
ambient occlusion
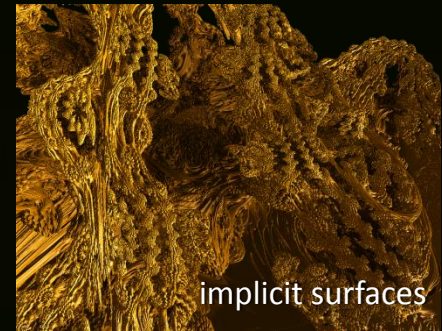
implicit surfaces

global illumination

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

Accelerating Pipelines — **Rendering Tasks**

Accelerating Rendering — **Offline Production Rendering**

Accelerating Design & Creativity — **Progressive Production Rendering**

Interactive Ray Traced Rendering

Providing Interactive Accuracy

Non-Graphic Applications — Accelerating Analysis

Interactive Calculations — Accelerating Collision, Volumes, Hit Testing, etc.

Hybrid OGL / D3D Rendering — Maximizing Viewport Fidelity w/ Tight Coupling with OGL & D3D graphics

# 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
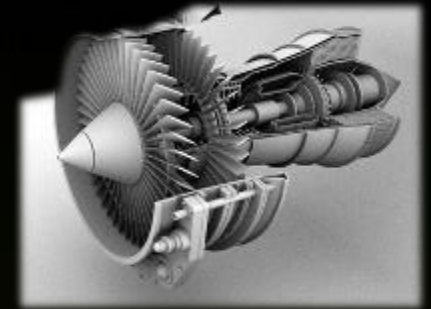
ambient occlusion
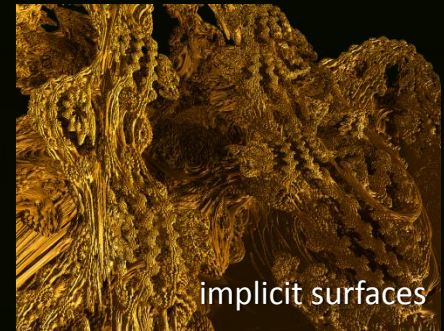
implicit surfaces

global illumination

GPU Ray Tracing et. al.
addressing the spectrum of GPU ray tracing needs

- **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

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