



SIGGRAPH2009

NEW ORLEANS

Beyond Programmable Shading

Why and How is Interactive Graphics Programming Changing

Aaron Lefohn
Intel Corporation

Disclaimer about the Course Notes

- The material in this course is bleeding edge
 - We could not share most of the details with you until now
 - Most talks are missing from the published notes
 - The talks that were included changed substantially

- To address this inconvenience
 - All course material posted to a permanent web page
 - <http://s09.idav.ucdavis.edu/>

Interactive
rendering techniques
are created using an inseparable mix of
data- and task-parallel algorithms
and graphics pipelines

How do we write new
interactive 3D rendering algorithms?

Fixed-Function Graphics Pipeline

- Writing new rendering algorithms means
 - Tricks with stencil buffer, depth buffer, blending, ...

- Examples
 - Shadow volumes
 - Hidden line removal
 - ...

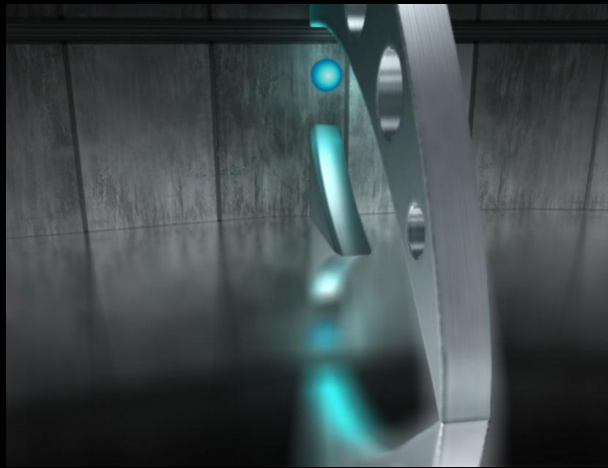
Programmable Shading

- Writing new rendering algorithms means
 - Tricks with stencil buffer, depth buffer, blending, ...
 - Plus: Writing shaders

- Examples
 - Parallax mapping
 - Shadow-mapped spot light
 - ...

Beyond Programmable Shading

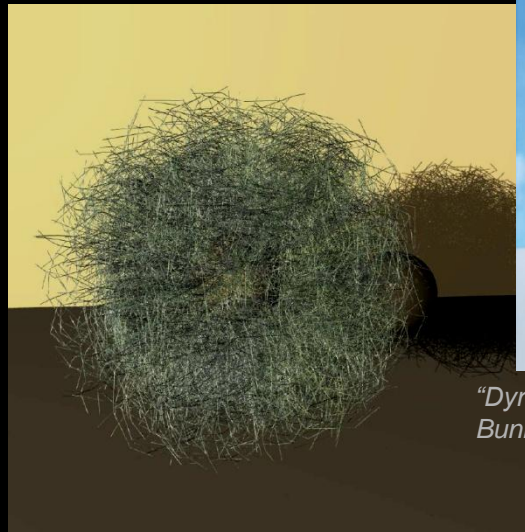
- Writing new rendering algorithms means
 - Tricks with stencil buffer, depth buffer, blending, ...
 - Plus: Writing shaders
 - Plus: Writing data- and task-parallel algorithms
 - Analyze results of rendering pipeline
 - Create data structures used in rendering pipeline
- Examples
 - Dynamic summed area table
 - Dynamic quadtree adaptive shadow map
 - Dynamic photon mapping
 - ...



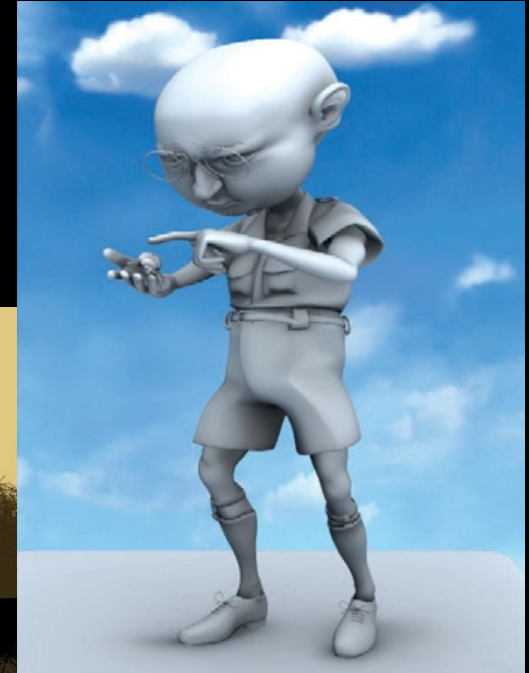
*"Fast Summed-Area Table Generation and its Applications,"
Hensley et al., Eurographics 2005*



*"Real-Time Approximate Sorting for Self Shadowing
and Transparency in Hair Rendering,"
Sintorn et al., I3D 2008*



*"Resolution Matched Shadow Maps,"
Lefohn et al., ACM Transactions on Graphics 2007*



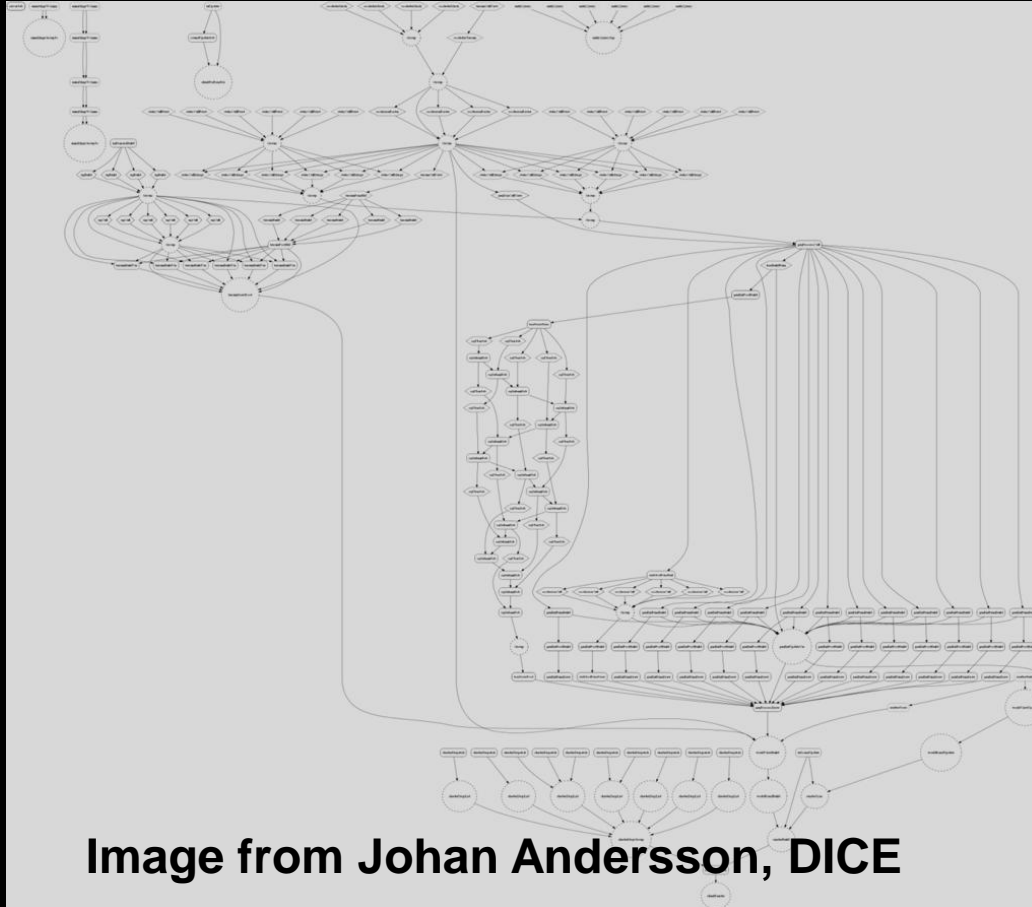
*"Dynamic Ambient Occlusion and Indirect Lighting,"
Bunnell, GPU Gems II, 2005*

Beyond Programmable Shading

- Writing new rendering algorithms means
 - Tricks with stencil buffer, depth buffer, blending, ...
 - Plus: Writing shaders
 - Plus: Writing data- and task-parallel algorithms
 - Analyze results of rendering pipeline
 - Create data structures used in rendering pipeline
 - Plus: Extending, modifying, or creating graphics pipelines
- Examples
 - PS3/XBox360 hybrid Cell/CPU + GPU graphics pipelines
 - Interactive ray tracing
 - Interactive micropolygon rendering
 - *Five talks this year in this course on this topic*

Braided Parallelism

- Intermixed task-, data-, and pipeline parallelism



*“Braid: Integrating Task and Data Parallelism,”
West and Grimshaw, 1994*

This Course Offers...

- Introduction to the HW causing/enabling this change
- Parallel programming models for graphics
- Game developers, academic researchers, and IHVs:
 - Showcasing new interactive rendering algorithms that result in more realistic imagery than is possible using only the pre-defined D3D/OpenGL graphics pipeline

Morning Schedule

- Why and How is Interactive Graphics Programming Changing?
8:30 – 8:50 Aaron Lefohn, Intel
- Beyond Programmable Shading Retrospective
8:50 – 9:15 Mike Houston, AMD
- Running Code at a Teraflop: Overview of GPU Architecture
9:15 – 10:00 Kayvon Fatahalian, Stanford
- Q&A
10:00 – 10:15 All Speakers
- Break
10:15 – 10:30
- Parallel Programming for Interactive Graphics
10:30 – 11:10 Tim Foley, Stanford / Intel
- Parallel Graphics in Frostbite - Current & Future
11:10 – 11:45 Johan Andersson, DICE
- id tech 5 Challenges
11:45 – 12:15 J.M.P van Wavern, id software

Afternoon Schedule

- Intro / recap of morning course
1:45 – 1:55 *Mike Houston, AMD*
- GPU Primitives---Case Study: Hair Rendering
1:55 – 2:25 *Ulf Assarsson, Chalmers University*
- A Real-Time Micropolygon Rendering Pipeline Is Not Far Away
2:25 – 3:00 *Kayvon Fatahalian, Stanford*
- AMD Case Study
3:00 – 3:30 *Justin Hensley, AMD*
- Break
3:30 – 3:45
- Innovating in a Software Graphics Pipeline
3:45 – 4:15 *Paul Lalonde, Intel*
- NVIDIA Case Study
4:15 – 4:45 *David Luebke, NVIDIA*
- Panel: "What Next for 3D Graphics Programming Models?"
4:45 – 5:30 *Moderator: Kurt Akeley*

Additional Panelists

- Cass Everitt, Epic Games
- Jonathan Ragan-Kelley, MIT

BATTLEFIELD

BAD COMPANY 2™





Be on the Lookout For...

- What forms of parallelism are used?
- Which hardware is used and why?
- Why was the standard graphics pipeline not enough?
- What is the future of the existing graphics APIs?

Course Evaluations

- Please fill in the course evaluation at:
http://www.siggraph.org/courses_evaluation/
- You could win a Siggraph'09 mug
- One winner per course, notified by email in the evening

<http://s09.idav.ucdavis.edu>