State of the Art in Hardware
Shading

Marc Olano
Chas Boyd
Bill Mark
Michael McCool
Jason Mitchell
Randi Rost
Overview

8:30 – 10:15 Shading Hardware
- 8:30 Introduction — Marc Olano
- 9:00 NVIDIA — Bill Mark
- 10:00 ATI — Jason L. Mitchell

10:15 – 10:30 Break

10:30 – 12:15 Shading Hardware (cont)

12:15 – 1:30 Lunch

1:30 – 3:15 APIs

3:15 – 3:30 Break

3:30 – 5:15 APIs (cont)
What is Shading

Ultimate control of appearance

Programmable
- Arbitrary computation

Procedural
- Simple procedures
- High-level language
RenderMan Types

Compute what?

- Surface color
- Light color and direction
- Fog density and attenuation
- Surface displacement
Hardware Types

Compute what?

- Vertex position
- Vertex texture coordinates
- Vertex color
- Pixel color
Non-Real Time / Real Time

Not Real-Time
• Seconds to hours per frame

Real-Time
• Tens of frames per second
Interactive Rendering

Illusion of Presence

• 10 – 30 – 60 frames per second
• Immediate response
• Simple appearance
Interactive Rendering

Vector
Flat
Gouraud
Texture
+Fragment Lighting
Shading
Uses for Real-Time Shading

More realistic appearance
• Automotive styling

Visualization
• Data fields on surfaces

Non-realistic appearance
• Games, Illustration
A Short History

History

- Pixel-Planes 5 [Rhoades 1992]
- PixelFlow/pfman [Olano 1998]
What about now?

Present

- SGI OpenGL Shader
- NVIDIA Cg / Vertex shader + register combiners
- ATI Vertex & Pixel Shaders
- Microsoft DirectX
- OpenGL 2.0
What’s coming next?

Future
• SMASH?
But How Do I Choose?

This course may help you compare...

• Three common examples from each presenter
• One to show off
• “Tutorial” style
Example 1

Shiny Bump Map
• Dependent texturing
  • Environment texture depends on bump texture results
• Popular
Example 2

Homomorphic BRDF Factorization

- BRDF factored into three texture terms
- Non-standard texture coordinates
  - Maps indexed by local \( V, L \) and \( H \)
- Renders a wide range of real surfaces
Example 3

Parameterized Wood

- Push complexity
- Growth ring size, dark and light colors, grain, shininess, ...
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  • 1:30 DirectX — Chas Boyd
  • 2:30 OpenGL 2.0 — Randi Rost
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3:30 – 5:15 APIs (cont)
  • 3:30 OpenGL 2.0 (cont) — Randi Rost
  • 3:45 API Design — Michael McCool
  • 4:45 Panel Discussion and Q & A — All