Making Faces
Eve Online’s New Portrait Rendering

August 7, 2011 – Session: Facing Hairy Production Problems
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Introduction

- Eve Online, an 8 year old MMO on PC
- Still growing, always upgrading technology
- Aiming at DX9, commodity hardware
- New Character Creator
Agenda

• Faces
  ➢ Modeling
  ➢ Customization
  ➢ Shading

• Hair
  ➢ Modeling
  ➢ Shading
  ➢ Shadows
Face - Modeling

- ~8500 triangles; ~120 blendshapes
- 4 races x 3 bloodlines x 2 genders = 24 base models
- Modeled separately at first
  - Lots of data to ship
  - Lots of time to (re)publish, ~9 hours
  - No “one size fits all” accessories possible
• Invention of “Rubberhead”
  ➢ All models have same topology / vertcount
  ➢ Average them to a middle-of-the-road face (per gender)
  ➢ Each variation becomes a morphtarget
• Less data: 1/6th of original
• Faster publish, ~45 mins
• Accessories now work everywhere
  ➢ Blendshape a good start on how to distort it to fit
• (Bonus: can mix bloodlines)
• ~120 blendshapes does not work with sliders
• Solution: triangle fields
  ➢ 2D triangle mesh, overlay (invisible)
  ➢ Each vertex encodes N blendweights
  ➢ Mouse move: find triangle, find barycentric coord, interpolate weights
• Set up field to give illusion of sculpting
Face - Customization

• Separate fields for separate face parts
• Separate fields for side- vs. front-view
  ➢ eg. side = make nose crooked; front = make it wider
• Also works for animation
  ➢ “morphptarget weights” becomes “blendtree weights”
  ➢ Used for eye-look-at, smirking, head posing, etc.
Face - Shading

- Specular: Skin BRDF [Kelemen01]
- Diffuse: texture-space light diffusion [d’Eon08]
- Multiple passes done in Python
  - Good: hot-reload = zero iteration time
  - Bad: performance overhead
  - Fix: OpenGL-style display lists
    - Record what python does in C++ list
    - Fast playback every frame
Face - Shading

- Similar focus on Python for wrinkles
- If eyebrows go up, activate forehead zone
- Active zone = pull in displaced N, shift hue
  - 12 zones
- Python code watches bones, drives shader
  - Iteration by TechArt, can use Maya
- Similar to [Jimenez2011]
Agenda

- Faces
  - Modeling
  - Customization
  - Shading
- Hair
  - Modeling
  - Shading
  - Shadows
Hair - Modeling

• Up to ~5000 triangles; 2-5 days; 51 hairstyles
  ➢ Player can change color of root, mid, tips
• Mesh based, jumble of alpha-blend polys
• Avoid runtime sorting: “onion layers”
  ➢ Concentric shells
  ➢ Each layer carefully self-contained
  ➢ Draw the layers inside->outside
• **Authoring**
  - group tris into layers in Maya
  - publish will export in->out order

• **Double sided geometry**
  - Backfacing tris must be drawn outside->in
  - Engine supports drawing in reverse

• **Animation: realtime Apex physics** [Omarsson10]
  - “Negligible production overhead”
  - Note: needs to support blendshapes
Hair - Shading

• Old fashioned anisotropic shading [Kajiya85], with two highlights
   One white, shiny, “specular”
   One colored, soft, “scattering catch-all”
   Tried more stuff, in the end this was enough
   Strand direction painted in 2nd UV set
Hair - Shadows

• Hair does not receive shadows
• Deliberate “bug” — glows in the dark
  ➢ But usually goes unnoticed! :p
• Reason: hard contact shadow reveals structure
• Same reason: no SSAO
  ➢ Instead: negative light for fake AO
Hair casts shadows though

Art direction = strong, black shadows. Also, BLACK.

So: use 5x5 PCF [Reeves87]
  
  VSM = light leaking [Lauritzen08, Chen09]

But: looks bad with translucent hair/glasses

Fix: screendoor transparency

```
vp = frac( vp * 0.5 ) - 0.5;
vp.x *= vp.y;
clip( vp.x * spotlight.z );
```

Beautiful endgame: CSSM [McGuire11]
No PCF
$1024^2$
Hair - Shadows

• This needs good resolution
  ➢ 1024^2 client, 2048^2 server
  ➢ Up to 4 spotlights
• 90% of time focused on face
  ➢ Shrink scene OBB until touching the frustum
  ➢ Phew, dodged convex polytopes
Hair - Shadows

• Alternative: Fourier Opacity Mapping [Jensen10]
• Pro: overlapping, transparent shadow casters without any sorting
  ➢ DX9 friendly, too
• But: occluder depth is approximate
  ➢ Ghost shadows
  ➢ Some temporal issues too
Credits and Thanks

- Vigfus Omarsson
- Hjörtur Bjarnason
- Johann Gunnarsson
- Andrei Cristea
- Sarah Tariq
- All the artists for making the shader guy look pro

- More information
  - [Fanfest 2011 Presentation](#) / more shader tricks & details
  - [Apex live authoring demo](#) at GDC 2010 by CCP’s Lead TechArtist
[Gritz08] “The Importance Of Being Linear”, Larry Gritz et al, GPU Gems 3
[Hable10] “Uncharted 2: HDR Lighting”, John Hable, GDC2010
[Hable09] “Fast Skin Shading”, Hable et al, ShaderX7
[Lauritzen08] “Summed-Area Variance Shadow Maps”, Andrew Lauritzen, GPU Gems 3
[Chen09] “Lighting Research At Bungie”, Chen et al, Siggraph 09 Course
[Reeves87] “Rendering Antialiased Shadows with Depth Maps”, Reeves et al, Siggraph 1987
[Omarsson10] “Physically Simulated Clothing”, Omarsson et al, GDC2010
[Colossus06] “The Making of Shadow Of The Colossus”, Online document
Thanks! 😊 Any questions?...