GeomCaches for VFX in Ryse

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GeomCaches in Ryse

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GeomCaches

- aka Alembic Caches
- aka “VFX Setpieces”
- aka “this is why we CAN have nice things”

- Crytek’s real-time geometry cache pipeline

- Used for:
  - Cinematic Setpieces
  - Animated Props in-game
  - Interactive Objects in-game
  - anything with many moving parts that isn’t a character

- [Video 01]
Why GeomCaches?
GeomCaches – Why?

- Previously used character animation pipeline
  - Cumbersome (bake to joints)
  - Error-prone (manual XML setup)
  - Inefficient to render (runtime skinning)
Pipeline
GeomCaches – Pipeline

DCC App
- Model
- Rig
- Animate
- Export

Alembic File
- Baked Result
- Goes into P4
- Lossless intermediate

RC
- Validate
- Clean up
- Fix issues
- Compress
- Make Engine-ready File

CRYENGINE
- Stream
- Animate
- Render

[Video 02]
Features
GeomCaches – Features #1

- Imports vanilla Alembic Caches
  - Animated transform hierarchies
  - Homogeneous, deforming meshes

- User-friendly
  - No engine-markup (besides mat-ID)
  - Auto cleanup & optimization
  - Importer presets

- Additional data-streams
  - Tangent Frames
  - Visibility (i.e. fracturing)
  - Vertex Colors [Video 03]
GeomCaches – Features #2

- Memory-friendly (7.5x avg. compression)
- Efficient Rendering [Video 04]
- Sandbox-esque [Video 05]
  - Flowgraph- & Trackview-integration
Limitations
GeomCaches – Limitations

Unfortunately...

Right?

ONE DOES NOT SIMPLY

RENDER HOLLYWOOD
GeomCaches – Limitations

- Many polygons are still expensive
  - Still need to create LODs
- Loading data is still slow
- No physics support *(yet)*
- Not all Alembic features supported
  - No heterogeneous meshes *(i.e. particle fluid caches)*
  - No SubD surfaces
  - No curves
- Can be used or abused
  - Requires experienced artists
Development
GeomCaches – Development

- Dedicated Engineer and Tech Artist

- **Engineer:**
  - Compression (RC)
  - Streaming System
  - Renderer Integration
  - Editor Integration
  - Build support

- **Tech Artist:**
  - Pipeline specs
  - VFX RnD
  - prototypical User
  - Tech Evangelist
  - VFX TD
New team with little ‘cinematic’ experience
Required lots of Research & Documentation
- Keeps goals visible
- Simplifies handoff (i.e. outsourcing)
- Answers FAQs [Video 06]
Case Studies
GeomCaches – Case Study #1

- Formation Banner [Video 07]
  - Marks contextual action for player
  - Must work in any environment (ignore wind etc.)
  - Complex cloth motion (unrolling, tassels)

- Cannot rely on real-time physics
GeomCaches – Case Study #1

Setup:
- Special Entity wraps caches, LODs & logic
  - Game logic
  - Streaming
  - Animation (unrolling & looping)
  - LODing
- Tech Artist creates asset & sets up prefab
- Level Designers place it & works out of the box
GeomCaches – Case Study #2

- Destructible Siege Tower [Video 08]
  - Wood, ropes, cloth
- Player attacks weak spots
- ~700 moving parts, 50 drawcalls
GeomCaches – Case Study #2

- Maya Setup:
  - nCloth & nHair
    - traditional RBD not suitable for scaffolding
    - nCloth rigid’s more stable & forgiving
  - 6 layers of simulation (large, small, cloth, ropes, …)
  - Result merged into deforming mesh
GeomCaches – Case Study #2

- Game Setup:
  - Separate cache per weak spot
  - Game logic starts/stops animation
  - Static LODs for distance
GeomCaches – Case Study #3

- Cinematic Ocean [Video 09]
  - Character swimming in it
  - Art-directed motion for camera angle
- Cannot use procedural in-engine ocean
GeomCaches – Case Study #3

- **Maya setup:**
  - HOT Maya Plug-in (Tessendorf waves, multiple layers)
  - SOuP Maya Plug-in (per-vertex expressions sculpt waves)
  - 2d-fluid solver for character ripples
  - Character rig attached to ocean surface
GeomCaches – Case Study #3

- Custom Ocean Shader
  - Works on arbitrary geometry
  - Vertex colors drive foam & SSS
  - SSR for contact reflections
  - Procedural normal map & rain ripples
GeomCaches – Case Study #4

- Character Cloth [Video 10]
  - 5 main characters
  - Complex costumes & hairstyles
  - Cannot setup/tweak before final animation

- GeomCaches: can polish/tweak every vertex
GeomCaches – Case Study #4

- 70+ animation clips
- 1-2 characters per rigging TA
  - Trained by VFX TD on GeomCaches
- Set poly limits early in production
Conclusion
GeomCaches – Conclusion #1

Ryse Production:

- 11 artists using GeomCaches autonomously
  - (at the end of production)

- 150+ cache files

- 1,5 hours cache content
  - 1 hour character cloth
  - 30 minutes bat-shit crazy destruction, oceans & sailboats

- 170+ GB Alembic

- 25.4 GB GeomCache
Future Work:

- **Physics**
  - Passive proxies
  - Turn active on contact?
  - Blend cache & real-time sim?

- **Heterogeneous Meshes?**
  - DMM
  - Thinking Particles
  - Particle Fluids

- **Cache Blending?**

- **CRYENGINE → Alembic Exporter**
THANK YOU.
The Shout-Outs...

Alexander Raab  Dominik Butnaru  Michael Kopietz
Atri Dave       Eric Werner       Nicolas Schulz
Axel Gneiting   Fabio Silva      Riham Toulan
Bogdan Coroi    Jeffery Khou     Thomas Franta
Chris Evans     Joseph Garth     Travis Ramsdale
Chris Mead      ...and everybody at Crytek!
Bonus Slides
The ugly part of the pipeline: **Material Order**

The Problem:
- "Which material does this polygon use?"
- Every 3D-package does this differently
- CRYENGINE requires material-IDs per face

Our solution:
- Alembic has "face sets"
- Generated by script before export
- Mat-ID = first integer found in face set name
Maya 2014 Alembic export tricks:

- MEL command has more features than exporter dialogue!
- "-writeColorSets" exports vertex colors
- "-writeFaceSets" exports face-sets
- Learn more, using "AbcExport -help;"
GeomCaches – Bonus Slide #3

- Debug old Alembic files with HDFView: