THE WITCHER 3:
ENABLING NEXT-GEN EFFECTS THROUGH NVIDIA GAMEWORKS™

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Overview

The Witcher 3
- Game Intro
- NVIDIA HairWorks Integration
- Artist Workflow

NVIDIA GameWorks™
- Overview
CD Projekt RED

ABOUT US

- The Witcher series
- Over 200 people
- 2 studios
- Separate department developing the REDengine
- Programmers, Tech-artists, QA, Localization
- ~50 people in total
- Core team develops common technology for all our games
BRIEFLY ABOUT THE GAMES
THE WITCHER 3: WILD HUNT

- PC, Xbox One, PS4, 2015
- Mature story driven TPP RPG set in a fantasy universe
- Jaw-dropping story spanning over 100 hours of gameplay (50h main story arc) that will pull in newcomers and longtime fans alike
- Vast, borderless open world with various ways of exploration (sailing, horseback)
BRIEFLY ABOUT THE GAMES

CYBERPUNK 2077

- PC, next-gen platforms
- Futuristic story driven RPG + open world
- Dense city environment + surroundings
- Tons of customization
FUR AND HAIR IN THE REDengine
MOTIVATION FOR FUR AND HAIR

- Characters are very important (RPG)
- Monsters / beasts
INDUSTRY SOLUTIONS

Demos/Benchmarks/Offline - Millions of strands
INDUSTRY SOLUTIONS

Games - Mostly alpha tested fins
PROBLEMS WITH CREATING YOUR OWN

- Simulation time can explode
- Rendering can also become tricky
HAIRWORKS INTERNALS

Runtime

- Skinning update
- Simulation CS on guide hairs
- Rendering using tessellation and GS
HAIRWORKS EVALUATION

Easily got asset into viewer, looked promising
HAIRWORKS EVALUATION

- Got the integration done in a few days
- Close cooperation with Nvidia helped
EVALUATION RESULT
THE ROAD TO FULL INTEGRATION

- Pixel shader overriding
- Initially no way
- Finally all parameters (textures, constants)
THE ROAD TO FULL INTEGRATION

Skinning integration

- Texture skinning not supported
THE ROAD TO FULL INTEGRATION

- Waviness
- Clumping
CLUMPING
THE ROAD TO FULL INTEGRATION

Integrating with a game

- Wind
- Growth
THE ROAD TO FULL INTEGRATION

- LOD - continuously changing density and width
- Consoles - special LOD level
HAIR

- Collisions
- Style control
CONCLUSIONS

- Very interesting to work on getting something from a research project into the game engine
- Fur and hair rendering is hard but possible
NVIDIA HairWorks Pipeline

Hair File
- Growth Mesh
- Guide Hairs
- Behavior Attributes
- Growth Mesh

Via APX

TXB
- Graphics Mesh (Shaved)

Textures
- Color
- Simulation Control

Groom
- 3dsMax
  - Hair and Fur
- Maya
  - Shave and a Haircut

Photoshop

Preview Tool
HairViewer

Tweak Attributes in Real Time

Game Engine
MODEL PREP

- Create a Growth mesh from GFX mesh (this is where you grow the hair!)
  - Uniform mesh density is best for uniform hair/fur coverage
- GFX Mesh should be built as if it were a “shaved” animal.
  - Remove poly strip hair
    - Many current models are built with strips of polygons that have hair textures on them.
    - These compete with simulated hair and must be removed.
Grooming is done through the existing DCC tool chain.

Requirements:
Export requires a spline (guide curve) rooted to a vertex on the growth mesh.
Currently we export through Max/Maya with a Gameworks format.

Common software:
- 3ds Max
- Hair and Fur
- Hair Farm (3rd party plugin)
- Maya
- Shave and Haircut (3rd party plugin)
THE WAY IT’S MEANT TO BE PLAYED

GAME PLATFORMS

NVIDIA GAMEWORKS

GAME TECHNOLOGY
### NVIDIA GameWorks™

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- PhysX: Samples - Particles, Destruction, Clothing, Flex
- VisualFX: Samples - FaceWorks, HairWorks, Turbulence, FlameWorks
- OptiX: Samples - Interactive Ray Tracing, Ambient Occlusion, Procedural Surfaces, Light Baking
- Samples: Soft Shadows, Particle Shadows, Motion Blur, Terrain Tessellation
VisualFX SDK

- Cinematic visual effects
- Robust and easy to integrate
- Multi-platform support
NVIDIA FlameWorks
Cinematic Smoke, Fire, Explosions

TOOLS
TBD

FEATURES
Real-time eulerian fluid simulation
High performance multi-grid solver
New combustion model for fire
Supports grids up to 32M voxels
Cinematic Volumetric Effects
Support for Stochastic shadows and scattering
User-defined force fields, emitters and collision objects

PLATFORMS
PC
NVIDIA HairWorks
Dynamic Hair and Fur

TOOLS
3dsMax/Maya DCC plug-in/Previewer

FEATURES
Off-the-shelf grooming tools
Support for character skinning
Support for dirty fur/hair
Shape preservation
Self shadowing
Wind interaction
Level of Detail
Scalability

PLATFORMS
PC

Call of Duty: Ghost
NVIDIA WaveWorks
Realistic Waves

TOOLS
Standalone tool

FEATURES
- Tessendorf’s spectral algorithm, based on Phillips spectrum
- Multi-res simulation
- Quad-tree tile-based LoDing
- Host read-back
- DX11 tessellation
- Foam simulation
- A “no graphics” path for clients (MMO servers)

PLATFORMS
PC, Steam OS, Linux, MacOS, PS4, XBOX1
NVIDIA Turbulence
Next-gen Particle Effects

TOOLS
Standalone Tool

FEATURES
Interactive massive particle simulation based on eulerian fluid simulation
Heat sources and jets
Integrated with PhysX Particles
Noise support

PLATFORMS
PC

ENGINE INTEGRATION
UE3/UE4 patch, CryEngine patch
NVIDIA FaceWorks
Enabling Realistic Skin Rendering

TOOLS
TBD

FEATURES
- High Quality Skin Shaders
  - (Skin Subsurface Scattering)
- Deep Scattering
- Light Transmission Through Thin Membranes
- Eye Refraction (upcoming)

PLATFORMS
PC, Android
NVIDIA GI Works
Global Illumination

TOOLS
TBD

FEATURES
Real-time global illumination
Color bleeding
Specular effects
Emissive materials
Fully dynamic
Reduces content creation time
Scalable

PLATFORMS
PC
NVIDIA PostWorks
TXAA

TOOLS
TBD

FEATURES
Temporal AA
8xMSAA quality at 4xMSAA cost
Can be mixed with hardware MSAA and SSAA
Better alias detection filter
New spatial-only algorithm
Free high quality up-sample

PLATFORMS
PC
NVIDIA PostWorks
Depth of Field and Bokeh

TOOLS
N/A

FEATURES
Diffusion DoF Solver
- Arbitrary blur size
- Constant cost
FFT based Bokeh
- Fixed cost
- Uses direct compute FFT implementation
- Fast convolution in frequency space

PLATFORMS
PC
NVIDIA ShadowWorks
HBAO+

TOOLS
N/A

FEATURES
State of the art SSAO
- FullScreen
- FlickerFree
- ArtifactFree
Interleaved rendering
Scalable

PLATFORMS
PC
NVIDIA ShadowWorks
Advanced Soft Shadows

TOOLS
N/A

FEATURES
State of the art soft shadows
- PCSS, MVSS, ...
Simple but powerful interface
Support for cascaded shadow maps

PLATFORMS
PC, SteamOS, PS4, XBOX1, Android
PhysX SDK

Most popular physics engine: 500+ games

Simulation-driven effects

Major engine integration

Multi-platform support

World-class authoring tools
PhysX SDK
In over 500+ titles!

TOOLS
PhysX Visual Debugger

FEATURES
Rigid Body Dynamics
Collision Detection
Character Controller
Particles
Vehicles
Cloth
FLEX (upcoming)

PLATFORMS
Win, OSX, Linux, XBOX/PlayStation,
Android, iOS

ENGINE INTEGRATION
UE3, UE4, Unity, ...
PhysX FleX
Unified GPU Simulation Pipeline

TOOLS
TBD

FEATURES
Unified solver for effects
Rigid/deformable bodies
Phase transition
Particles
Fluids
Cloth
Rope

PLATFORMS
Win, Linux, XBOX1/PS4, Android

ENGINE INTEGRATION
UE4 upcoming
PhysX Destruction

TOOLS
3dsMax
PhysXLab

FEATURES
Full/partial destructibles
Voronoï/Slice and cutout
Integrated with PhysX Particles
Hierarchical Destruction
Network Support
Level of Detail
Scalable

PLATFORMS
Win, XBOX, PS, Android

ENGINE INTEGRATION
UE3, UE4
PhysX Clothing

TOOLS
3dsMax plug-in
Maya plug-in

FEATURES
Hybrid of simulated and skinned clothing
Self-collision support
Clothing constraints
Embedded solver
Level of Detail
Scalable

PLATFORMS
Win, XBOX, PS, Android

ENGINE INTEGRATION
UE3, UE4
PhysX Particles & Fluids

TOOLS
Particle Editing Tool (PET)

FEATURES
Full Collision with PhysX environment
Force field interaction (wind, explosions, ..)
Authorable behavior and effect modifiers
Sprite and mesh rendering supported
SPH fluids

PLATFORMS
Win, XBOX, PS, Android

ENGINE INTEGRATION
UE3
OptiX SDK

Light baking in game authoring pipelines

Realistic rendering for replays, configurators and rewards

Collision detection, line-of-sight, occlusion and acoustics

Scalable realism that can dovetail with Direct3D or OpenGL
OptiX
Interactive Ray Tracing

FEATURES
Hyper-realistic interreflections and refraction
Use on most sensitive scene elements, like headlamps

PLATFORMS
PC, Linux, MacOS
OptiX
Light Baking

FEATURES
Offline tool for baking all lighting inputs for static scenes
Fast turnaround time on desktop or render farm
Physically-based light transport projected onto arbitrary representation

PLATFORMS
PC, Linux, MacOS
NVIDIA OptiX
Procedural Surfaces

FEATURES
Ray trace against arbitrary geometry, not just triangles: hair, SubD, Bezier triangles, etc.
Compact geometric representation
Highly accurate smooth surfaces

PLATFORMS
PC, Linux, MacOS
OptiX
Ambient Occlusion

FEATURES
Fast offline baking process
Vertex-based AO is very compact
Properly handles difficult geometry like trees

PLATFORMS
PC, Linux, MacOS
Graphics and Compute Samples

Example visual effects, rendering techniques and perf optimizations

Sample apps, support libs and tools

A mix of source code, example code and binary libraries/apps

Detailed documentation

Vendor neutral
Graphic Samples
Particle Shadows

FEATURES
Percentage Closer Filtering (PCS) with uniform kernel size
Percentage-Closer Soft Shadows (PCSS) with variable kernel size
Contact Hardening Shadows (CHS)

PLATFORMS
PC, Linux, Android
Graphic Samples
Motion Blur

FEATURES
Motion blur for fast moving objects
2D-full screen post process
Not dependent on scene geometric complexity

PLATFORMS
PC, Linux, Android
Graphic Samples
FXAA

FEATURES
High performance and high quality screen-space software approximation to AA

PLATFORMS
PC, Linux, Android
“With PhysX Clothing integrated directly into the Unreal Engine, we were able to easily create a highly immersive and dynamic environment in Daylight, which contributes to a heightened tension for players. We also used NVIDIA’s turbulence technology to create dynamic fog, particle, and smoke effects to deepen the user experience even further. Our artists were able to quickly generate the desired effects using these NVIDIA GameWorks tools.”

Jared Gerritzen, Studio Director, Zombie Studios
PhysX Particles
NVIDIA Turbulence
Enhanced 4K Support
TXAA
HBAO+
Improved 4k and SLI support
NVIDIA GameWorks™

NVIDIA GAMEWORKS™ WEB PAGE
• http://developer.nvidia.com/gameworks
• Find out latest info and download options

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• Http://YOUTUBE.com/user/nvidiaGameWorks
• Latest videos for NVIDIA GameWorks™ effects and game integrations

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• Learn the latest about NVIDIA GameWorks™
WE WOULD LIKE YOUR FEEDBACK

Please take a moment to fill out this 2 minute survey on your own device for this talk

We appreciate your input