Art pipeline: Transition from Offline to Realtime CG

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1. Introduction

There are number of labor intensive and time consuming tasks in CG such as lighting setup, special effects and image post-process tuning, primarily due to lack of interactive feedback in traditional tools. Recently there are number of solutions which introduce interactivity via static scene relighting or by employing game engines for real-time rendering, however subject of full production pipeline involved is rarely touched.
We will discuss challenges and solutions in transitioning from traditional offline CG production towards interactive approach used in creation of animated short *Butterfly Effect*. *Butterfly Effect* is a real-time CG-animated short developed in a collaboration between *Unity Technologies* and *Passion Pictures*.

2. Elaboration

Main highlights of our approach:

- Initial scene setup including geometry, cameras, rough lighting, material properties and animation can be done in traditional modeling tools. Results are automatically exported into intermediate set of standard or human-readable formats. All changes applied to initial scene in modeling tool are automatically imported and available in Unity Editor almost instantaneously.
- Lighting, material properties, object placement and non-character animations can be overridden on per-shot or globally across the whole film inside Unity.
- Core library of lighting and surface shaders was implemented in hardware language to match shaders for offline renderer (Mental Ray Architectural shader library) allowing to convert material properties directly.
- Animated short scenario called for flapping robes and loose clothing which currently could not be achieved with suitable artistic control at run-time. Cloth is simulated in the offline tools and transferred into Unity Editor as a set of geometrical deformations where it is applied to coarse cloth geometry before subdivision. Same approach is used for animations of facial expressions.
- Cloth simulation developed in offline tools posed a challenge on exact synchronization with real-time entities on both geometry deformation and physical simulation level. First was solved by introducing proper Catmull-Clark subdivision instead of approximations possible on GPUs today, latter was solved by persisting real-time physical simulations during time jumps when switching between shots.
- Very coarse hair groom and hair animation was done in traditional modeling tool. GPU-based procedural hair and fur modeling system takes it from there to produce real-time results.
- Custom tools for realtime editing of explosions and volumetric effects based on pyroclastic noise were developed inside Unity Editor.
- A set of caching mechanisms was used to capture global illumination. Global illumination solution is requires offline computation step, however number of tricks such as updating only selected region is employed to improve feedback loop.
- A custom approach was developed to manage time jumps between separate shots while preserving state of physically simulated bodies. This allowed edit decisions at any stages of the pipeline.

3. Results

A set of custom tools and plugins was developed during production of *Butterfly Effect* to match the existing art pipeline of the studio with predominantly offline CG experience. Results were then carried over into an interactive environment (the Unity Editor), which was customized to provide a familiar set of tools and attributes for artists.
We found that direct illumination and surface shading on modern GPU can give almost pixel-perfect results compared to industry standard offline renderer (MentalRay in this case) given high order anti-aliasing. Real-time shadows and reflections require special approaches and yield visually different results, which however can be offset by artistic flexibility of interactive authoring.

4. Conclusions

System has been used in the production of CG animated short, dramatically accelerating certain tasks and improving artistic creative freedom.

References

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