2D Animation in the VR Clouds

The Making of Disney's "a kite's tale"

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Figure 1: Puppy-Kite from Disney Animation's "a kite's tale." CGI combines with hand-drawn animated textures to create a unified character. Realtime VR clouds rendered in Disney's Hyperion are projected onto performant low-poly versions in Unity.

ABSTRACT

The experimental animated virtual reality short "a kite's tale" required cgi and hand-drawn characters to interact in a highly art-directed environment made of spectacular clouds. In this talk we'll examine the workflows developed to create the short, with particular emphasis on the integration of hand-drawn animation and performant real-time cloud rendering.

CCS CONCEPTS

• **Computing methodologies** → **Animation**; **Virtual reality**.

KEYWORDS

production, animation, virtual reality, VR, hand-drawn, clouds

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1 INTRODUCTION

The animated virtual reality short "a kite's tale" was created as part of an experimental program at Walt Disney Animation Studios. In a spectacular world made of clouds, a kite with the personality of a playful puppy tries to make friends with a stodgy dragon-kite. The production faced several challenges: designing and composing skyscapes for VR, creating real-time performant clouds, transitioning between multiple environments and animating a hybrid hand-drawn/CGI character.

2 CREATING AND RENDERING VR CLOUDS

A particular challenge on this production was creating spectacular cloud environments while remaining performant for the high framerates required by VR. We divided the generation of cloud elements themselves into two steps: the creation of art-directed cloud forms, and the adaptation of those cloud forms to the real-time render engine.

Cloud look and shape was accomplished in a custom toolset within Houdini. The cloud tools allowed for highly art-directable shapes via a recursive set of surface grooming tools. Artists started with a rough poly-mesh. Vectors on the surface of the poly-mesh were combed to create desired windflow. Modular tools then allowed artists to add details like density, billows, blur, and noise (pyroclastic, wispy, perlin, etc.) by painting attribute maps on the poly-mesh. Artists could then see those details represented in a

real-time volumetric visualization in Houdini which approximated the render look.

Clouds were passed as VDBs for lighting and rendering in Disney's Hyperion renderer, which uses high-order multiple scattering to portray light transmittance [Kutz et al. 2017].

In a standard animation workflow these renders would be the end result, but we still had to bring them into a real-time engine. We generated isosurface poly-meshes from the clouds and aligned multiple camera views, then projected UV coordinates onto those meshes from the camera positions. Still images from those cameras were rendered in Hyperion. Within Unity, these renders were then UV-mapped onto the low-poly meshes and rendered as unlit surfaces. By using unlit surfaces, we were able to maintain the lighting and color values from the Hyperion render, including the depiction of light transmission within the clouds.

Wisps and edge breakup were created by custom maps that revealed a noise pattern UV-mapped to the edges based on view angle. Additional breakup was accomplished by duplicating and scaling the clouds, creating a larger outer shell visible only at the edges.

Near-field clouds were visualized as an approximated volume by projecting RGBAZ images into a stack of planes. This would allow us to have characters partially emerge from the clouds.

3 COMPOSING CLOUD ENVIRONMENTS

With our cloud generation and rendering pipeline in place, we moved on to the next challenge: using these elements to construct a rich and compelling cloud environment. In motion pictures we frame the view from camera, and that becomes the primary element of visual composition. But how do we treat composition in VR when the viewer can look anywhere?

Our solution was to treat visual composition more like architecture than traditional cinematography. We imagined a designed environment, drawing inspiration from the interior of the Walt Disney Concert Hall with its smooth, flowing planes of walls and ceiling directing and drawing the eye. Ideally, one could design an environment of clouds that similarly draws the eye, signaling where the focus of the story will be even before the characters arrive.

Because stereo and kinesthetic perception of the space can only be evaluated in VR, this entire composition process had to be done within VR space. We roughed in cloud layouts in Oculus Medium. This allowed us to gauge scale and depth. We designed flowing clouds to direct the eye forward, and large flat clouds at our feet to ensure viewers feel safe from the heights.

To further complicate this process of world building, the ending of the film necessitated the creation of a second cloud environment with an entirely different visual design. In this part of the film, the viewer quickly flies upward with the kites; passing through a large cloud, emerging to see a dramatic golden sunset.

Obviously, this transition presented challenges. We needed to switch skydomes, lighting rigs and swap one set of clouds for another. This occurs within the continuous action of the story, so we also had to hide a character animation cut. We did this via a second camera view within Unity. This camera rendered the viewpoint of the inside of a sphere with an animated noise pattern and color that simulates flying inside clouds. We dissolve into that viewpoint just as the camera enters the cloud in environment one, and dissolve out as it exits into environment two.

4 ANIMATING HYBRID CHARACTER

Having established the environment, we went on to tackle animating our main Puppy-kite character through the space. Puppy-kite is a combination of hand-drawn pencil and paper animation and CGI. To accomplish this, we considered several workflows. The most pressing question was, which side leads: the drawings or the CGI? Artist availability schedules ultimately necessitated a collaborative approach, where rough CGI animation led the performance initially, but final timing and action was ultimately determined by the hand-drawn animator.

Previous hybrid character approaches at the studio had hand-drawn animation done to camera, in an image-plane space, which was then projected onto geometry, as in the film Moana [Keech et al. 2017]. We quickly decided against that approach, because the range of motion of Puppy-kite within the ultra-wide field of view in VR meant camera-space drawings of the character on paper would sometimes be impossibly small. Hand-drawn animators therefore worked in a perspective-free texture space, drawing the puppy as it would be seen as a flat texture before transform.

Because Puppy-kite's CGI and hand-drawn aspects were animated by different artists, tight coordination and visualization were required. CGI animators needed to see the drawn animation textured to the surface to pose the character. Rough 2D drawings were scanned and visualized in Maya as animated texture maps on Puppy-Kite for CGI animators, and animation was brought into VR for final evaluation before progressing into 2D cleanup. Cleanup animation and textured fill were hand-drawn via stylus in Toon Boom Harmony and composited in Nuke to create the final texture images.

Completed animated character meshes were imported into Unity as Alembic files, and the accompanying animated texture maps were applied and kept in synchronization with the mesh using custom scripts and Unity's Timeline feature.

5 CONCLUSION

Experimental projects like "a kite's tale" allow us to explore new types of animation, tackle new artistic and technical challenges and innovate within the craft. On this project we tacked challenges like designing for vr, creating spectacular clouds, and bringing those worlds into a real-time experience as well as bringing a hybrid hand-drawn/CGI character to life in VR. The message of friendship in the film echoes what we were attempting in the production: the joining of the old and the new, offline rendering and real-time rendering, pencil and paper animation and computer animation– soaring together in virtual reality.

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