The Look and Lighting of "Show Yourself" in "Frozen 2"

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Figure 1: Left: Renders with default look and lighting. Right: Renders with final look and lighting

ABSTRACT

During "Show Yourself" in Walt Disney Animation Studios' "Frozen 2," materials and lights are the main representation for three key story elements: glacial ice, the magic of the Spirits, and the concept of memory. This talk covers the creative approaches and collaborative workflows that brought these elements to the screen.

CCS CONCEPTS

• Applied computing → Media arts; • Computing methodologies → Rendering; Texturing;

KEYWORDS

ice shading, theatrical lighting, collaborative workflows

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1 INTRODUCTION

Elsa sings "Show Yourself" in Ahtohallan, a mystical glacier where the Elemental Spirits lead her to the answers she has been yearning for. The song builds from a delicate start to a grand crescendo as she finally discovers her true purpose.

To produce the visuals for this sweeping journey, the Look Development and Lighting departments formed a close partnership. Through a combined effort, we found workflows for achieving nuanced art direction in a highly reflective and refractive environment, while managing render efficiency.

2 CRAFTING GLACIAL ICE

Ahtohallan was Disney's first environment in six years to be composed entirely of ice, and the first glacier to be rendered in Hyperion, our in-house path tracer. Highlighting the beauty of glacial ice was a mandate from the production designers, who sought a seamless transition from the frosted, organic entryways to the smooth, architectural interiors.

This prompted the Hyperion team to re-examine our approach to ice shading. Rough dielectric materials such as frosted ice are known to lose energy because a typical microfacet model only accounts for the first light—facet interaction. A brute force random walk method [Heitz et al. 2016] was proposed but it was not practical for production usage. In the past, we resorted to ad-hoc workarounds such as raising the surface albedo beyond the physical range to compensate for such energy loss.

For "Frozen 2," we observed that the appearance of realistic glacial ice relied heavily on light bouncing around within the glacier.

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This multiple scattering nature revealed artifacts produced by nonphysically based shading choices. We developed a tabulation-based approach where the amount of energy lost in rough dielectric reflection and transmission was pre-calculated using the brute force method. Such energy was then re-injected during rendering. We integrated this technique into our ubershader [Burley 2015] resulting in a user-friendly and physically plausible ice material allowing for diffuse frosted ice, shiny clear ice, and naturalistic blends between the two.

The bouncing light dramatically affected the appearance of the ice, making the in-context scene lighting crucial to art directing the materials. To hone more theatrical pools of light, the ice needed to be frostier in targeted areas, helping to control the amount of indirect illumination reflecting across the caverns. Look and Lighting artists approached this challenge together, adopting a collaborative "rough to fine" approach, with progressive levels of refinement through multiple iterations. The artists would jointly present their work, allowing both teams to receive feedback and brainstorm together (a departure from the studio's norm of individual department reviews).

3 ANIMATING MAGICAL SPIRITS

The four Elemental Spirits appear in "Show Yourself" as bands of dancing light, guiding Elsa through Ahtohallan. Two different approaches were used to craft these lights. In the first approach, simple shapes were UV mapped onto a custom mesh and animated in Nuke. This allowed artists to evaluate the motion of the lights in real-time and rapidly iterate. Once the animation was approved, the mesh was placed behind the ice walls and rendered in Hyperion. In the second approach, a Nuke gizmo was developed to generate an HDR pattern evoking the lyrical movement of an aurora. This pattern was mapped onto multiple area lights which were subsequently animated behind the ice and rendered in Hyperion.

Look Development artists added environmental flourishes based on these traveling lights, including a standout moment with shimmering diamonds that were procedurally placed in the walls using Disney's XGen.

With seven Look artists, 24 Lighting artists, and six weeks left in production, managing resources was crucial. To effectively art direct the movement of the Spirits, every frame needed to be rendered. Low samples-per-pixel were used to speed up turnaround times, but the resulting images were noisy. Our in-house denoiser [Dahlberg et al. 2019] was crucial for making these renders usable during creative iterations.



Figure 2: Left: Dancing Lights HDR pattern. Right: HDR pattern in shot with diamonds

Sathe, Summers, Chiang, and Newland



Figure 3: Elsa sees a vision of her mother in the walls of Ahtohallan

4 REPRESENTING THE CONCEPT OF MEMORY

The climax of "Show Yourself" takes place in a palatial dome where the Spirits reveal visions of the past. The dome was made of concentric ice spheres, each with overlapping diamond patterns representing the connected yet fragmented nature of memory.

Six custom insert shots and 86 final shots from "Frozen" and "Frozen 2" were selected to be used as the visions Elsa witnesses. The Lighting team used Nuke and OFlow's frame interpolation to give these visions an ethereal slow-motion effect. The resulting images were then converted into emissive texture maps. A dragand-drop GUI repurposed from "Ralph Breaks the Internet" helped artists map the emissive textures onto dozens of cards floating behind the spheres.

When refracted through the pattern, some visions became murky, but others remained crystal-clear, particularly the ones featuring Elsa's mother. The sight of her mother smiling in the walls provides an emotional catharsis for Elsa, setting the stage for her final transformation into the Fifth Spirit.

5 CONCLUSION

Generally, materials and lights are used to add believability, mood, and appeal. For "Show Yourself" the team also used them to convey substantial components of the story. The blend of fantastical magic with realistic ice presented a wonderful opportunity to stretch creatively, allowing us to utilize a wide range of tools and techniques. It also allowed us to experiment with collaborative reviews and workflows, some of which we hope to continue for future projects.

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