Bringing Life to the Communiverse: Procedural Look Development in Pixar's *Elio*

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Fig. 1. The Communiverse is a complex, constantly moving system of procedurally modeled and shaded architecture ©Disney/Pixar

In Pixar's *Elio* (2025), Elio visits the Communiverse, a protopian space station populated by various species from throughout the universe. To convey a vivacious city inhabited by a diverse population, a small team of environment artists amplified the traditional pipeline with procedural techniques used in unique ways to develop a vast quantity of various biomes of alien terrains and architectures that pulsed with their own internal energy.

CCS Concepts: • **Applied computing → Media arts**.

1 INTRODUCTION

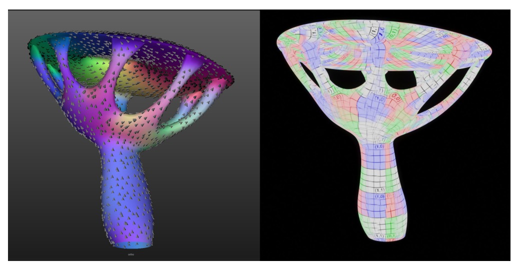

Fig. 2. Providing groomed vector information to hex tile projections controls direction of texture animation ©Pixar.

The Communiverse is a vast, energetic protopian space-station made up of inner and outer infrastructure cores and four unique biome discs. The four biomes — aquatic, frozen, verdant and hot desert — represent the various home planet ecosystems of the residents of the Communiverse and need to visually reflect these distinctions. Constantly in motion, the Communiverse is a machine suffused with energy. To quickly and efficiently convey this, we use unique combinations of simple procedural shading and modeling techniques including new applications of time-based shading to create cycles of visual motion. We use novel applications of — and improvements on — existing texturing, parallax mapping and ray marching techniques. Procedural modeling and dressing efficiently add visual complexity and scale.

2 PROCEDURALLY ANIMATED SHADING

Supporting the concept of the perpetual flow of energy and life requires the look of the Communiverse geometry to constantly be in motion without input from downstream artists. We combine simple offsetting and remapping of time and frame data, including use of trigonometry functions to create cycles, to generate time-varying input to shading signals. These data are modified per geometric instance and used for a combination of effects, including offsetting and rotating manifolds and manipulating masks, yielding uniquely artistic results at a variety of times and speeds. These cycles are also used to create animated displacement so that buildings appear to breathe and undulate.

Internal improvements to existing hexagonally-tiling texturing techniques have given us control to groom rotation directions within tiles. By animating offsets to those groomed projections we create a sense of four-dimensional motion as patterns flow through projection space. See Figure 2.

3 RAY MARCHING AND PARALLAX MAPPING FOR RENDERING EFFICIENCY

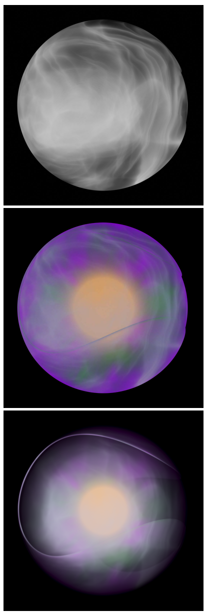

Fig. 3. Simple ray marched signals combine to approximate heterogeneous volumes ©Pixar.

To provide visual scale for architectural elements while maintaining rendering efficiency, simple parallax mapping and ray marching techniques are used in unique ways. Libraries of textures representing alien windows and other plausible architectural details animate and project into the volume of the geometry with parallax to provide depth. We use four-dimensional ray marched fractal signals to create the appearance of clouds within the geometry. Originally developed for Pixar's *Soul* (2020), we leverage and improve a shader that ray marches to distorting isosurfaces to create networks of moving auroral lines. By combining these techniques with simple fresnel effects, we approximate computationally expensive heterogeneous volumes at interactive rendering speeds. See Figure 3.

4 TERRAIN MODELING AND SHADING

Starting from a nonmanifold surface similar to a möbius strip, the Communiverse disk terrain is modeled in Houdini. The disk features are all designed procedurally from the base mesh. For example, we extrude the terracing and derive the patchwork regions based on custom noise patterns. UV attributes are carried through from the base mesh to the final geometry. We generate geometry-based shading signals in UV space such as distance to the patchwork edges and id patches. This procedural approach was essential for tuning the disk terrains and offered much more flexibility in design iterations for populating this complex environment.

For each disk, Houdini-generated geometric data and textures are leveraged in the shading to augment the terrace and patchwork generated in the modeling phase. We employ the same architectural shading techniques to add motion and volume to the terrain and provide a greater sense of scale.

5 LIGHT DRESSING

A few types of procedural light dressing fully flesh out this bustling universe. Procedural light dressing along terrace paths in secondary areas mimics the time consuming process of hand dressing these lights from hero areas. Scaffolding lights — meant to be reminiscent of an oil rig — surround some buildings and cityscapes, providing a sense of ongoing construction and structural scale.