The Cinematography of Wall•E
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Our cinematography was designed to evoke the sense of being in a realistic world -- ranging from the dry, gritty solitude of a trash-covered Earth to the slick exteriors of high technology -- while maintaining a classic, 1970s sci-fi cinematic feel without the “crispness” of traditional CG.

This presentation demonstrates the most important technical and aesthetic characteristics that were central to achieving the look of Wall•E.

1. Camera

An early mantra on Wall•E was “real cameras shooting real robots.” In order to accomplish this, our Camera Department researched live-action camera kits: lenses, dollies, booms, cranes, heads, and steadicams. A critical analysis was performed using a Panavision 35mm camera (with both spherical and anamorphic prime lenses) in our Studio’s atrium. We explored the following camera parameters: focal lengths, distances, and apertures using physical mockups of our main characters to learn how the filmed image responds to these variables.

As a result, Wall•E’s camera model was endowed with a number of the physical attributes seen in our tests: a non-proportional circle-of-confusion created via a new option in Renderman; a variable field-of-view based on focal distance and focal length (so-called “lens breathing”); and barrel distortion.

Similarly, we employed physically-inspired camera movement: non-nodal camera head; camera jitter; and dolly/track-style controls. While our camera work typically happens prior to animation, on Wall•E, we operated our cameras after animation, so we could truly follow the action as a camera operator would in live-action.

To ensure the aesthetic application of these characteristics, we improved our interactive hardware rendering to give our camera department improved feedback of their camera work (including the ability to respond to preliminary lighting designs -- something that traditionally happens much later in the Pixar pipeline).

2. Illumination Model

The Director’s vision pushed us from our traditional, Pixar illumination model into a more physically-based model. Each material layer had roughly two levels of controls. The first level was comprised of “correlated coefficients”: roughness, metallic and color. These knobs defined the percentages of diffuse, specular and reflection based on an energy-conserving relationship. A shiny material, for example, would send more light to specular/reflection and, consequently, less light would be available to participate in diffuse. In other words, we created a formula to tie these variables together so it wouldn’t vary from artist-to-artist. The second level knobs, “weight adjustments” were there primarily for lighters (though shading artists exploited their availability as well). These weighting factors would allow for precise illumination component adjustments (e.g., knock back the specularity without affecting the current diffuse value).

The last aspect of this model worth noting was the presence of fresnel in all our materials. Earlier films at Pixar turned this on as needed; however, on Wall•E, we intentionally flipped it on by default.

3. Lighting

While we continued with Pixar’s tradition of carefully designed lighting scenarios that reinforce the emotional core of the film, the lighting approach for Wall•E was decidedly the most photographic approach to date for Pixar.

In addition to simulating anamorphic flares, diffraction and blooming effects, we worked in an energy linear space using gamma correction. However, we decided to employ an additional display-time lookup table to simulate a traditional celluloid “printing process” -- i.e., the effect of printing a linear-intensity image onto a nonlinear medium. This brought more punch to the image by introducing contrast and preserved color in the darks while desaturating the brights. This is conceptually similar to a Director of Photography selecting their film stock as an additional creative variable in their arsenal. Further, atmospheric effects were heavily employed to give the air a palpable presence and provide a sense of scale and depth for nearly all our scenes.

In terms of the lighting toolset, we employed a new style of area light to achieve radiosity-like effects for lower cost than true radiosity solutions. These area lights additionally participated in specular, reflection/refraction beyond the standard diffuse-only approach. This was especially helpful in marrying emissive objects into their environments. Similarly, high dynamic range sources helped achieve a complexity in our reflections more closely matching a physical scene. In addition, our new illumination model allowed us to bake multiple material layers into a single suite of illumination coefficients, allow our realtime LPICS/relighting engine to more closely approximate the Renderman-rendered scene.

4. References