

Tokyo Race Lighting for *Cars 2*

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Tokyo at night is one of the world's most beautiful locations. The architecture combined with a massive quantity of illuminated signs creates a visual complexity rarely seen. The challenge was to recreate the emotional impact and excitement of downtown Tokyo but maintain the visual style of *Cars 2*. Additionally, this lighting setup had to work over a large number of locations and camera angles. This led to thinking about the setup as a lighting environment, and not just an angle specific rig. To break up the complexity of this visual problem, each component of the lighting was focused on individually.



Figure 1: Tokyo Race Lighting for *Cars 2*. ©Disney / Pixar. All rights reserved.

1 Diffuse Lighting in the Tokyo Race

In the Tokyo Race there are three major sources of diffuse light; the lights illuminating the track proper, the illuminated signs hanging on the buildings and the headlights of the racer's themselves. Each of these needed a unique approach. The track and racers are illuminated by a series of overhead lights on the sides of the track. For this, line lights (an analytic light created with a line segment) were implemented. These line lights have the perfect shape to mimic the throw of hundreds of fixtures all in a row. Shadowing these lights proved the more complicated issue. Many variations of ray-traced and mapped shadows were implemented before the correct balance of render time vs. aesthetic desire was achieved. The second largest influence on the set's diffuse lighting was the illuminated signs. There are 100's of signs hand placed throughout the set and they needed to have a flexible and accurate system of illumination. Surprisingly, a ray-traced solution using point based irradiance provided a great simulation of these signs. Lastly, the headlights of the racers themselves were a large contributor of diffuse illumination. These used a traditional approach of pointlights combined with shadow maps and shapers (barns and slides).

2 Reflection in the Tokyo Race

Reflection was the most complex and expensive portion of the setup to build and render. The major components were the track lights, illuminated signs, and the reflection of the buildings into each other and the racers. The illuminated signs were the most important visual feature of the reflections. Mimicking the approach for the diffuse component, ray-tracing was used to accurately simulate the



Figure 2: Rainbow Bridge Lighting for *Cars 2*. ©Disney / Pixar. All rights reserved.

sign reflections. The buildings themselves were fairly dim and they have a convenient rectangular shape, so using a texture based approach to simulate their reflections was accurate enough. Using a texture based approach also allowed for the baking of the diffuse irradiance into the texture, which would have been too expensive to calculate with ray-tracing. The race track lights also used a texture based approach, stringing 100's of texture cards along the bottom of the actual lamps.



Figure 3: Back Alley Lighting for *Cars 2*. ©Disney / Pixar. All rights reserved.

3 Optimization

With several thousand lights and a few dozen Tokyo city blocks full of geometry, the full Tokyo setup was fairly un-renderable. Careful optimization was needed to make sure each shot had the lights it needed but nothing more. The setup was built in a compartmentalized fashion, so that entire sections could be easily deactivated when not on screen. Additionally, in many cases, the lights themselves were built procedurally. This allowed the lighting setup to quickly adapt when the race course was modified and allowed different sections of the city to be built up quickly. Perhaps most importantly, the same general techniques were used throughout the city. The names of the lights and geometry might change, but the underlying approaches for the illumination was always consistent. This allowed the lighting artists to quickly ramp up in the different sections of the sequence and provided visual continuity for the sequence as a whole.