HDR TV Output and Lighting Gears of War 4

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Figure 1: Screenshot from Gears of War 4, showcasing the HDR lighting and materials. ©Microsoft

ABSTRACT

Gears of War 4 is one of the first titles to take full advantage of the High Dynamic Range (HDR) TV output of the Xbox One S. We developed techniques & technologies to do this, including using HDR reference photography, a modified tonemapper, lumen-based lighting, HDR sky materials, camera exposure ranges, post processes and a tuning environment for emissive surfaces and visual effects. We built a strong foundation of physically based materials and other shader techniques to create a wide variety of realistic surfaces that react beautifully to light. Our artists had the challenge of achieving the goals of art direction, while meeting the performance goals of 1080p30 in single player and 1080p60 in multiplayer gameplay. Using available lighting techniques in UE4 + custom tools, we implemented best practices to optimize our artist workflow resulting in stunning visuals.

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CCS CONCEPTS

• **Computing methodologies** → **Computer graphics**; *Rendering*;

KEYWORDS

HDR display, lighting, realtime rendering

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1 AUTHORING FOR HDR TV OUTPUT

Gears of War 4 was designed to support outputting to HDR TV when played on the Xbox One S, and our lighting team was faced with the challenge of authoring proper content for this new standard. We quickly realized that seeing our game with such an expanded luminance range highlighted shortcomings in our rendering tech and lighting workflow. Working with our rendering team, we came up with a modified tonemapper to bring out additional details in the darks, while keeping as much lighting information in the brights. Mismatches in individual artist decisions for various lighting settings resulted in inconsistencies upon viewing on HDR

TV. To calibrate our light intensities, we used lumen values for all sources whenever possible. This allowed us to estimate the relative intensities of all other light sources, which we collected additional information for using multi-exposure photography. For consistent presentation across all of our diverse maps in the game, we used fixed values for almost every lighting related setting in UE4 (i.e. Lightmass Gl bake settings, camera exposure range, bloom, lens flare, screen space ambient occlusion, atmosphere, film grain, vignette, tonemapper toe & shoulder, etc.). For emissive surfaces such as bulb filaments, neon signage, bioluminescence as well as visual effects such as fire, lightning and weapon fx, we provided artists with a tuning environment that allowed dynamic swapping of time of day/weather. This look development scene had all of our standardized lighting settings, so by tuning assets in here they would look correct in any level. Consistency of lighting was a major key to getting beautiful, natural results on HDR TVs.

2 PBR MATERIALS: THE FOUNDATION OF GREAT LIGHTING

Using a PBR (Physically Based Rendering) game engine greatly helps improve surface realism, but only if materials are authored correctly for it. Our artists had difficulty adapting to the newer PBR content authoring workflow. At first we used the buffer visualization view modes in UE4 to assess the base color, roughness, metallic and specular passes, and applied our knowledge of PBR to determine the incorrect content. This was time consuming and difficult to assess especially when partially metallic surfaces had been defined. We came up with a special view mode to highlight non-PBR compliant surfaces, taking all of the guesswork out of our previous workflow. Using code from this view mode, we developed a material function to automatically modify any material in our game to render PBR compliant, even if the artist desired to create dark, anodized metals (which most realtime PBR engines struggle with). To do anodized metals, our new material function converts non-PBR compliant darkly defined metals into layers of PBR-compliant metal and dark non-metal, blended together using dither patterns smoothed out with temporal anti-aliasing. By ensuring PBR compliancy, all of our materials react wonderfully to light without loss of energy, resulting in impressively realistic surfaces when viewed on HDR TV. We authored a shared library of PBR compliant base materials for our Material Masking System, which allows artists to combine them using masks for use on individual assets.

3 OPTIMAL LIGHTING WORKFLOW

Our goal with Art Direction, Design, and Tech Art was to create a HDR lighting experience with a strong artistic sensibility, which enhances gameplay and performs optimally on the Xbox One platform. We used strategically crafted lights to guide the player through important game objectives, and shaping lights to maximize the visibility of environmental cover and enemy targets. In order for lighting to achieve all of the above and remain within budget, including hitting the performance target of 1080p60 fps for online multiplayer levels, we employed a variety of lighting optimization techniques using both existing and customized features of the engine. For instance, we leveraged the strength of UE4's light baking system to generate static direct light, indirect bounce lighting and reflection captures for enhanced surface specular contribution, while reserving more costly runtime shadow-casting direct lights to enhance critical moments. A custom toolset allowed us to toggle dynamic lights with array controllers for optimal performance during heavy parts of the streaming levels. Volumetric and atmosphere scattering lighting effects were available to the artists to set the mood and serve as backdrops to silhouette enemy targets. The artists were required to regularly run performance measuring tools to make informed decisions when choosing different lighting techniques while preserving the artistic integrity of the HDR visuals.