Streamlining IBL workflows with computer vision and USD

Supplementary Material

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1 CASE STUDIES AND ARTIST EFFICIENCY

As mentioned in our paper, the adoption of new strategies to extract lights and produce IBL rigs was essential for the production of *Venom*: the sheer number of integration shots was setting a new level of challenges while raising the quality bar very high.

The combined factors of a black, shiny character and a majority of the sequences happening at night or indoor with many light sources soon made clear that the lighting on set wouldn't necessarily work for our CG creature. Often the VFX supervisor would say that "if Venom was on set, the DoP would have lit it differently". In terms of lighting this meant that an accurate reconstruction of the scene was not an option in most cases. Instead artists were asked to predominantly light using the specular component as opposed to the diffuse. With the *iblManager* at their disposal, they were able to do quick iterations and address any kind of artistic notes while retaining a natural feel of integration with the plate. Sometimes even portions of non emissive areas were extracted to be used as fill lights (see Figures 1 and 2).

On other occasions, the extraction of many lights was desirable to separate ambient lighting from other sources (i.e. for compositing purposes like splitting light components in AOVs), which would decrease the render performance. To resolve this artists would extract lights to generate a secondary environment map instead of a multitude of area lights, keeping the render times contained (see Figures 3 and 4).

Since the process of extraction was extremely fast, the *iblManager* was frequently used to generate disposable light rigs. These rigs were simply used as catalogs of textured lights from where artists could cherry pick to produce interesting reflections. This was especially true for Venom's eyes and generally in full CG shots (see Figures 5 and 6).

LightCache proved to be relevant beyond the lighting domain: it was an isolated USD pipeline which worked as an fundamental testbed and preparation for a wider adoption of USD throughout the company, similar to DreamWorks' approach described in [Blevins and Murray 2018].

Figure 1: Arbitrary placement of lights to deal with the character's peculiar shader. ©2018 Sony Pictures. All rights reserved.

Figure 2: The resulting shot where reflections are used to light the character. ©2018 Sony Pictures. All rights reserved.

2 FUTURE WORK

When drawing our conclusions on the first year of usage of both *iblManager* and *LightCache* we mentioned that we're evaluating a variety of improvements and features, which could benefit from both the computer vision paradigm and the USD framework. In the following, we're outlining some of these options.

To reconstruct the lights' size and position, we're considering an automated variation of [Suter et al. 2016] using OpenCV, feature matching and a LDR pano (e.g. from a Ricoh Theta) as a secondary image. We're also evaluating positioning via projection onto the LIDAR, both in Nuke and in Clarisse, since it is required for placement of the light rig in scene anyway.

The interactivity of *iblLightFind* could be improved by allowing to adjust the light bounding box in the preview, before extraction.

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Figure 3: An environment map used for ambient and fill lighting. ©2018 Sony Pictures. All rights reserved.

Figure 4: Extracted lights exported as latlong map. ©2018 Sony Pictures. All rights reserved.

Figure 5: An example of Venom using arbitrarily extracted lights. ©2018 Sony Pictures. All rights reserved.

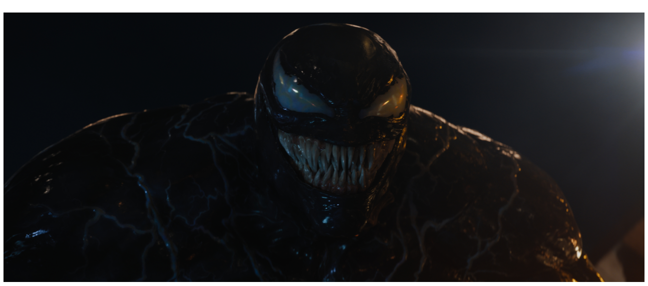

Figure 6: An example of lights used for eye reflections. ©2018 Sony Pictures. All rights reserved.

Artists would also benefit from having the projection of each bounding box displayed onto the latlong map.

For HDRIs of exteriors, we plan to automatically detect the sun, optionally extract it as a directional light and allow halos to be removed from the sky. We are interested in testing the results of applying Debevec's Median Cut Algorithm [Debevec 2006], as an additional control parameter to drive the distribution of lights extracted via computer vision.

We are also assessing the option of decoupling the core logic from Nuke and leverage more of USD to allow manipulation of rigs in other DCCs. For example, USD light schemas could be extended to support projections and expressions which would allow non-destructive light repositioning to compensate exposure changes based on each light distance form the rig's center. Forthermore, USD could be extended to display lights in its standalone usdview application.

Finally, regarding performance, we're currently assessing pros and cons of porting our code to C++ in a Nuke plugin. This would allow live processing of the stream rather than the top node image as in the current implementation.

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