Interactive Lighting Of Effects Using Point Clouds In “BOLT”
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1. Introduction
Integrating effects into an environment is often a challenging task. This is especially true when the light source is a dynamically changing organic shape such as a lick of flame against a wall of smoke or glowing embers wrapping around a character. Typically, this illumination can be faked with a large number of artistically placed animated lights. However, this often takes time and experimentation to get a pleasing and plausible result. We created a pipeline that is flexible and allows us to generate interactive light from any environmental effect that we would create.

2. Technique
Typically, RenderMan point clouds and the “indirectdiffuse” calculation will generate colored bounce light from one surface to another. We have taken that basic idea and expanded it as a primary light source for a majority of environmental effects that we would create. In addition to having effects like fire illuminating hard surfaces, we integrated the lighting calculation into our volume smoke pipeline to also receive light from point clouds.
   a. All effects surface, volume and sprite shaders written with the “bake3d” call in order to generate point clouds from any effect. Point clouds also exportable directly from Houdini.
   b. Point clouds filtered in order to combine or reduce point counts to a manageable size using pmerge and custom point cloud tools.
   c. All effects surface, volume and sprite shaders written with the “indirectdiffuse” call to receive illumination from the generated point clouds.
   d. Surfaces in our standard pipeline would receive our point clouds and use ptfilter to combine and pre-calculate the illumination for use on surfaces.

3. Tools Developed For Flexibility
In order to fully integrate point clouds into our effects pipeline, a number of useful tools were created.
   a. Houdini point cloud reader/writer. Point clouds generated from any source could be brought into Houdini to be visualized, manipulated and exported. Point clouds could also be generated directly from Houdini without rendering.
   b. Point cloud filter. Heavy point clouds could be filtered down in point count with this utility. A time filter option would mix in a percentage of before/after frames to avoid time aliasing due to culling random points.
   c. Maya point cloud visualizer. A visualizer inside of Maya displayed animated point clouds and any attributes. This was extremely useful for both effects and lighting artists.

4. Illumination in Volumes
Illuminating smoke from animated and organic light sources is extremely difficult using standard light types. By using point clouds generated from the actual effects provides interactive lighting, which is easily adjustable. In order to use the “indirectdiffuse” call on volumes and sprites, it is necessary that there is no falloff of intensity based on the surface normal or I vector. Setting the “distribution” to “uniform” will enable this behavior. Since a volume does not have surface normals, we would pass an arbitrary normal and it’s inverted direction for each shaded point. We would then sum the lighting contribution from both directions. This would make sure that you were receiving the “indirectdiffuse” calculation from all directions for each volume point.

5. Conclusions
Typically the integration of organic effects that emit light would require a great deal of effort from a lighting artist. By using point clouds in the pipeline, interactive illumination of effects is easily obtainable and art directable. These point clouds can also be used to provide interactive lighting on smoke, which would be difficult with conventional light sources. By creating supportive tools, use of this technique becomes a simple and robust part of both the effects and lighting workflow.

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