Bakery Relight™

Interactive Lighting, Shading & Rendering for Pros

What is Bakery Relight™?

Bakery Relight™ is the first interactive, all-in-one 3D lighting and rendering solution for the high-end computer graphics market. It was created to streamline and accelerate workflows and to enhance the artistic process on flat and stereoscopic 3D animated and live action/visual effects feature films and television series, and on industrial, automotive and architectural design projects.

Bakery Relight has shown that it markedly enriches the creative process, increasing productivity, efficiency and turnaround times by up to 300%.

Key Benefits of Bakery Relight:

Ideal for look development and prototyping

- Manages many lighting scenarios simultaneously
- Enables users to navigate directly towards their data by picking materials, geometries, lights, etc. on the rendered image

A powerful, full-featured rendering engine

- Point cloud-based illumination: ambient occlusion, global illumination,

  sub-surface scattering, environment lighting
- Fast volume rendering
- Generates hair from clumps, guides, maps, or external packages
- Comprehensive, highly customizable, shadowing system:

  soft and deep shadow maps, ray-traced shadows
- Precise control of depth of field, 3D motion blur and displacement

Interactive lighting, even on extremely complex scenes

- Multiple users can access the same data simultaneously and

  work in parallel with easy ins-and-outs at a single or remote locations
- Native instancing and level of detail support
- Distributes computations on multiple machines

- Immediate, final image quality feedback

Native stereoscopic 3D management

- The only complete interactive lighting and rendering solution for stereoscopic 3D content — it is no longer necessary to relight images in the final composite
- 4K HD stereoscopic player enabling instantaneous video preview
- Rapid 3D rendering with left eye and right eye processing
- Streamlined color correction can be performed in 3D using volumetric objects

Who is Bakery Relight's Target Audience?

Bakery Relight was created for animation, visual effects and design companies seeking to expand their artistic palette while streamlining and accelerating workflows on high-end feature film and TV content. It is the ideal solution for 3D CG animated and hybrid live action/VFX content with 3D animated elements, especially in the action adventure, fantasy and science fiction genres. It is also the premier product for industrial, automotive design and architectural companies interested in enhancing workflows and producing more vivid and realistic simulations on complex assignments.

How Do People Deal with Lighting in Production Today?

In a production pipeline, the lighting stage is often considered as a bottleneck, as it brings together several assets, each with its own geometry, rigging, animation, shaders, textures, etc… Many layers of complexity have to be processed at the same time. This can represent a huge amount of complex algorithms, and lead to long calculation times.

However, while an artist is attempting to obtain the desired lighting on a shot, many successive iterations and tweaks are usually needed before a final rendering can be delivered. Client re-takes can often increase the amount of iterations, which demands a high level of reactivity.

With existing lighting solutions, every single change carried out on a lighting scene forces everything to be re-calculated again, whatever the real impact of that change. This situation considerably slows down the lighting process, as well as the reactivity of the artist. In addition to this undesirable loss of time, the delay between an artist's actions and the feedback he receives from the software slowly transforms the artistic part of his work into a technical one.

Before Bakery Relight, the existing solutions available to handle these issues were:

- To translate an important part of the rendering calculation into compositing, in post-rendering. Sometimes up to the point where the shader's layer combinations (diffuse, specular, reflections, ao, gi) are re-composited later in the compositing process. This process has become very popular due to the lack of any better solution, but this unfortunately gave rise to new problems: anti-aliasing, transparencies, raytracing, stereo management, are difficult to handle in a compositing application. In addition, the complexity of the shader's need to be reproduced in complex compositing trees, and this process relies on a high amount of buffers generated by the renderer, which can cause important disk storage issues.

- To work on an approximation of the final rendering during lighters' iterations. This can be done in many ways: rendering with low-quality settings, simplifying parts of the calculation, using progressive refinement, etc... Doing so, the lighter does not see the exact result of his work, and several submissions to the render farm are often necessary before the lighting is finely tuned.
- To use GPU shaders. Doing so, the lighter can work in real-time. But several problems often arise with GPU, which do not make it a very popular solution in production: additional work often needs to be done to translate the shaders in GPU, the result is often an approximation of the real rendering (leading to the problems listed above), and the whole production becomes dependent on hardware, which is always in constant evolution. In addition, hardware costs are far from being negligible, as it may double the cost of a render farm.

New Solutions Made Possible with Bakery Relight:

In addition to these existing solutions, Bakery Relight aims to extend the realm of possibilities, with the following guidelines:

- It allows the artist to work interactively on the shading/lighting
- It allows the lighter to work without any approximation in comparison to the final rendering, meaning that nothing is "faked" during interactive sessions.
- It enables the artist to work on the lighting of a scene with final quality setting (2K, accurate anti-aliasing, motion blur, etc...).
- It operates on any hardware (without relying on GPU).
- Can handle any level of complexity in terms of shading/lighting.
- A good scalability with the complexity of the scenes is necessary, as production scenes can often be extremely complex.
- It is compatible with any production pipe-line, which is different in each company. Any retakes on modeling/rigging/layout/animation, are possible and easy to do.
- It offers a cutting-edge Reyes renderer with a "human" interface, without needing additional development to render a scene.

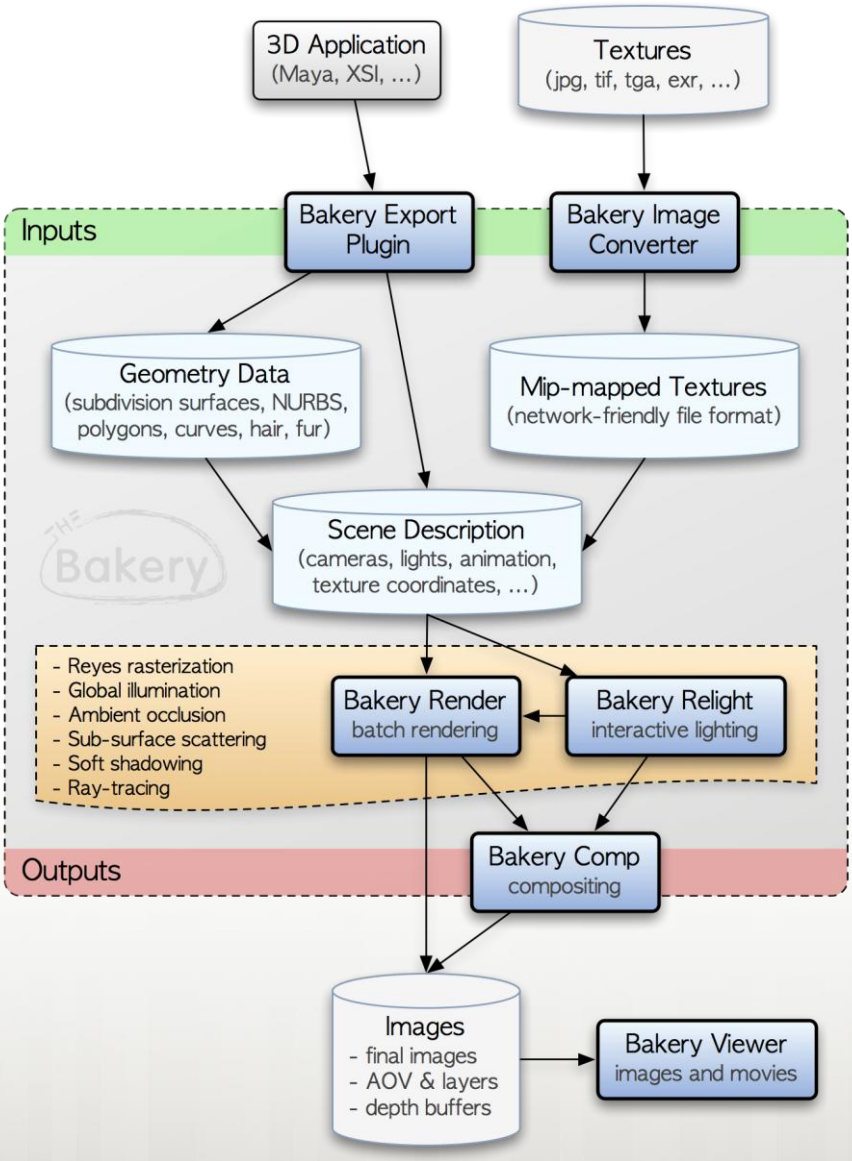
How Can Bakery Relight Achieve Interactivity?

In Relight's renderer, the rendering process is split into several components, and each time-consuming calculation is automatically cached in temporary files. The granularity of this system is extremely high, as each operator of the shading tree can cache its own information. After a first image has been rendered, Relight's sophisticated dependency graph allows the automatic detection of which part of the calculation will need to be processed again by the computer, when the artist modifies any parameter of any node.

The remaining (unchanged) calculations will be skipped, by reading the information cached in the previous rendering. In practice, the fraction of computation that can be skipped between two iterations is often surprisingly high. Note that this caching system does not rely on 2D buffers, but on real 3D information, as required by the renderer. This means that the usual issues caused by compositing do not apply here.

How Can Bakery Relight Be Integrated Into a Production Pipe-line

Data is exported from software packages such as Autodesk® Maya® or Autodesk® Softimage® XSI and transferred from the animation department to the lighting & surfacing department, where it is imported into Bakery Relight. Creative and technical lighting is performed with Bakery Relight, after which the data is sent to the rendering department, where the final render is also completed with Bakery Relight. Rendered data is delivered to the compositors, who can either use Bakery Relight to perform their work, or they can ingest the files into another solution for the final composite.



Bakery Relight's Integration Pipeline

In practice, a production pipe-line is usually split between "assets" and "shots", where an asset is meant to be used in one or several shots:

- When an asset has been modeled, it can be exported to Relight, where the surfacing will be done. Any re-takes in the modeling (in the 3rd party application) will be handled, without losing the work done in Relight.
- When a shot is exported, Relight's lighting scene will reference all the previous assets (with the surfacing done in Relight), and will apply all the necessary modifications, such as point caches. Any change in the original asset scene will be automatically updated in all the shots. It is still possible to apply local changes at the shot level.

Bakery Relight's Architecture:

Relight's backbone is a full-feature scene graph, with Generic Object Model representation and full blown animation package. In its framework, it is possible to create, modify and animate any light, camera or geometry in the scene. This architecture can easily be integrated into a pipe-line, as custom objects can be created to represent assets. Relight's API enables the creation of plugins, or custom nodes to be used as shaders, geometries, particles, compositing nodes, etc... Finally, Relight comes with a customizable scriptable user interface.

User View of Bakery Relight

The User Interface of Relight has most of the features found in common 3D applications. It is designed to allow the user to intuitively manipulate any element in the scene. More than 15 different windows can be displayed and organized as desired, so that each user can work with their favorite layout.

Relight's User Interface

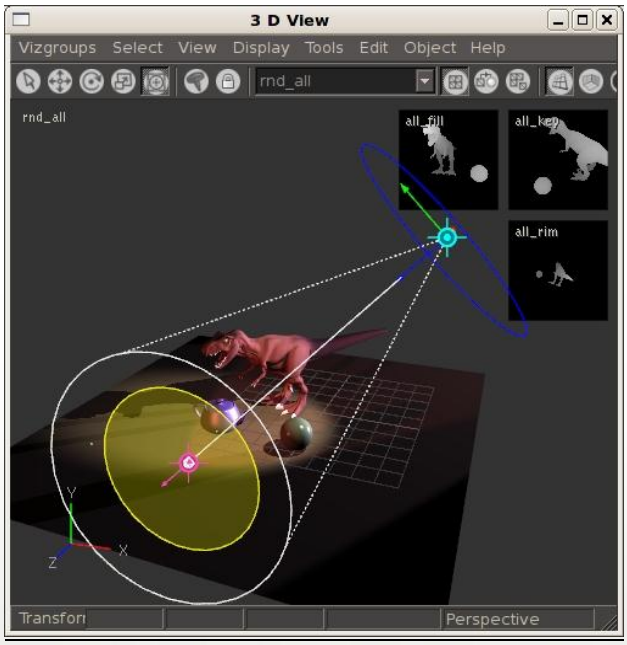
An element in the scene can either be geometry, a shader, a light, an instancer, a particle node, etc.... It can be selected and modified via several windows:

- The Hierarchical View, shows the scene as an outliner, allowing the user to navigate into the scene sub-elements (file referencing / parenting / grouping). An Attribute Editor can be used to modify any attribute of any node.

- The SpreadSheet is useful to organize and manipulate the nodes as desired. It gives quick access to any element in the scene, and allows the user to easily apply changes on several objects at the same time.

- The Graph Viewer shows a nodal view of the scene. In Relight, most of the nodes can be connected together, in order to build complex trees. In a Shading Tree, the common node is called a Shadop (Shading Operator), which can either be a procedural noise, a texture, a node used to blend the result of other Shadops, etc… But it is also possible to connect the result of a light, geometry, a group of geometries, or many other things into any shadop. The Graph Viewer can also display a Particle Tree, which can be created and modified to instantiate a geometry, or to render these particles as volume shaders.

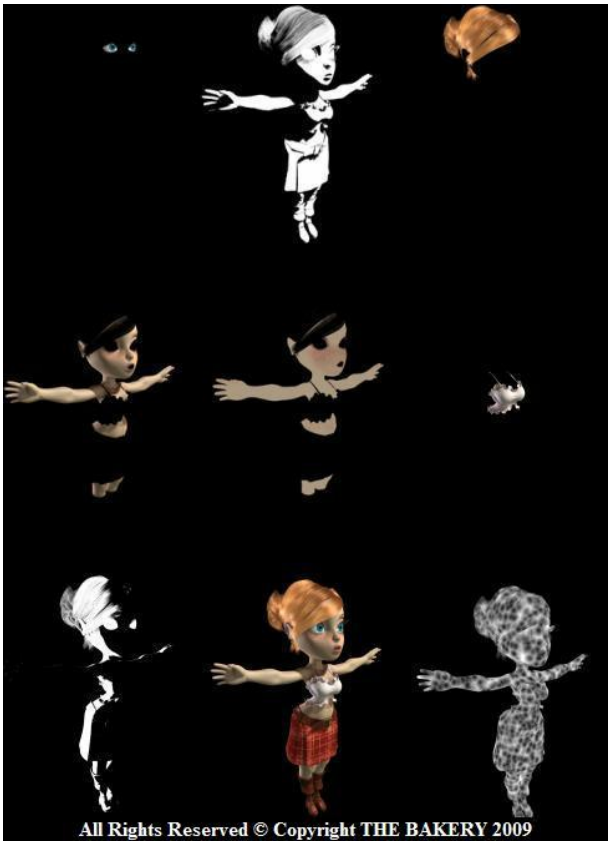
- 3D View: As in common 3D applications, Relight's User Interface contains a 3D View, which allows the user to manipulate objects in the scene, move/animate lights, hide geometries, etc… Several groups of geometries (called Vizgroups) can be used to instantaneously choose which objects need to be visible in the viewer. In complex scenes, choosing which geometries are displayed avoids slowing down the whole application because of the OpenGL display. It is also possible to work multiple 3D views, by adding as many tabs as desired.



Relight's 3D View

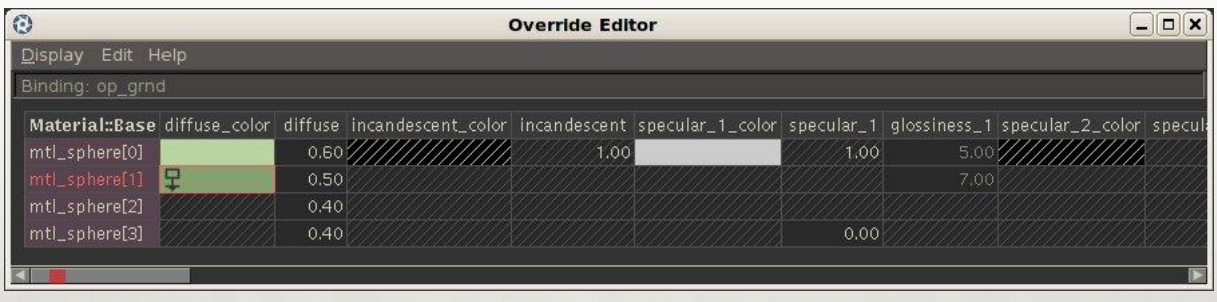
- The Render View is a central window in Relight. It not only displays the result of the rendering, but it also allows the user to select any object in the scene from the resulting image. It allows the user to visualize intermediate calculations at any moment, which makes it

very easy to debug a scene, and understand the contribution of each node in the shading tree. Several other features are useful in the render view, such as adding a background image, storing as many images as desired, toggling between the current and the previous result, etc…



Each layer's contribution can be visualized in the Render View

- Override Editor: Relight's architecture allows users to work in a non-destructive workflow, by applying overrides to an existing scene, and by incrementing the working override level at any time. Different levels can therefore be used for different stages of the pipe-line: Look-Dev, Surfacing, Lighting, Final Retakes, etc... A window called Override Viewer displays the successive changes carried out at each level. As only the "delta" is saved between 2 different levels, it is possible at any moment to apply a low-level override (in an Asset's Shading scene for example), and expect this change to be updated in any Shot that references this asset.



Override Viewer displays the successive changes carried out on a node for each override level.

Bakery Relight's Rendering Features:

Reyes Rasterization

Relight's renderer is built on a cutting-edge Reyes rasterization, that allows:

- Fast high-quality rendering, with low-cost anti-aliasing.
- Low-cost Displacement
- 3D Motion Blur
- 3D Depth-of-Field
- Easy rendering of large amounts of fur
- Load On Demand (Automatic Delayed Archive)
- High Level Of Detail
- Instancing
- Subdivision Surfaces
- No need to parse complex RIB files

Shading

Relight is designed to allow the artist to obtain high-quality Shading, thanks to the following features:

- The Shading Tree allows for infinite complexity in the surfacing.
- Mipmap textures are streamed, in order to limit the amount of memory dedicated to textures.
- Several Illumination models can be used (Lambert, Phong, Cook-Torrance, Lafortune, Kajyia-Kay, Ward anisotropic, etc...)
- Progressive Refinement allows users to refine the resolution of the shading progressively, in order to accelerate visual feedback.
- Macros can be created, to represent a group of nodes in the shading tree. These macros can then be stored and re-used in other shading trees.

Point Clouds

Point clouds are a central part of many of our advanced shading operations, such as:

- Multi-bounce Global Illumination
- Ambient Occlusion
- Sub-Surface Scattering
- Glossy Reflections
- Environment Lighting

Relight's proprietary point cloud format and its unique set of features make these usually hard-to-control and time-consuming methods feel like a breeze!

Point Cloud Viewer

Fully-fledged shadowing system

Several methods can be used for shadowing, as it is possible to compute either regular shadow maps, soft shadow maps, deep shadow maps or ray-traced shadows. Soft-shadowing methods can compute shadows with accurate penumbras, only at the cost of a regular shadow map, while deep shadow maps allow for high-quality shadowing on detailed geometries, even with transparency, motion blur and volume shadows. It is also possible to append several shadow maps for a single light. This allows users to compute the shadowing for static objects only once for a whole sequence, for example, and to append it at render time with an animated "per-frame" shadow map.

Volume rendering

A wide range of volumetric data can be handled: Voxels, Particles, Light beams, Fog… Voxel shaders can be automatically exported from Maya Fluids. In addition, simple ASCII descriptions for Voxels and Particles are provided, as well as an API to generate custom particle nodes, allowing users to write their own particle simulation. Relight's Volume rendering is extremely fast and comes with:

- Self shadowing and shadow casting on regular geometries
- Overlapping volumes
- Volume shaders can be mixed with other shading operators (noise, textures,etc…), indeed complex shading trees can be built
- Fluid velocity motion blur
- Unique algorithm that avoids Reyes artefacts with transparencies and motion blur
- Particle Rendering
- Meta-balls

Ray-tracing

Relight offers a full hybrid render engine, switching to a competitive ray-tracer when sharp reflections or refractions are needed.

Fur Support

Several techniques can be used to render fur:

- Curves exported from 3rd party applications can be directly rendered in Relight.
- Fur can be procedurally generated over a surface in Relight.
- Input fur geometry can be used as guide hairs, in order to generate millions of interpolated render hairs. With this solution, one can export the animated guide hairs with dynamics from a 3rd party application, and generate/stylize the render hairs in Relight.
- Stylize hair using procedural parameters (clump, jitter, twist, etc….), which can all be connected to textures, or procedural noise operators.
- Brush the hair using either our proprietary 2D or 3D hair painting tools.
- Use an in-put fur geometry to generate procedural meshes.

Fur generation and styling can be carried out directly in Relight

Particle Tree

Particle data can be read from particle files, or generated procedurally in Relight. These particles can be modified in a Particle Shading Tree, and can be used as an input either to instantiate geometries, or for volume shaders. It is possible to read natively:

- An in-house ASCII particle file format.
- PDC files (can be generated by Maya)
- Softimage ICE cache outputs can be read natively, with all their attributes.
- New nodes can easily be developed to read any custom particle format, using our API.

AOVS (Arbitrary Output Variables)

Even though Relight's interactivity reduces the need for compositing, it is still possible to render multiple layers in one single process. The contribution of any node in the shading tree can, indeed, output its result in a specific buffer, meaning that one can expect the following buffers to be rendered without any additional cost:

- Diffuse, Specular, Reflection, Incandescence, Albedo, Refraction, Shadows, etc…
- Output of Shading Operator (noise, texture, custom expression, etc…)
- Render contribution of a single light
- Mask of a geometry, or a group of geometries
- Aliased Index per Geometry/Shader
- Aliased Depth
- Coverage, to be used with aliased Aovs.

COMPOSITING

The Bakery suite comes with a proprietary Compositing Tool, which can be synchronized with Relight. It is then possible to see the final composited image, while the artist is working in a Relight interactive session. Custom compositing nodes can easily be created using our API.

Bakery's Compositing application synchonized with Relight's interactive sessions

SDK / API / Scripting

Bakery Relight can be scripted with Python or QScript (Nokia Qt's implementation of JavaScript), in order to generate relight scenes, assemble data, modify attributes, reference scenes, override parameters, generate macros, customize the export from 3rd party applications, and thus integrate Bakery Relight in any production pipe-line. The interface can also be scripted, to create custom menus and plugins in Relight.

An API (in C++) can be used to generate custom shaders, geometries, particles, compositing nodes, which makes it easy to develop new nodes to read custom file formats for example.

Even Shaders can be scripted in Qscript!

About the Bakery:

The Bakery (bakery3d.com) is a 3D computer graphics company that provides pioneering software solutions for the feature film, TV and the industrial, architectural and automotive design industries. The company's first product is Bakery Relight™, an interactive lighting and rendering suite of tools for the high-end feature film, TV and design markets. The Bakery was founded in Gemenos, France in 2007 by veteran motion picture artists and technologists Erwan Maigret and Arnauld Lamorlette. Lamorlette earned a 2011 Academy Motion Pictures Arts and Sciences Technical Achievement Award for co-developing a global illumination solution, and Maigret holds a patent on laser-based glasses technology.

For further information on Bakery Relight™, please visit: www.bakery3d.com