

Interactive Light Transport Editing for Flexible Global Illumination

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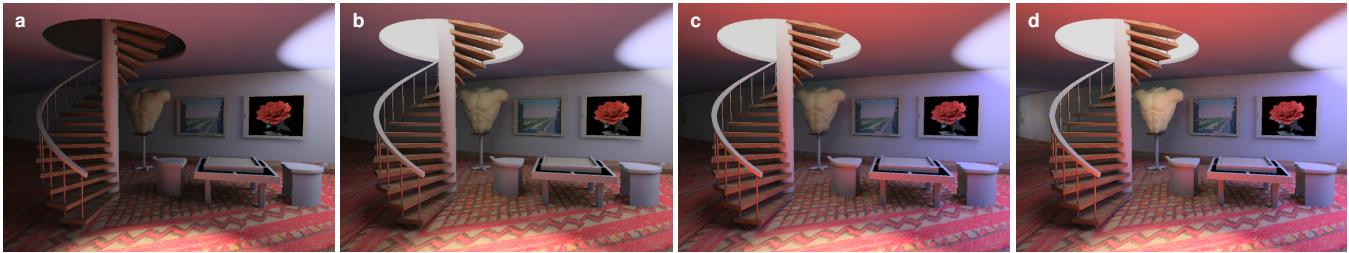


Figure 1: A lighting design session in LightShop. (a) Lighting process starts by placing two spotlights. LightShop instantaneously shows physically-based global illumination solution, which serves as a starting point for applying light transport editing tools. (b) The intensity of the indirect light emitted by the cylindrical object above the staircase is increased using the Light Source Brush. Notice pronounced soft shadows under the staircase and under the table. (c) The contribution of light reflected off the floor is modified by increasing its saturation and intensity with the Caster/Receiver Tool. (d) The Illumination Brush is used to paint indirect illumination on the far end of the wall and on the statue. The adjustments were exaggerated to illustrate achievable effects.

Introduction

The limited flexibility imposed by the physics of light transport has been a major hurdle in the use of global illumination in production rendering. It has been a common practice in computer cinematography to write custom shaders [Christensen 2003] or manually edit rendered images [Thacker 2006] to achieve lighting effects desired by directors. This process is lengthy, cumbersome and too technical for artists. To remove this hurdle, we propose a novel interface that allows users to modify light transport in a scene. Users can adjust effects of indirect lighting cast by one object onto another or paint indirect illumination on surfaces. As opposed to previous approaches such as [Schoeneman et al. 1993] our work departs from solving optimization problems in favor of more user control.

Our main contribution is a new approach to lighting design based on intuitive light transport editing with interactive painting interface. Real-time feedback facilitates prompt transformations of design ideas into actual images. This framework is an important step towards elimination of the thorniest problems related to lighting design with global illumination – restricted flexibility due to adherence to physically correct light propagation in rendering systems and resulting inefficient workflow requiring knowledge of several applications in order to apply artistic effects that are not physically correct.

The LightShop system

Our light transport editing framework works by modifying outgoing radiance values as light propagates through a scene and bounces off surfaces. The user is provided with a set of tools, which allow her to override physical laws of light transport by intuitive painting and also provide per-object control over spatial localization of painted modifications. We designed our toolset in collaboration with artists from a digital media production company. With only few operations, our framework is general enough to encompass the majority of effects related to lighting with global illumination.

Figure 1 shows an example lighting design session in LightShop. The session starts with a physically correct global illumination solution. Subsequently, the user applies LightShop’s tools for light transport editing to arrive at a desired image.

The **Indirect Illumination Brush** allows the user to manipulate light at its last bounce before it reaches the camera. In typical production situations, the Indirect Illumination Brush is used to perform final touch-ups such as brightening up a dark corner in a room. The **Light Source Brush** is used to modify light transport at the first to last bounce. Since every surface in a scene is a source of indirect lighting, this tool allows the user to create sources of indirect lighting literally by painting them. In production, this tool is used to create soft shadows or manipulate color bleeding. In addition to the painting paradigm, LightShop contains the **Caster/Receiver Tool** to provide precise spatial control and restrict applied operations to selected objects in the scene (i.e. to a subset of light paths).

We present our light transport editing interface as an independent abstraction that can be built on top of various rendering engines. In order to achieve real-time performance, we built our implementation upon the rendering algorithm developed by Hašan et al. [2006]. All described operations are implemented as procedural modifications of radiance values on gather/view samples applied in GPU shaders. The procedural representation is critical, because it can be used to connect the interface to a production renderer and thus propagate all changes into final images of highest quality.

Conclusion

We have shown that by overriding physical laws of light transport using a painting interface and by providing real-time feedback, artists can not only achieve vast majority of desired lighting effects (that are usually created as a post-process), but can also enjoy the benefits of an intuitive workflow at the same time.

References

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