

Photographic lighting design

Master degree subject

Romain Vergne

Georges-Pierre Bonneau

Joëlle Thollot

Contacts: Romain.Vergne@inria.fr, Georges-Pierre.Bonneau@inria.fr, Joelle.Thollot@imag.fr

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Context. Setting-up a proper lighting environment when rendering an object requires advanced skills to reveal particular features in the scene: object’s shapes, materials, depth, texture, shadows, etc. If professional artists (game designers, movie makers or photographers) might subjectively tweak camera and lighting parameters to obtain a desired style, they also rely on objective rules to enhance object properties. For instance, grazing lights enhance shape details, or large light boxes can be used to reveal shape and material of a rounded shiny object (Fig. 1). Reflections should sometimes be avoided as shown in Fig. 2: no highlights should appear on a photo of a picture.



Figure 1: Different cases of “bad” and “good” lighting designs in photography. Left: creating a grazing light reveals texture details. Right: the light travels through a large diffusion panel to exaggerate the shape of this highly reflective black turtle. Images from [Pho].



Figure 2: One must carefully avoid the reflection of the lamp in photos of pictures and paintings. Images from [HBF12].

A few attempts have been done in computer-graphics to edit and control lighting parameters in a 3D scene. Inverse problems are often solved to compute a lighting environment based on direct shading modifications on top of an object [SDS+93, PBMF07, OMSI07, Pe110]. Boyadzhiiev et al. [BPB13] propose a tool for smart composition of multiple photographs of a scene taken with different lighting conditions. Some other works exaggerate shapes by modifying the laws of physics [LHV05, VPB+09]. Finally some techniques also try to optimize the placement of lights in order to reveal shapes [SL01, SBD14] or material properties [BCRA11]. This former work by Bousseau et al. [BCRA11] automatically creates an environment to enhance object’s material in a still scene (using metrics based on perceptual and photographic properties) and is thus closely related to this topic.

Subject. The goal of this internship will be to take inspiration from photographic lighting techniques [HBF12, dp, Pho] as well as studies on shape and material perception [KA10, Mot10, XWG⁺14, FTA04] to automatically design photographic lighting setups based on a given fixed 3D scene and camera parameters. As opposed to [BCRA11], the student will try to represent basic photographic setups that usually use only a few lamps, possibly diffused or attenuated by other objects. These lamps will have to be placed in the 3D scene so that they reveal different properties of the scene: shapes (depth, edges, curvature) and/or materials (diffusion, reflections, transparency/translucency, etc). Additionally, the user may prescribe specific constraints (e.g. prescribe color in some regions). In order to leave a control on the final result, each of these renderings could also be done separately and composed afterwards. This internship involves:

- A bibliography stage: previous works done in computer graphics, but also courses and books on photographic techniques and perceptual studies on shape and material perception.
- A set of rules deduced from the bibliography, that should be automatically applied for a given condition (input shape/material).
- The design and representation of simple photographic tools, like light sources, light modifiers, or reflecting objects.
- The implementation of the rules for various 3D scenes and materials (this includes the analysis of the scene and the choice of light parameters).
- An evaluation of the method

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