Project Team INRIA:

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Author of the proposal:

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Title of the proposal:

SA3E
Shading Analysis for Appearance Acquisition and Enhancement

Scientific context

Since the early age of Computer Graphics, a lot of work has been done for modeling the different phenomena involved in the illumination captured either by the human visual system or any other devices such as cameras. The current state of the art solutions allow to compute amazingly realistic solutions, taking into account a large number of inter-reflections in between the different objects that compose a 3D scene. Based on these theoretical bases, some researches are now focusing in analysis of the resulting shading (first order [1], frequency [2]) to characterize the different phenomena and their visual impact on the result. Such an analysis is useful to develop more comprehensive acquisition systems (e.g., using tailored light sources to optically project the reflectance into a given basis [3]), to segment the different visual component of appearance [4] or to tuned the physical model in order to more efficiently convey the visual information [5].

Goal

The main goals on this project is to **develop in parallel models, acquisition systems and visualization tools**: this would lead to new solutions to explore real data using all the flexibility of computer models that can tweak the physical equations to its own purposes.
In order to reach this main goal, we will have to rely on some sub-goals that are:

- **Analysis** of the different parameters of shading and their characteristic influence on the result
- **User-controlled rendering** techniques to hide/emphasize features issued from these parameters
- **Direct acquisition** of the selected parameters

To illustrate these goals, we might take as an example the case of BTF model for the appearance representation. Currently, analysis is biased due to the lack of accuracy at grazing view angles. With an improve acquisition system, we can thus expect first higher quality rendering but also, to use this representation for tuning the rendering systems in order to emphasize details contained into the spatially varying materials or in the underlying meso-geometry.

Project

For this project, a strong backgrounds on realistic lighting in **Computer Graphics** or on **Optics** and on **Mathematics** will be required. Of course, as in all Computer Graphics project, some programing skills are required. Finally, an experience on acquisition devices (for geometry, reflectance, ...) could provide a high value to the project.

This project will certainly be done in collaboration with researchers in Optics from either the CEA research center, from University of Bordeaux, or from the up-coming research center of the Optics Institute. The PhD student will also be involved into the design and the development of acquisition facilities in the up-coming INRIA building.

Duration:

36 Months

References:

[1]. **A First-Order Analysis of Lighting, Shading, and Shadows.** R. Ramamoorthi, D. Mahajan & P. Belhumeur, *ACM Trans. Graph.*, 26(1), 2007.

[2]. **A frequency analysis of light transport**. F. Durand, N. Holzschuch, C. Soler, E. Chan & F. X. Sillion, *ACM Trans. Graph.*, 24(3), 2005.

[3]. **A Basis Illumination Approach to BRDF Measurement.** A. Ghosh, W. Heidrich, S. Achutha & M. O'Toole. *International Journal on Computer Vision*, 2008

[4]. **Image-based Separation of Diffuse and Specular Reflections using Environmental Structured Illumination.** B. Lamond, P. Peers, A. Ghosh & P. Debevec. *IEEE International Conference on Computational Photography*, 2009.

[5]. **Light Warping for Enhanced Surface Depiction**. R. Vergne, R. Pacanowski, P. Barla, X. Granier & C. Schlick, *ACM Trans. Graph.*, 28(3), 2009