Image- and Video-Based Relighting for Virtual Environments

Doctoral Thesis Topic

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The goal of this Ph.D. topic is to develop new algorithms which will allow the relighting of virtual environments. The idea is to develop a new approach that which will capture the "lighting gist" of images or video, possibly aided with some basic 3D information, similar in spirit to that developed by (Oliva and Torralba 2006).

Using a combination of image-based and 3D computer graphics techniques for illumination and relighting, we will develop fast and efficient approaches to change the lighting conditions in images and videos. We will base our approach on our accumulated knowledge of 3D lighting simulation, developed in computer graphics, and recent advances in computational photography for image and video processing. It is possible that advanced machine learning techniques could be used to improve certain estimations.

For outdoors scenes, we will start with well known landmarks, for which vast databases of photographs with different lighting conditions are easily available; this will allow us to "learn" the "lighting gist" faster, and the transformations required to achieve relighting. These databases have been recently used (see work of U Washington/GRAIL lab (Snavely et al 2006) , and CMU graphics lab (Hays and Efros 2007) and (Lalonde and Efros 2007)) to (semi-) automatically extract basic 3D information which will be very useful in using the computer graphics global illumination algorithms developed over the years.

Examples of composites from a large image database built using the method of (Lalonde and Efros 2007)

One potential demonstrator could involve taking a picture of known landmark e.g., on a cloudy day in the morning, and presents a relit version of the same view on a sunny afternoon, or a different time of year on the monitor of the mobile device. This transformation will preserve all elements (people, cars etc) existing in the scene, since it will simply modify the pixels of the current image.

Requirements

The successful candidate should have a Masters degree in Computer Science, and have preferably taken courses in computer graphics and have experience in computer graphics programming, with knowledge of OpenGL or DirectX, and some experience with shading languages such as GLSL/HLSL/Cg. Knowledge of linear and non-linear optimization techniques is desirable.

References

Oliva, A. and A. Torralba (2006.). " Building the Gist of a Scene: The Role of Global Image Features in Recognition." Visual Perception, Progress in Brain Research **155**.

Noah Snavely, Steven M. Seitz, Richard Szeliski (2006), "Photo tourism: Exploring photo collections in 3D," ACM Transactions on Graphics (SIGGRAPH Proceedings), 25(3), 2006, 835-846. http://phototour.cs.washington.edu/

James Hays, Alexei A. Efros (2007), “Scene Completion using Millions of Photographs” SIGGRAPH 2007. http://graphics.cs.cmu.edu/projects/scene-completion/

Jean-François Lalonde, Alexei A. Efros (2007), “Using Color Compatibility for Assessing Image Realism”, ICCV 2007. http://graphics.cs.cmu.edu/projects/realismcolor/