L3 research internship proposal

Gabor noise

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Description

This internship is situated in the field of *computer graphics*. One of the main research topics in computer graphics is rendering, where a new image is synthesized from a description of a three-dimensional scene, including the geometry of the objects, the appearance of the objects, and the characteristics of the light sources. Modeling the appearance of objects is often done using *noise* [EMP+02]. Noise is a random and unstructured pattern, the random number generator of computer graphics so to speak. Noise is used for efficiently adding rich visual detail to synthetic images. This is illustrated in Fig. 1.

Gabor noise [LLDD09] is a procedural noise function based on sparse convolution and the Gabor kernel. Gabor noise offers a unique combination of properties not found in other noise functions: accurate spectral control with intuitive parameters for easy texture design, setup-free surface noise without surface parameterization for easy application on surfaces, and analytical anisotropic filtering for high-quality rendering.

PBRT [PH04] is both a book that introduces the concepts and theory of photorealistic rendering, as wel as the source code for a sophisticated physically-based ray tracer. PBRT is also the foundation of LuxRender (`http://www.luxrender.net/`), a popular open source software rendering system for physically correct image synthesis that generates stunning images. The extensive documentation provided by the book, and the clean, well documented source code in C++ allows easy implementation of additional features.

In the first stage of the internship, the succesful candidate will implement gabor noise, as described in [LLDD09] as an extension to PBRT.

In the second stage of the internship, the intern will explore a number of research extensions to Gabor noise. Potential extensions include making Gabor noise faster, by implementing a caching scheme to partially reuse results of previous evaluations, or making Gabor noise suited for *non-photorealistic*

Figure 1: Modeling the appearance of objects with noise. (Left) A noise pattern is designed by a user. (Middle) A leather texture is obtained by combining the noise pattern with a color map. (Right) The leather texture is mapped onto a dynamically changing implicit surface. (Figure from [LLDD09].)

or *expressive* rendering, building on very recent research results [BLV+10]. Of course, we are also open for ideas developed by the intern while experimenting with Gabor noise and PBRT.

Practical

Lab REVES / INRIA Sophia-Antipolis (`http://www-sop.inria.fr/reves/`)

Duration three months (June 1st 2010 - August 31th 2010)

Supervisors

- Ares Lagae (Postdoctoral Fellow of the Research Foundation — Flanders (FWO), Katholieke Universiteit Leuven and REVES / INRIA Sophia-Antipolis, `http://www.cs.kuleuven.be/~ares/`, `ares.lagae@cs.kuleuven.be`)
- George Drettakis (Group Leader, REVES / INRIA Sophia-Antipolis, `http://www-sop.inria.fr/members/George.Drettakis/`, `George.Drettakis@sophia.inria.fr`)

Prerequisites computer graphics (optional), computer science (C/C++), mathematics (Fourier analysis)

References

[BLV+10] Pierre Benard, Ares Lagae, Peter Vangorp, Sylvain Lefebvre, George Drettakis, and Joelle Thollot. A dynamic noise primitive for coherent stylization. *Submitted for publication, reference available on request*, 2010.

[EMP+02] David S. Ebert, F. Kenton Musgrave, Darwyn Peachey, Ken Perlin, and Steven Worley. *Texturing and Modeling: A Procedural Approach*. Morgan Kaufmann Publishers, Inc., 3rd edition, 2002. `http://www.cs.umbc.edu/~ebert/book/book.html`.

[LLDD09] Ares Lagae, Sylvain Lefebvre, George Drettakis, and Philip Dutré. Procedural noise using sparse Gabor convolution. *ACM Transactions on Graphics*, 28(3):54:1–54:10, 2009. `http://www.cs.kuleuven.be/~graphics/publications/LLDD09PNSGC/`.

[PH04] Matt Pharr and Greg Humphreys. *Physically Based Rendering: From Theory to Implementation*. Morgan Kaufmann, 2004. `http://www.pbrt.org/`.